ROYAL CANADIAN AIR FORCE
JOURNAL

SUMMER 2017 • VOL. 6, NO. 3

EDITORIAL TEAM

NOTE TO READERS

As a bilingual publication, readers should take note that where quotations are translated from their original language, we will use the term [Translation] at the end of the quote to indicate that readers can find the original text in the other language version of the *Journal*. Unless otherwise noted, photographs appearing in the *RCAFJ* are attributable to the public domain.

ROYAL CANADIAN AIR FORCE
JOURNAL

AIRPOWER
IN FORMATION
AGILE • INTEGRATED • REACH • POWER

SUBMISSION REQUIREMENTS

The *ROYAL CANADIAN AIR FORCE JOURNAL (RCAFJ)* welcomes the submission of articles, book reviews and shorter pieces (which will be published in the Letters to the Editor, Points of Interest, Pushing the Envelope and Point/Counterpoint sections) that cover the scope of air-force doctrine, training, leadership, lessons learned and air-force operations: past, present or future. Submissions on related subjects such as ethics, technology and air-force history are also invited.

JOURNAL SECTIONS

ITEM	WORD LIMIT*	DETAILS
LETTERS TO THE EDITOR	50–250	Commentary on any portion of a previous *RCAFJ*.
ARTICLES	3000–5000	Written in academic style.
BOOK REVIEWS	500–1000	Written in academic style and must include: • the book's complete title (including subtitle); • the complete names of all authors as presented on the title page; • the book's publisher, including where and when it was published; • the book's ISBN and number of pages; and • a high resolution .jpg file (at least 300 dpi and 5 by 7 inches) of the book's cover.
POINTS OF INTEREST	250–1000	Information on any topic (including operations, exercises and anniversaries) that is of interest to the broader aerospace audience.
PUSHING THE ENVELOPE	250–2000	Forum for commentary, opinions and rebuttal on *RCAFJ* articles and/or issues that are of interest to the broader aerospace audience.
POINT/COUNTERPOINT	1500–2000	Forum to permit a specific issue of interest to the RCAF to be examined from two contrasting points of view.

* Exclusive of endnotes

AUTHORS ARE ASKED TO NOTE THE FOLLOWING GUIDELINES:

- Submissions may be made in either official language.
- Authors must include a brief (one paragraph) biographical sketch which includes current appointment/position, telephone number and email address. Please include all professional and academic designations as well as military decorations.
- Selected articles that have been peer reviewed have a ⊕ to the left of the title.
- The Senior Editor will notify contributors on the status of their submission. It may not be possible to publish all submissions.
- All text submissions must be digital, in Microsoft Word or rich text format. Files must not be password protected and must not contain macros. Files may be submitted by mail or email at the addresses provided below.
- All supporting tables, images and figures that accompany the text should be sent in separate files in the original file format (i.e., not imbedded in the text). Original vector files are preferred; high resolution (not less than 300 dpi) .psd or .jpg files may be submitted.
- Authors are required to provide "alternate text" with detailed description for all figures. The alternate text is to be labelled as such and placed below the caption.
- Copyright permissions are required for all material that is not Department of National Defence or author originated. It is the author's responsibility to obtain and submit the necessary written permissions which must include the author's/artist's name as well as the publisher's name and location. Any material not meeting these requirements may be omitted from the article.
- The Senior Editor may select images or have graphics created to accompany submissions.
- Authors should use *Oxford English* spelling. When required, reference notes should be endnotes rather than footnotes and formatted in Chicago style. For assistance refer to *The Chicago Manual of Style, 16th Edition* or CFAWC Production Section at CFAWCProd@forces.gc.ca
- Acronyms and abbreviations should be used sparingly:
  - If they are required in the text, the term is to be written out in full the first time it is used and then followed by the abbreviated form in parentheses.
  - A list of all abbreviations (and their terms) used in the text will be included at the end of each submission.
- The Senior Editor reserves the right to edit submissions for style, grammar and length but will not make editorial changes that will affect the integrity of the argument without consulting the author.

FOR FURTHER INFORMATION OR TO MAKE A SUBMISSION PLEASE CONTACT THE SENIOR EDITOR AT:

Canadian Forces Aerospace Warfare Centre
8 Wing / CFB Trenton
Box 1000 Stn Forces
Astra, Ontario K0K 3W0

Attn: LCol Doug Moulton CFAWCRCAFJournal@forces.gc.ca

CALL FOR SUBMISSIONS

For the Winter issue: **30 October**

For the Spring issue: **30 January**

For the Summer issue: **30 April**

For the Fall issue: **30 July**

DISCLAIMER

CONTENTS
SUMMER 2017
VOLUME 6 • NUMBER 3

Photo: DND
This nursing sister was one of seven nurses trained as RCAF parachute-rescue professionals in 1951–1953, showing that the RCAF has long been open to practical doctrine options.

EDITOR-IN CHIEF'S
MESSAGE

This is my first Editor-in-Chief's message after assuming command of the Canadian Forces Aerospace Warfare Centre. It is an important opportunity to reinforce the role this great *Royal Canadian Air Force Journal* of ours plays in the ongoing development of our collective professional airpower mastery. It is an excellent publication that provides those of us with a strong commitment to the profession of arms a forum to academically discuss and debate our history, our theories and our ideas for the future. I challenge all of you to take up your quill, put your thoughts to parchment and participate in the debates about the very important issues that confront us all. Our great air power institution and our profession of arms is all the better for healthy and hardy academic debate. I look forward to reading your future submissions, as we collectively work to improve professional airpower mastery.

This issue has a strong focus on both theory and the application of doctrine. As you read the very well-written articles in this issue, I would ask you to reflect on the importance and application of doctrine in the Royal Canadian Air Force and in the development of professional airpower mastery—you cannot assume to be a true proponent of air power without having a robust understanding of doctrine's role. It is fundamental to the profession of arms and addresses the application of strategy down through the operational level of war (including a comprehension of our joint warfighting model) to the tactical needs of units, which require authoritative training, techniques and procedures. Doctrine represents, therefore, the foundation for all military activity.

Why is doctrine important? Because it provides the platform for the education programmes in our schoolhouses. We teach doctrine to ensure that our airmen and airwomen are trained to accepted operational standards. There is a clear operational nexus between our doctrine and readiness standards. It is the basis of our operational standards, and it underscores our approach to real combat and air power delivery. It provides us a shared mental model such that, as prepared individuals, we are able to participate in the common-team understanding of what needs to be done. We shouldn't follow doctrine rigidly, but it certainly provides us a point of departure, contingent on the operational situation that confronts us.

As we learn lessons in combat and real operational situations, they drive amendments to our doctrine, so that schoolhouse education is contemporary and our readiness standards are further improved. And so, the cycle continues; it is one of continuous improvement. Doctrine should always strive to represent the best practices, shared among our joint and allied partners. A simplified perspective? Absolutely! But as you read the articles, I ask you to reflect on the doctrine cycle, because improved professional airpower mastery requires that we all commit to our doctrine construct. Don't fall into the trap of thinking doctrine is something you can ignore. Effective air power operations require a detailed understanding of our doctrine, as this understanding acts as the pre-flight planning for your professional innovation and initiative. You cannot be part of an agile, integrated air force if you don't appreciate how and why it works. Doctrine provides the foundation for advanced understanding on the road to airpower mastery.

I hope that this helps contextualize this issue's content as you read and reflect.

Colonel Shayne Elder, MSC, AM
Editor-in-Chief

EDITOR'S
MESSAGE

This issue of the *Royal Canadian Air Force Journal* aims to explore the linkages from air power theory to the practical use of doctrine and air power capabilities. In my experience, theory in the use of air power is often overlooked, as many of us are all too often concerned about tactical problems rather than asking conceptual questions. Fortunately, Captain Kevin Foster has taken the time and effort to examine the history and continued importance of two of the greatest air power theorists of all time—John Boyd and John Warden—in order to make us think about conceptual matters. Foster's article invites us to think more about strategic air power and to appreciate Boyd's and Warden's importance to the present and future of our profession.

The next article, on Operation DESERT STORM by Major Nathan Burgess, provides a concise overview of how the theories of Warden and Boyd were used in the 1991 Iraq conflict. More relevant to the Royal Canadian Air Force (RCAF), he also shows how the practical application of air power can lead to insight on the doctrine we plan to use to fight the next conflict. Burgess shows how theory translates into the application of force.

On the next step down from theory, Major Bill March offers an interesting historical look at the operational use of doctrine by the Royal Air Force (RAF) in the Dieppe raid of August 1942. This fresh approach to Operation JUBILEE, 75 years after the disastrous raid, shows that RAF doctrine was incorrectly assessed as effective because air power was the only aspect of this combined operation that came close to success. It remains relevant today that an honest assessment of any operation is an essential step in judging the success of doctrine before the next conflict.

The following article then takes the discussion beyond the application of force and focuses on the use of air power to support the domestic responsibility of search and rescue (SAR). This article acknowledges 70 years of SAR provided by the RCAF, describes how the role of SAR ended up as a military responsibility and then makes the case for the importance of military aircraft and aircrew in some aspects of SAR service delivery. There are supporting aspects of air power that are not necessarily captured at the theoretical level but that have become essential aspects of our doctrine and perhaps should become part of future theory.

The final article, by Major Matthew Thompson, makes a case for Canadian Armed Forces space doctrine. This article completes our cyclical theme from theory to the practical application of air power and back to the development of new theory and doctrine. The point-of-interest article is offered as insight into one current practical problem that can limit the development of new doctrine and capabilities.

Theorists provide a new way of thinking about where and why to apply air power, staff figures out how to put those thoughts into action, and practitioners get the job done. It is occasionally useful to merge the three worlds and ask if the practical things we do are captured in the theory and doctrine that guide us all; the intellectual journey is always worthwhile.

Enjoy the read.

Sic Itur Ad Astra

Major James Pierotti, CD, MA
Guest Editor
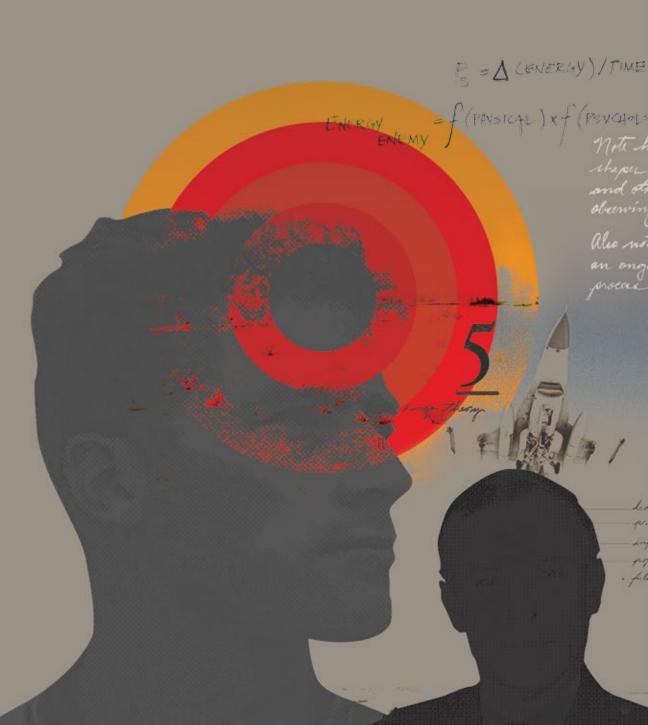
STRATEGIC
AIRPOWER

By Captain Kevin Foster

EDITOR'S NOTE:

The term *airpower* and the phrase *air power* are not interchangeable. Airpower is the intellectual aspect that guides and develops the delivery of air power. Air power is the delivery of an air force's output, specifically it is "the element of military power that is applied within or from the air operating environment to create effects above, on or below the surface of the Earth."[1]

Observations Feed Forward Synthesis Decision (hypothesis) Feed Forward Action (test)

New Information Previous Experience

Outside Information

Unfolding Interaction with Environment

Feedback

Feedback

Unfolding Interaction with Environment

$$P_s = \left[\frac{T-D}{W} \right] v$$

$$P_S = \Delta (ENERGY)/TIME$$

ENERGY
ENEMY

$$= f(PHYSICAL) \times f(PSYCHOL\ldots$$

Note h...
shapes
and ot...
observing

Also no...
an ong...
process

5

Energy Theory

Aviation and airpower have undergone dramatic changes since the Wright brothers first flew. Early airpower thinkers believed the use of aircraft could be a war winning strategic weapon, hoping to break free of the land-centric, battlefield paradigm of the times.[2] Strategic airpower came into its own during the years between the two World Wars. With the dropping of the atomic bombs on Hiroshima and Nagasaki, strategic air power appeared to reach its zenith, a point from which strategic theory would soon decline.[3] The advent of the nuclear age, space and missile technology as well as the growth of deterrence theory cast aside conventional strategic airpower theory.[4] Strategic came to mean nuclear, with all its destructive consequences, while tactical meant support of ground forces. Further adding to the decline of strategic thought were the limited wars the United States (US) found itself fighting in Korea and Vietnam. Greater emphasis was placed on air power in support of ground operations in the subsequent shift on thinking toward the Soviet Union and the US Army's AirLand Battle. The strength of the tactical community continued to build during these years.[5] During this time, two important thinkers—John Boyd and John Warden—emerged. Both men were driven to innovate and were informed by the emerging scientific thought of the times and—coupled with a deep personal interest in studying the lessons of past conflicts—created a revival in strategic thought.

THE MEN

By examining aspects of Boyd's and Warden's lives and experiences, their ideas and their place among previous theorists, we can see how they came to their conclusions and how they differed from those who came before. Boyd said little, if anything, on air power. Rather, following his retirement from the United States Air Force (USAF), he set about thinking about thinking. That is to say, he began looking at the decision-making process. He developed a theory on how one could defeat an adversary by out-thinking, disorienting, confusing and paralysing the enemy decision-making process rather than through sheer physical destruction.[6] Warden, on the other hand, sought to bring conventional airpower theory back to the operational and strategic levels. He argued that air power, correctly applied, could bring about the paralysis and defeat of an enemy at the operational and strategic levels.[7] The ideas of these men, when combined, offer a renewal of, and powerful blueprint for, the conceptual basis of conventional airpower theory.

Both Boyd and Warden can be thought of as disruptive and innovative thinkers. The two men shared numerous character traits that have been noted in innovative thinkers. Both men had a keen ability to *observe* and learn through their life experiences and interests in military history; to *associate* different concepts and ideas, such as scientific and systems theories and warfare; to *experiment* with new ideas and concepts and test them for validity; to *question* if there was a better way, this often earned the ire of senior officers and others, many times not taking no for an answer; and finally, to *network* and get their ideas out or force them out.[8] It is helpful, therefore, to very briefly sketch out the experiences, influences and interests of John Boyd and John Warden so that we may better understand how they came to believe what they did.

John Boyd —

John Boyd was born January 23, 1927, and grew up in the town of Erie, Pennsylvania. He enlisted in the US Army as the Second World War was ending and spent a brief tour as part of the occupation force in Japan. At the end of his enlistment, Boyd returned home and later attended the University of Iowa, earning a bachelor's degree in economics, under the Air Force Reserve Officer's Training Corps programme. After graduation, Boyd was selected for pilot training and went on to become a fighter pilot. In the spring of 1953, Boyd was sent to Korea, where he would fly several combat missions in the F-86 Sabre. His next tour saw him posted to Nellis Air Force Base, Nevada, where he attended, then later instructed at, the Fighter Weapons School. During his time at the school, he amended the curriculum and wrote *Aerial Attack Study,* which, for the first time, codified many of the tactics and procedures for aerial combat he conceptualized.[9]

In 1960, taking advantage of a military educational programme, Boyd began attending the Georgia Institute of Technology and pursued a second bachelor's degree, this time in engineering. This education would expose Boyd to the world of scientific ideas and principles that greatly affected his later ideas on warfare. His engineering education also led him to develop what he would term Energy-Maneuverability (EM) Theory.[10] At his next posting, Eglin Air Force Base in Florida, Boyd teamed with civilian contractor Tom Christie and further fleshed out this theory using what could essentially be called stolen computer time.[11] This event is just one demonstration of Boyd's habit of bypassing proper channels in pursuit of his ideas. With this concept, he could analyse, predict and map out performance characteristics of fighter aircraft. His EM Theory has been instrumental in the development of fighter aircraft ever since.

In 1966, Boyd was posted to the Pentagon in Washington, District of Columbia, where he would remain for the rest of, and after, his career. During his career, particularly at the Pentagon, Boyd made as many enemies as friends.[12] He had an in-your-face style and dogged determination to pursue what he thought was right, regardless of process or consequences. He played a role in the development of the F-15 and, somewhat unhappy with that project, played a central role in the F-16 programme as a member of the so called "Fighter Mafia."[13] As the story goes, Boyd bypassed the usual military chain of command and was able to get the procurement approved by using his connections and going directly to the then Secretary of Defense, James Schlesinger.[14] Following his retirement in the summer of 1975, Boyd stayed on at the Pentagon as a consultant. It was during this period that Boyd's ideas on warfare truly began to develop. The major contributor to this was Boyd's interest in and great study of military history.

Boyd had begun looking into military history a few years previous when he became involved in the project that would eventually become the A-10. Boyd and project lead Pierre Sprey had interviewed Second World War German Stuka pilots during their research to help ascertain what is involved in attacking tanks and armoured personnel vehicles.[15] This led Boyd to further inquire into the strategy and tactics of the Second World War. This study raised questions in Boyd's mind as to how the concepts he had read about had developed. This then led Boyd to read about the First World War and further back through 19th and 18th century warfare; making a detailed study of Napoleon and the great theorists of those times (Carl von Clausewitz and Henri Jomini), Boyd finished his examination with Sun Tzu. Boyd's approach was to read history backwards, as opposed to starting in ancient times working to the present. As a result, he was able to detect continuities in conflict; that is to say, he saw what had remained the same versus what had changed.[16]

His experiences flying fighter aircraft, the strength of his personality, his scientific education and his intense interest of military history all combined to inform his views on warfare and, more particularly, the human element. He would formulate his ideas and present them in a collection of briefings he called *A Discourse on Winning and Losing.* Two of the primary components of this collection will be examined later. Though a different journey, many of the same elements in the development of ideas from Boyd can also be identified in the experiences, influences and ideas of John Warden.

John Warden

Warden was born December 21, 1943, and grew up in a military family. His great-grandfather had served with the Confederacy in the US Civil War; his grandfather had been in the US Army and attained the rank of brigadier general, and his uncle had been in the US Army Air Corps, later the US Air Force. As such, military thinking had already been impressed on the young Warden. In 1961, he began studying engineering at the USAF Academy. He soon realized that his true interest lay in the humanities, and history became his favourite subject.[17] He was introduced to figures such as Generals Henry Arnold and Carl Spaatz as well as the theories of the Air Corps Tactical School (ACTS). However, he noticed a trend in the material that emphasized management, facts and figures rather than air power's achievements and ideas.[18] His thoughts on strategy and warfare deepened after a professor introduced him to *The Generalship of Alexander the Great* by the renowned British theorist J. F. C. Fuller.[19] Warden combined scientific concepts from his engineering studies with history, allowing him to conduct a deductive and systemic study of history and strategy believing that this would prepare a military officer's mind for battle.[20] After graduating in 1965, Warden was selected to fly the F-4 Phantom II and proceeded to flight training.

Shortly into his first tour at Seymour Johnson Air Force Base in North Carolina, Warden requested a transfer to fly the OV-10 Bronco in order to deploy for operations in Vietnam. Initially, Warden flew close air support (CAS) missions directly supporting ground forces and later flew missions of reconnaissance and interdiction against North Vietnamese and Vietcong supply routes. By having first-hand experiences of these roles, Warden's views on how air power could or should be used were further solidified.[21] Warden also felt that much of the limits of air power stemmed from limits placed upon air power and that good tactics could never make up for bad strategy.[22] On returning from Vietnam, he sought to remedy some of the issues he saw.

Returning to the F-4, Warden began writing and discussing his ideas on the independent use of air power. He discussed his ideas with anyone who would listen regardless of rank.[23] In 1974, he went to Texas Technical University, completing a master's program in political science in one year versus the normal two. His studies introduced him to national-level planning and strategy, and he wrote his thesis on the decision-making process of nations going to war and how they win or lose.[24] His next posting was at the Pentagon; interestingly, he arrived the same month Boyd was retiring and began a tour in the planning directorate of the Middle East and African division. Here again, regardless of rank or position, he would continue to advocate his views and opinions on strategy and air power.[25]

Over the next years, Warden would return to flying, in the F-4 and F-15, and serve in positions at the wing level, where he continued to develop and refine, through training exercises, his ideas on air power.[26] Beginning in 1985, he attended the National War College where his thesis on the use of air power would later be published as *The Air Campaign: Planning for Combat.* Next, Warden became wing commander in Bitberg, Germany. His tour there would last only one year, as he was removed early due to numerous issues and sent back to the Pentagon in a planning position.[27]

While assigned back at the Pentagon, Warden played an instrumental role in the planning of the 1991 Gulf War, a conflict where many of his ideas on the strategic use of air power played out.[28] Warden later went on to become commandant of USAF's Air Command and Staff College (ACSC). At the time of his arrival, the institution was seen by many as simply another check in the box before moving on in their careers.[29] Here, Warden's stubbornness was put to good use in instituting reforms that emphasized personal professional reading programmes, military history, airpower theory, air campaign planning as well as focused classes on the operational and strategic levels of war.[30] At the end of his tour in 1995, Warden retired from active duty to start a consulting firm in the private sector.

THEIR THEORIES

With a general understanding of these men's lives, we can now begin to look at their theories and how they came to be. As noted before, our times and experiences influence how we see the world and how we operate. At the time these men developed their theories, the US—and strategic airpower—had undergone a tremendous amount of change since the days of early airpower theorists such as Gulio Douhet, Sir Hugh Trenchard and Billy Mitchell.

With the end of the Second World War and the advent of nuclear weapons (and the missile systems to deliver them), strategic-bombing theory gave way to deterrence theory. The development of theory was pushed to academic think tanks as USAF thought more on how to target and not on why.[31] Conventional strategic airpower theory had been pushed aside by a reliance on nuclear weapons and the tactical nature of limited wars such as Korea and Vietnam.[32] The events of the Vietnam War

caused a great deal of soul searching within the US military on how to avoid another such quagmire. On the theoretical thinking aspect of this search, Boyd and Warden had a great deal to offer.

Boyd —

Boyd began to develop the basis of his ideas in the early 1960s while attending his engineering studies; interestingly, Warden was also pursuing his engineering degree at the same time. This era was a time of tremendous scientific thought and optimism; new technologies and theories—as well as the space race—were in full swing. Boyd took a major interest in scientific developments and was greatly influenced by what Frans Osinga calls the "scientific zeitgeist" of the times.[33] In the end, he created not an airpower theory but a general military theory built primarily on decision making and how humans win or lose in a competitive world.[34] Boyd was not a trained historian or academic, his studies and ideas derive from his own personal reading and methods and reveal his thoughts on human interaction. His opus is a collection of four briefings and one essay titled "A Discourse on Winning and Losing." The two best-known elements for our purposes here are his unpublished essay "Destruction and Creation"[35] and his historical briefing "Patterns of Conflict."[36]

"Destruction and Creation" forms the philosophical underpinnings of much of Boyd's later work. It is highly influenced by aspects of Boyd's studies on cybernetics, epistemology, systems theory, cognitive science, evolution, quantum mechanics as well as chaos and complexity theory among others.[37] His purpose was to sketch out how the human mind creates and destroys mental images or patterns in order to make sense of, and interact with, the changing environment.[38] Boyd posits that the goal of individuals is to improve their capacity for independent action, tending to form groups, tribes, nations, militaries, businesses or other organizations—in other words, systems—to aid in this.[39] This banding together then creates competition for scarce resources, requiring the need to make decisions and be adaptable in order to survive. Boyd synthesizes from three scientific principles— Gödel's Proof, Heisenberg's Indeterminacy Principle and the Second Law of Thermodynamics or Entropy—in order to explain how decisions must be made within a system.[40] By combining these ideas, Boyd concludes that a system cannot determine its consistency from within itself and that any attempt to do so will create uncertainty and disorder within that system; this inward orientation will only increase the degree of mismatch between reality and perceived reality.[41] What Boyd shows us is that any system—if it is unable to bring information in, observe and interact with the outside world—is unable to adapt and unable to create mental models or images to guide the decision process. Any image it does create will not accurately reflect the reality of the situation. This cycle will continue to worsen until those decisions and actions become meaningless. Through his study of military history, Boyd began to identify concepts and events where this process appeared to be true; it led him to compile his findings in his best-known briefing "Patterns of Conflict."

Boyd had a voracious appetite for military history.[42] He studied conventional, irregular or guerilla as well as revolutionary warfare. His findings, coupled with his ideas on systems and human decision making, led to the creation of his "Patterns of Conflict" briefing. By any account, he presented this briefing over a thousand times to members of the US military, US Congressional and political leaders, members of the press and anyone who was interested.[43] The briefing is almost entirely about land warfare, and Boyd's intent was to provide a framework in which to think of conflict: not a series of actions or what to do.[44] His brief does not necessarily present anything new, his insights can be read elsewhere if one commits to studying military history. It does, however, bring together many disparate sources and presents a refreshed view or rediscovery of much of the material presented.[45] Comprising some 193 slides, the briefing is far too expansive to cover in depth here.[46] The result shows a melding of Boyd's historical study with his scientific insights in order to formulate his ideas on warfare and how to be successful.

Boyd begins with observations on air-to-air combat in Korea, specifically the dogfights between the F-86 Sabre and MiG-15. While on paper the MiG-15 was more manoeuvrable, Boyd determines that the Sabre's design provided the pilot better observation which—when coupled with the pilot's superior training and the aircraft's ability to change manoeuvres quickly, due to hydraulic controls— created rapidly changing situations that the MiG pilots were unable to adapt to and overcome.[47] The MiG pilots would then become frustrated, tired and mentally defeated, leading to them becoming physically defeated.[48] Boyd ties this in with his ideas on survival being about increasing one's own freedom of action and inhibiting an adversary's. Boyd then introduces his most well-known, though also most misunderstood concept, the Observe-Orient-Decide-Act (OODA) Loop (see Figure 1).

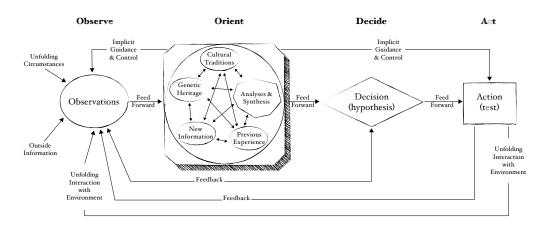Figure 1. The OODA Loop [49]

Note how orientation shapes observation, shapes decision, shapes action, and in turn is shaped by the feedback and other phenomena coming into our sensing or observing-window.

Also note how the entire "loop" (not just orientation) is an ongoing many-sided implicit cross-referencing process of projection, empathy, correlation, and rejection.

— John R. Boyd, 1992

Tying in with his ideas on systems, Boyd notes that any organism, individual, organization or military must go through this loop in its decision-making process. It must interact with the outside world to observe what is going on, it must then orient that observation. Orientation is the critical step in the loop. It involves processing information through the filters of one's experiences, cultural traditions, genetic heritage and other things.[50] In other words, the information brought in must be accurately translated into meaning to inform a decision which is then acted upon, thus starting another loop. For Boyd, the key is to cycle through this loop at a quicker tempo than the adversary, thereby causing the adversary to be unable to make accurate decisions in the face of a rapidly changing environment. Boyd then turns this thought to his study of military history to discern patterns in successful conflicts.

In his examination, Boyd finds many theories and cases which involve the paralysis of the enemy mind or decision making as being key to victory. He finds a divergence of views between Western and Eastern thinkers though history, with Western thinkers often focused on winning the battle, whereas Eastern thinkers seek to defeat the enemy by minimizing or avoiding battle.[51] Boyd is heavily influenced by the ideas of Sun Tzu and the notion of "unhinging" the enemy mind. He is also greatly influenced by 20th century thinkers such as Fuller and Basil Liddell-Hart and their ideas on paralysing the enemy rather than destroying it. He sees this in action throughout history, a product of his reverse study method to see constants rather than changes. He views Clausewitz's notion of friction in terms of reducing one's own but also in increasing friction for the enemy, thus inhibiting their OODA Loop and creating a rapidly changing environment that makes it difficult to operate in. He sees aspects of this at work in the wars of Genghis Kahn, T. E. Lawrence and in blitzkrieg. In viewing the enemy as a system, Boyd identifies the connections between the various centres of gravity as the key to attack. If one can sever the links between these, one can create many non-cooperative centres of gravity.[52] In doing so, the system is unable to form a cohesive response to attack. If they are severed from each other, the separate entities are unable to adequately take in information and respond in a meaningful way, they become paralysed and ineffective.[53]

Warden —

While Boyd is descriptive, Warden is prescriptive. That is to say Boyd spoke of how to think of conflict, and Warden speaks of how to conduct conflict. As noted previously, Warden had a deep interest in military history going back to his days at the USAF Academy. He was heavily influenced in his early thinking by Fuller, as was Boyd, and the avoidance of force-on-force battles when one could seek to paralyse the enemy.[54] Warden was also greatly informed by his experiences in Vietnam, his critical views on the conduct of air operations, his time on various squadrons as well as his budding interests and beliefs in how to better conduct air warfare. His thesis from the National War College was later published as *The Air Campaign: Planning for Combat,* where he expanded his historical study and focused on writing about the operational level of war and how conventional air power could be used. The vast majority of his historical examples are taken from the Second World War's various theatres, as this was the greatest use of air power to that time, though he also draws from the Arab–Israeli conflicts of the 1960s and 1970s on a number of occasions to support his conclusions.

In his book, Warden expresses his ideas on air power at the operational level and develops his ideas on centres of gravity which would take form as his Five-Rings Theory, which will be discussed later. According to Warden, the first aim of air power is to achieve air superiority, all other operations are subordinate to this goal.[55] He identifies the enemy command as being the primary target of attack, the true centre of gravity; he also identifies three spheres or components of command that

can be attacked: information, communication and decision.[56] As with Boyd, Warden notes that the decision-making sphere is the most critical; destruction or isolation of the command element can have fatal consequences to enemy units.[57] Warden also points out that targets can be attacked individually or collectively, meaning in serial fashion one at a time, or in parallel with multiple elements attacked at once; they can also be attacked directly or indirectly.[58] Many of the views and ideas expressed by Warden in *The Air Campaign* would be further developed in his later writings, particularly in his science-informed view of the enemy as a system.

A few years after the 1991 Gulf War (where Warden and his planning team at Checkmate in the Pentagon formed the basis of the initial air campaign plan), he published an article titled "The Enemy as a System" in which he developed his Five-Rings Theory and built on his ideas of centre of gravity identification and targeting. Warden's Five-Rings are the central element of much of his writing since. He portrays the enemy system as consisting of five concentric rings, perhaps more of a dart board, to conceptualize.[59] The components of the system, from the inner ring out, are leadership, organic essentials, infrastructure, population and fielded forces;[60] each ring can be further broken down to find more centres of gravity. Warden contends that this form of systemic identification, or modelling, can be used for everything from a state to a criminal or terrorist organization.[61] The key for Warden, informed by his experience and background, is to avoid imposing one's own system or views on the enemy; that is to say, one must see the enemy system as it sees itself and identify accurately how it operates and what is of value to it.[62]

If we view the enemy as a system and acknowledge, as Warden contends, that every system by definition has an organizing centre, then that centre must be the primary target.[63] With the enemy leadership as the target, Warden views three ways to change enemy behaviour and get it to do what it is we wish it to: make it expensive politically, economically or militarily; prevent it from acting or paralyse it; or destroy it.[64] The first of these is difficult to predict as it involves the enemy's cost/benefit analysis, which we are not likely to know fully; the last of these is rare in history and likely prohibitively expensive physically, economically and politically.[65] This leaves the second, paralysis as the best course of action. Warden follows in the vein of Fuller and Liddell-Hart by seeing a blow to the enemy brain as causing the rapid collapse of the enemy system and its ability to fight, achieving the ultimate aim of strategic paralysis.[66] The enemy would, thus, be unable to mount an effective response to attack.

AIRPOWER THEORIES

Both Boyd and Warden viewed the enemy as a system; both were greatly informed by their previous service and experiences as well as by an in-depth study and knowledge of military history. These aspects combined to bring them to the conclusion that to win modern conflict in the quickest, least costly manner meant imposing strategic paralysis on the enemy mind.[67] With a basic understanding of the ideas of Boyd and Warden, we can next briefly look at how their ideas differed from, or were similar to, previous thoughts on the use of air power.

In conveying their ideas on strategy, Boyd and Warden caused a reorientation of strategic thought. Their efforts attempted to break through the land-oriented, force-on-force paradigm of their times; in this, they shared a goal with previous airpower thinkers.[68] Though they shared many ideas in common with the early thinkers, they differed in one very significant way. Boyd and Warden, informed by their scientific and historical interests, focused more on the why than the how or what of targeting.[69]

5

rings theory

leadership

organic essentials

infrastructure

population

fielded forces (action units)

Early Theorists —

Most of the early theorists of airpower were service members and faced a number of challenges. Many of their ideas were formed in the atmosphere of justifying their service's existence.[70] That is to say, the airplane was in its infancy and the role or use of it in warfare was still unclear. These theorists often had to argue for the existence of a separate force within their respective militaries and attempted to define what air power could accomplish. The horrors of the trenches of the First Word War were fresh in the memory of writers such as Giulio Douhet, Sir Hugh Trenchard and William Mitchell, who all believed air power could overcome, and overfly, the frontlines to strike decisively at the heart of the enemy. For them, that heart was in the psychological will of the enemy nation.[71]

For Douhet, the population was the target. He believed that attacking an enemy population and infrastructure with explosives, incendiaries and gas would create panic and terror, eventually ending with the overthrow of the government to bring about an end to hostilities.[72] A major element of airpower of the Father of the Royal Air Force, Sir Hugh Trenchard, was also to attack the civilian morale. Believing it abhorrent to attack populations directly, he sought to affect their morale indirectly through attacks on infrastructure, communications and industry.[73] These attacks would also weaken the ability for forces at the front to continue fighting. The loss of will in the civilian population would put pressure on the government to change its ways. American William "Billy" Mitchell shared many traits of an innovative thinker, but his antics and singlemindedness of purpose and advocacy often alienated more people than he won over to his cause.[74] Like Trenchard, Mitchell was also against direct targeting of civilians but sought to collapse morale through bombing agriculture, industry and infrastructure.[75] Mitchell's ideas, along with those of contemporaries such as William Sherman and Edgar Gorrell, would form the basis of US ACTS thinking between the wars.

ACTS is perhaps best known for its Industrial Web Theory.[76] This theory holds many parallels with the ideas of Boyd and Warden, but there are also many important differences. Like Boyd and Warden, ACTS viewed the adversary as a system; however, their main goal of attack was physical paralysis through industrial targeting.[77] Through analysis, the enemy nation could be examined to identify vital centres or centres of gravity. These elements could then be attacked to destroy civilian morale as well as the enemy's economic and industrial ability to make war.[78]

Most of the early airpower theorists portray a Western, industrial view. The main focus is on attacking enemy economic and industrial centres for the effect it has on civilian morale to support the conflict. Many theorists also note the follow-on effect of damaging the ability for fielded forces to continue fighting. Far from avoiding a repeat of the carnage of the First World War, the Second World War showed many weaknesses in airpower theory and capability. Early airpower thinkers were largely ignorant of sociology, psychology, politics, anthropology and other mental fields that would expand and broaden views during the scientific revolution of the post–Second World War years and influence the ideas of Boyd and Warden.[79]

Boyd & Warden —

As previously mentioned, the major divergence of Boyd and Warden with earlier airpower thinkers is in the why of targeting. They saw the enemy leadership, or mind, as the central target. Previous theories, as viewed through Warden's Five-Rings, can be seen as attacking rings two through five primarily for the effect it would have on ring four, the population ring. Whereas for Warden, all targeting must be done for the effect it has on ring one; leadership. For Boyd, all actions and strategy must be aimed at the enemy's ability to make decisions or act appropriately; if their actions

do not reflect the reality of what is happening, then the enemy will be unable to effectively react.[80] Their ideas—combined with modern technology and weapons, parallel attack, speed and reach—allow for massive attacks on specific target sets chosen for their effect on the enemy mind and leadership. This can potentially create, in a very short time, an enemy leadership that is deaf, blind and mute.[81] The enemy system is unable to respond properly and becomes paralysed.

CONCLUSION

One of the visions of the early airpower theorists was to attempt to limit the destructiveness and bloodshed of major conventional wars. The ideas of Boyd and Warden can be seen as taking this initial aim and marrying it with their life experiences, systems theory and historical study to give focus to the idea of paralysis, not destruction, of the adversary in order to achieve victory. Boyd and Warden represent a renewal and refinement of the early strategic theories. Their early experiences coupled with their interest in scientific ideas and military history helped airpower break out from the stagnation of nuclear and tactical focus, offering an optimistic vision about what air power could accomplish.[82] They were innovative thinkers, which is quite often not helpful to one's career.[83] Their ideas focused on why to target something and what was the effect to be achieved. For both men, the effect was aimed at the mind of the enemy leadership and its ability to decide and to resist. Recent times have seen asymmetric, or unconventional, warfare become more prevalent than traditional state warfare. This, of course, means that our theory must also evolve to meet this challenge. With their emphasis on the conceptual, vice the mechanical, Boyd and Warden are still valuable today as a basis to begin our search and remold airpower. As Boyd often preached, "machines don't fight wars. Terrain doesn't fight wars. Humans do, and they do it with their minds."[84]

Captain Kevin Foster is a CF188 pilot currently posted to 409 Tactical Fighter Squadron at 4 Wing Cold Lake. He has been previously posted to 419 Tactical Fighter Training Squadron as an instructor pilot on the CT155 Hawk and to 425 Tactical Fighter Squadron at 3 Wing Bagotville flying the CF188. There he deployed on Roto 0 for Operation MOBILE, flying combat missions over Libya in the spring of 2011. He has also participated in numerous exercises across North America and overseas. He holds a Bachelor of Arts degree in Political Science from the University of Calgary and is currently pursuing a Master of Arts degree in War Studies, focusing on airpower, from the Royal Military College of Canada.

ABBREVIATIONS

ACTS	Air Corps Tactical School
CAS	close air support
EM	Energy-Maneuverability
OODA	Observe-Orient-Decide-Act
US	United States
USAF	United States Air Force

NOTES

1. *Defence Terminology Bank* record 43951

2. John Andreas Olsen, "Airpower and Strategy," in *Airpower Reborn: The Strategic Concepts of John Warden and John Boyd*, ed. John Andreas Olsen (Annapolis: Naval Institute Press, 2015), 1.

3. Martin Van Creveld, "The Rise and Fall of Air Power," *The RUSI Journal* 156, no. 3 (June 2011): 51, accessed November 17, 2016, http://www.tandfonline.com/doi/full/10.1080/ 03071847.2011.591091?scroll=top&needAccess=true.

4. Carl Builder, *The Icarus Syndrome: The Role of Air Power Theory in the Evolution and Fate of the U.S Air Force* (New Brunswick: Transaction Publishers, 1994), xiii.

5. Jeffery J. Smith, *Tomorrow's Air Force: Tracing the Past, Shaping the Future* (Indianapolis: Indiana University Publishing, 2014), Kindle edition. Chapters 5–7 examine the period from 1947 to 1992 and provide a vivid account of the factors in the decline of Strategic Air Command (SAC) and the rise of influence of Tactical Air Command (TAC) after the Vietnam War.

6. Colin S. Gray, *Airpower for Strategic Effect* (Maxwell Air Force Base, AL: Air University Press, 2012), 207, accessed November 17, 2016, http://aupress.maxwell.af.mil/bookinfo.asp?bid=496.

7. Ibid., 208.

8. Houston R. Cantwell, "Col Boyd's Innovative DNA," *Air and Space Power Journal* (Sept–Oct 2015): 100, accessed November 17, 2016, http://www.airpower.au.af.mil/digital/pdf/articles/2015-Sep-Oct/ c-cantwell.pdf. Houston's examination of Boyd references traits from *The Innovator's DNA,* by Jeff Dyer, Hal Gregersen and Clayton Christensen; however, these traits can also be seen in Warden through the reading of his biography and own writings.

9. Robert Coram, *Boyd*: *The Fighter Pilot Who Changed the Art of Warfare* (Boston: Little Brown and Company, 2002), 116. Much of this manual would form the basis of tactical fighter thought and procedures of air forces around the world.

10. Ibid., 142–150. Boyd gathered data regarding various aircraft attributes such as thrust, weight, lift coefficients, drag, wing loading and others. He devised mathematical formulas that could be used to predict aircraft performance, turn rates, turn radius, G-loading and energy addition or loss, based on speed and altitude. He was, thus, able to quantify aircraft performance and enable predictions to be used in the design of future aircraft as well as comparisons between existing American and Soviet aircraft.

11. Ibid., 180–82. USAF accused Boyd of using one million dollars of government computer time on an unauthorized project (EM Theory) without proper authority. Following an investigation, no charges were laid.

12. Grant T. Hammond, "The Essential Boyd," accessed November 17, 2016, http://fasttransients.files. wordpress.com/2012/03/hammond-theessentialboyd1.pdf.

13. Coram, *Boyd*, 237–40.

14. Grant T. Hammond, *The Mind of War: John Boyd and American Security* (Washington, DC: Smithsonian Institution Press, 2001), Kindle edition, loc 2135.

15. Ibid., loc 2654.

16. Ibid., loc 2660.

17. John Andreas Olsen, *John Warden and the Renaissance of American Airpower* (Dulles: Potomac Books, 2001), Kindle edition, loc 537.

18. Ibid.

19. Ibid., loc 561. The ideas of Fuller and fellow theorist Liddell-Hart would have a large influence on the ideas of both Warden and Boyd in their thoughts on paralysis of the enemy.

20. Ibid., 577.

21. Ibid., loc 694. Warden saw CAS as an ineffective use of air power. Given the relatively short duration of most battles he took part in, air power would often appear overhead too late to aid to any great extent. In all, Warden flew 266 combat missions and was already convinced by this time that air power had been misapplied in Vietnam.

22. Ibid., loc 741.

23. Ibid., loc 820–27.

24. Ibid., loc 946.

25. Ibid., loc 1032. Like Boyd, one sees a single-minded sense of purpose in Warden getting his opinion across. He would occasionally speak at meetings reserved for generals to get his ideas out. This confirmed his belief that it was sometimes necessary to bypass the bureaucracy to achieve results.

26. Ibid., loc 1345. When Warden returned to the F-4 at Moody Air Force Base, Georgia, his attempt to refocus the wing on air-to-air skills, rather than the wing-mandated air-to-ground mission, was blamed for dismal readiness reports. This led some to believe that Warden had sacrificed the wing for his own interests in proving the efficacy of his ideas.

27. Ibid., loc 2255. Warden's time in Bitberg was controversial. Within weeks of taking command he issued an 18-page memorandum containing some 93 initiatives. His single-minded approach to instituting change and pursuit of his ideas met with resistance, as many felt the changes went too far, too quickly. Many ideas were not discussed with affected units and other leaders on base were often left to deal with the consequences of changes.

28. Ibid. Chapters 8–10 give a detailed account of the planning for DESERT STORM and Warden's deep involvement.

29. Builder, *Icarus Syndrome.* Builder's study posits that USAF had become more focused on means rather than ends. USAF had emphasized equipment and technology, and airpower theory and ideas fell to academic think tanks. Builder also notes that many officers had become preoccupied with their career advancement rather than professional education, seeking the right check in the box but not having fuller knowledge of air power.

30. Olsen, *John Warden and the Renaissance,* loc 5916.

31. Peter Faber, "Paradigm Lost: Airpower Theory and Its Historical Struggles," in Olsen, *Airpower Reborn,* 34.

32. Philip S. Meilinger, "The Historiography of Airpower Theory and Doctrine," *The Journal of Military History* 64, no. 2 (April 2000): 495.

33. Frans Osinga, "The Enemy as a Complex Adaptive System: John Boyd and Airpower in the Postmodern Era," in Olsen, *Airpower Reborn, 52.*

34. Ibid., 50.

35. John Boyd, "Destruction and Creation," unpublished essay 1976, accessed November 17, 2016, http://pogoarchives.org/m/dni/john_boyd_compendium/destruction_and_creation.pdf.

36. John Boyd, "Patterns of Conflict," unpublished briefing, video of briefing and slides on YouTube, 14-part video posted by Dan Grazier December 6, 2015, accessed November 17, 2016, https://www.youtube.com/watch?v=9iiQlBaGJQA&list=PL4pmLxkc7CTcukIlpD0UThT7Y_K09oxXe&index=1. The briefing consists of 193 slides covering topics as varied as air-to-air combat, decision making, conventional warfare, guerilla warfare, revolutionary warfare, blitzkrieg and counters to each. A video of Boyd delivering a condensed version of the brief, with follow-along slides, to a political group in the 1980s is available on YouTube and consists of 14 parts roughly 30 minutes each in duration.

37. Frans Osinga, *Science, Strategy and War: The Strategic Theory of John Boyd* (New York City: Routledge, 2007), Kindle edition. This book, which evolved from Osinga's PhD dissertation, provides a highly detailed examination of the scientific underpinnings and influences on Boyd.

38. Boyd, "Destruction and Creation."

39. Ibid.

40. Osinga, *Science, Strategy and War,* loc 3155–3310.

41. Boyd, "Destruction and Creation."

42. Hammond, *Mind of War,* loc 242; and Coram*, Boyd,* 380*.*

43. Coram, *Boyd,* 355.

44. Osinga, "Enemy as a Complex Adaptive," 80.

45. Ibid., 54. Figures well known today, such as Sun Tzu, were all but unheard of in many areas of the senior US military leadership in the late 1970s and 1980s.

46. Boyd, "Patterns of Conflict.*"*

47. Ibid.

48. Ibid.

49. Coram, *Boyd*, 344.

50. Osinga, "Enemy as a Complex Adaptive," 75.

51. Boyd, "Patterns of Conflict.*"*

52. Ibid.

53. Ibid.

54. Olsen, *John Warden and the Renaissance,* loc 561. Warden was particularly interested in Alexander the Great and the Battle of Arbela, where Alexander directly targeted his efforts at the Persian King Darius vice the Persian forces. Of note, Boyd also directly references this battle in "Patterns of Conflict."

55. John A. Warden III, *The Air Campaign: Planning for Combat* (Washington, DC: National Defense University Press, 1988), 17.

56. Ibid., 53.

57. Ibid., 51.

58. Ibid., 54.

59. John A. Warden III, "The Enemy as a System," *Airpower Journal* 9, no. 1 (Spring 1995), accessed November 17, 2016, http://www.airpower.maxwell.af.mil/airchronicles/apj/apj95/spr95_files/warden.htm.

60. Ibid.

61. John A. Warden III, "Employing Air Power in the Twenty-first Century," in *The Future of Air Power in the Aftermath of the Gulf War*, ed. Richard H. Shultz Jr. and Robert L. Pfaltzgraft Jr. (Maxwell Air Force Base, AL: Air University Press, 1992), 64.

62. Ibid., 69.

63. Warden, "Enemy as a System."

64. John A. Warden III, "Air Theory for the Twenty-first Century," in *Challenge and Response: Anticipating US Military Security Concerns*, ed. Karl P. Magyar (Maxwell Air Force Base, AL: Air University Press, 1994), 354.

65. Ibid.

66. David S. Fadok, *John Boyd and John Warden: Air Power's Quest for Strategic Paralysis (*Maxwell Air Force Base, AL: Air University Press, 1994), 6.

67. Ibid., 3.

68. Faber, "Paradigm Lost," 19.

69. Ibid., 43.

70. Raymond P. O'Mara, "Clearing the Air: Airpower Theory and Contemporary Airpower," *Air Force Journal of Logistics* 34, no. 1/2 (2010): 52.

71. Peter Faber, "Competing Theories of Airpower: A Language for Analysis," *Aerospace Power Chronicles* (1996), accessed November 17, 2016, http://www.au.af.mil/au/awc/awcgate/au/faber.htm.

72. O'Mara, "Clearing the Air," 55.

73. David R. Mets, *The Air Campaign: John Warden and the Classical Airpower Theorists* (Maxwell Air Force Base, AL: Air University Press, 1999), 21.

74. Ibid., 44.

75. Ibid., 35.

76. Scott D. West, *Warden and the Air Corps Tactical School: Déjà Vu?* (Maxwell Air Force Base, AL: Air University Press, 1994), 1.

77. Fadok, *John Boyd and John Warden*, 40.

78. West, *Warden and the Air Corps*, 9.

79. Faber, "Competing Theories of Airpower."

80. Faber, "Paradigm Lost," 44.

81. Fadok, *John Boyd and John Warden,* 42.

82. Faber, "Paradigm Lost," 45.

83. Olsen, *John Warden and the Renaissance,* loc 2422.

84. Boyd, "Patterns of Conflict.*"*

Operation DESERT STORM:

AIR POWER
CAPABILITIES IN PRACTICE

By Major Nathan Burgess, CD, MA

The First Persian Gulf War began after the Iraqi invasion of Kuwait in August 1990. The United States and coalition countries initially responded by deploying forces into theatre to halt Iraqi forces and prevent further annexation of territory. This initial coalition defensive operation, known as Operation (Op) DESERT SHIELD, lasted approximately five and a half months. The operation succeeded in halting Iraqi advances and gave the United States and coalition forces time to develop a detailed plan for Op DESERT STORM, which was to be offensive in nature. Op DESERT STORM began in January 1991 with the goals of liberating Kuwait and substantially degrading Iraqi military capabilities.[1]

Op DESERT STORM demonstrated the full spectrum of air power capabilities. The Royal Canadian Air Force's (RCAF's) *Air Force Vectors* (*AFV*) identifies five core air power capabilities: control of the air, attack, surveillance and reconnaissance (S&R), air mobility as well as support to joint operations and civil power[2] (See Table 1). This article will use the first four of these capabilities as a framework to analyse Op DESERT STORM. The core roles under the fifth air power capability, support to joint operations and civil power, are redundant. For example, personnel recovery can be captured under air mobility. Situational awareness can be captured under intelligence, surveillance and reconnaissance (ISR).[3] Maritime support can be captured under counter-sea, and given the significant overlap between the two, the air-mobility core role of support to joint operations and civil power will be combined with the air-mobility core air power capability.[4] This article will demonstrate that all core air power capabilities were utilized by coalition forces during Op DESERT STORM.

Photo: USAF
Oil well fires rage outside Kuwait City in the aftermath of Operation DESERT STORM. The wells were set on fire by Iraqi forces before they were ousted from the region by the coalition force.

RCAF CORE AIR POWER CAPABILITIES	CORE ROLES	AIR POWER MISSIONS
CONTROL OF THE AIR	Battlespace management	Airspace control Navigation systems Enable air commerce Air command and control
	Counter-air	Offensive and defensive counter-air Air defence
ATTACK	Counter-land	Interdiction Close air support
	Counter-sea	Antisubmarine warfare Antisurface warfare
	Strategic effect	Deep strike
SURVEILLANCE AND RECONNAISSANCE	Persistent surveillance Routine patrols Cued reconnaissance	Recognized air picture Early warning
AIR MOBILITY	Airlift Air-to-air refuelling	Strategic or tactical
SUPPORT TO JOINT OPERATIONS AND THE CIVIL POWER	Maritime support	Antisubmarine warfare Antisurface warfare
	Airmobility	Battlefield mobility Special operations
	Personnel recovery	Search and rescue Aeromedical evacuation
	Situational awareness	Signals intelligence Imagery intelligence

Table 1.
RCAF core air power capabilities[5]

CONTROL OF THE AIR AND ATTACK (STRATEGIC EFFECT)

According to *AFV,* control of the air is comprised of battlespace management and counter-air roles.[6] Attack is comprised of counter-land, counter-sea and strategic-effect roles.[7] Control of the air and attack (strategic effect) are grouped together in this article as control of the air in Op DESERT STORM was largely accomplished using strategic-effect deep strikes against Iraqi air defence and Air Force centres of gravity. There were a limited number of counter-air attacks because the majority of the Iraqi Air Force was destroyed on the ground using strategic strikes. This perhaps identifies a logical flaw in the RCAF's grouping of core air power capabilities since control of the air can be realized by counter-air strikes or by destroying adversarial air forces on the ground using strategic strikes.[8]

Op DESERT STORM began on 17 January 1991 with overwhelming use of coalition air power. Iraq had hoped to defend against coalition air power and control the air by using its integrated air defence system (IADS). The IADS was comprised of a sophisticated network of sensors designed to detect incoming aircraft; once aircraft were detected, the IADS would cue anti-aircraft artillery, surface-to-air missiles, electronic countermeasures or fighter jets, as required.[9]

Coalition forces were well aware of the Iraqi IADS. The intent of initial coalition strategic air strikes was to control the air by destroying the Iraqi IADS; this included early warning radar sites, sector operation centres, intercept operation centres, Scud missile sites, runways, forward operating locations, aircraft and the air defence headquarters.[10] Through well-planned, strategic deep strikes on air defence centres of gravity, coalition forces rapidly defeated the Iraqi Air Force. Interestingly, control of the air was attained almost entirely by using strategic deep strikes rather than air-to-air fighting. This demonstrates the need to reconsider the current delineation of traditional air power roles. Perhaps future iterations of *AFV* could explain that strategic deep strikes can be categorized under attack *and* control of the air in certain circumstances.

Coalition forces also conducted strategic deep-strike attacks against other Iraqi centres of gravity. Targets included the Iraqi Air Force Headquarters, telephone exchanges, presidential bunker, TV- and radio-transmitter sites, power plants, transformer facilities, the presidential palace, fibre-optic repeater stations, telecommunications centres as well as other command, control and communications (C3) systems.[11] These strikes were quickly expanded to include other key targets such as biological weapons bunkers, nuclear research facilities, petroleum storage facilities, Republican Guard command posts, Saddam Hussein's residence, missile sites, pilot training bases, railroads and Republican Guard troops.[12] Strategic air strikes on terrestrial targets were augmented by strikes from Aegis Cruisers using Tomahawk Land Attack Missiles (TLAMs).[13] This demonstrates that air power is not limited to air forces. In fact, the aircraft carrier has replaced the battleship as the capital ship of the modern navy.[14]

ATTACK (COUNTER-LAND AND COUNTER-SEA)

Air power was used to strike targets in the counter-sea core role. Iraq had small missile-firing boats that posed a significant threat to coalition forces. Counter-sea strikes were used to destroy most of these boats.[15]

Air power platforms also conducted counter-land strikes in support of coalition ground forces. Coalition armies were sent into battle only after air power had attrited the Iraqi Army by 50 per cent.[16] "This attrition would achieve a favorable force ratio for coalition attackers against Iraqi defenders

and ensure success while keeping the coalition casualties low."[17] On 24 February 1991, four days before the end of Op DESERT STORM, coalition land forces joined the battle.[18]

Coalition air forces provided close air support (CAS) and air interdiction—missions categorized under attack (counter-land) in *AFV*—to coalition land forces.[19] CAS proved very effective against Iraqi armour and artillery; however, there were unfortunate instances of fratricide.[20]

Air interdiction missions targeted Iraqi lines of communication to destroy supplies and reinforce troops from the rear as well as to catch retreating troops and destroy roads and bridges.[21] As planned, joint coalition forces ultimately drove the Iraqi forces from Kuwait and significantly weakened the Iraqi military.[22]

Photo: USAF
An A-10A Thunderbolt II aircraft flies over a target area during a ground attack in Operation DESERT STORM.
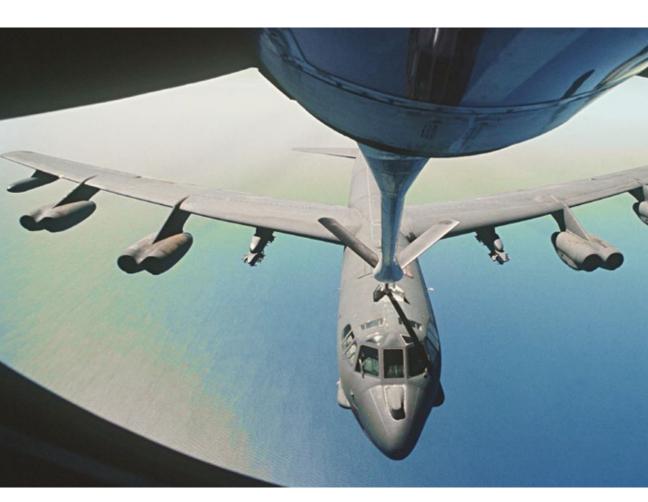
INTELLIGENCE, SURVEILLANCE AND RECONNAISSANCE

Aerial ISR is comprised of persistent surveillance, routine patrols, cued reconnaissance, signals intelligence (SIGINT) and imagery intelligence (IMINT).[23] ISR was used extensively throughout Op DESERT STORM. For example, Iraqi attempts to manoeuvre and assemble troops at night were detected by airborne ISR platforms, including the Joint Surveillance Target Attack Radar System (JSTARS).[24] ISR aircraft also cued air-land attack aircraft to intercept enemy troops.[25]

Airborne ISR platforms identified potential targets for coalition air strikes as well.[26] ISR platforms also conducted battle damage assessments to determine the effectiveness of coalition air strikes.[27] Overall, coalition targeting and intelligence cycles were unable to keep pace with the rapid and relentless pace of operations during DESERT STORM.[28] Nonetheless, coalition forces managed to win a rapid victory in spite of an inadequate intelligence system.

Related to the intelligence cycle, it is important to note that Op DESERT STORM provided a practical application of two prominent airpower theories: Colonel John Boyd's Observe, Orient, Decide, and Act (OODA) loop theory as well as Colonel John Warden's centres of gravity / concentric rings theory. These theories were applied and validated, at least in part, during Op DESERT STORM.[29]

AIR MOBILITY

Air mobility is comprised of strategic and tactical airlift, air-to-air refuelling and personnel recovery. Air mobility is a core air power capability that is often overlooked in the context of Op DESERT STORM; however, this was the greatest strategic airlift operation in military history.[30] In preparation for the operation, strategic airlift transported 99 per cent of military personnel into theatre.[31] Strategic sealift, on the other hand, brought 95 per cent of the requisite equipment and supplies into theatre.[32]

Air mobility played a key role within theatre as well; 52,300 intratheatre sorties carried 514,600 passengers and 245,200 tons [222,442 tonnes] of cargo.[33] This movement of forces to forward staging areas and airfields during Op DESERT SHIELD set the stage for Op DESERT STORM. Air mobility continued to play a vital role once Op DESERT STORM commenced. For example, airlift was used to transport copies of daily air tasking orders, aerial reconnaissance photographs, supplies and personnel within theatre.[34]

Personnel recovery, or combat search and rescue (CSAR), was another key air-mobility mission. CSAR was provided on a 24-hour-per-day basis by special operations forces.[35] Sea-based CSAR was provided by organic Navy assets in the Persian Gulf.[36]

CONCLUSION

Op DESERT STORM demonstrated the use of all four core air power capabilities: control of the air, attack, ISR and air mobility. Two core air power capabilities are particularly noteworthy in the context of DESERT STORM. First, the air-mobility operation leading up to and during DESERT STORM was the largest in military history. Second, strategic attacks were so effective that they virtually eliminated Iraqi air defences and Air Force before a significant number of counter-air battles for control of the air could take place. Air control was largely realized by strategic deep strikes on air defences and Air Force centres of gravity.

From an RCAF perspective, this case study provides two important takeaways. First, the five core air power capabilities described in *AFV* could be logically grouped into four core air power capabilities since the fifth one—support to joint operations and the civil power—is redundant. Second, the hard delineation of strategic deep strikes from control of the air in *AFV* should be addressed in future versions. Strategic deep strikes can be logically categorized under attack *and* control of the air when strategic deep strikes contribute to control of the air.

Photo: USAF
A boom operator for a KC-135 Stratotanker refuels a B-52 Stratofortress during air operations for Operation DESERT STORM.

Major Nathan Burgess is a communications and electronics engineering officer in the RCAF. He has held positions within various RCAF and Canadian Armed Forces organizations, including the Directorate Aerospace Equipment Program Management (Radar & Communication Systems), 42 Radar Squadron and 4 Wing Telecommunications & Information Services Squadron at 4 Wing Cold Lake, Canadian Operational Support Command, and the Canadian Forces School of Communications & Electronics. Major Burgess holds a Master of Arts in War Studies and is currently employed as the Space Integration Officer at the Canadian Forces Aerospace Warfare Centre in Trenton.

ABBREVIATIONS

AFV	*Air Force Vectors*
CAS	close air support
CSAR	combat search and rescue
DND	Department of National Defence
IADS	integrated air defence system
ISR	intelligence, surveillance and reconnaissance
Op	operation
RCAF	Royal Canadian Air Force
S&R	surveillance and reconnaissance
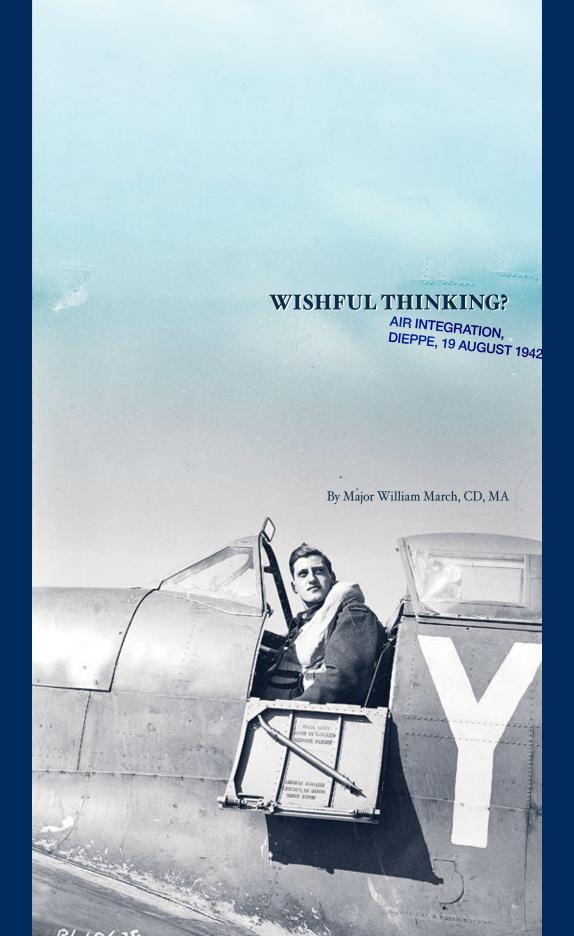
NOTES

1. Thomas A. Keaney and Eliot A. Cohen, *Gulf War Air Power Survey Summary Report* (Washington, DC: United States Air Force, 1993), 1, accessed March 1, 2017, http://www.dtic.mil/dtic/tr/fulltext/u2/a273996.pdf.

2. Canada, Department of National Defence (DND), A-GA-007-000/AF-008, *Air Force Vectors* (Ottawa: Director General Air Force Development, RCAF, 2014), 27, accessed March 1, 2017, http://www.publications.gc.ca/pub?id=9.697371&sl=0.

3. For the purposes of this article, the S&R core air power capability in *AFV* will be broadened to intelligence, surveillance and reconnaissance (ISR).

4. As stated in the *Defence Terminology Bank,* **air mobility** is "the capability of conducting airlift and air-to-air refuelling roles" (record 37284), and **airmobility** is "a capability of airmobile forces which permits them to move by air while retaining the ability to engage in ground combat" (record 3421).

5. Canada, DND, A-GA-007-000/AF-008, *Air Force Vectors,* 27.

6. Ibid.

7. Ibid.

8. This very issue has been the subject of debate since the early days of air power. See Chapter 2 of James Sterrett, *Soviet Air Force Theory, 1918–1945* (New York: Routledge, 2007). World War I Soviet theorists also discussed achieving control of the air, or air superiority, by using strategic strikes to eliminate enemy forces on the ground.

9. Diane T. Putney, *Airpower Advantage: Planning the Gulf War Air Campaign 1989–1991* (Washington, DC: United States Air Force, 2004), 339–40; and "Iraqi Air Defense – Introduction," GlobalSecurity.Org, accessed March 1, 2017, http://www.globalsecurity.org/military/world/iraq/air-defence.htm.

10. Putney, *Airpower Advantage,* 339–41.

11. Ibid., 339–43.

12. Ibid., 342, 344–45.

13. Ibid., 340–41, 343.

14. "The Aircraft Carrier Remains the Capital Ship of the Naval Forces," *Brèves Marines*, no. 187 (February 2016), accessed March 1, 2017, http://cesm.marine.defense.gouv.fr/images/BM/anglais/BM-187-aircraft-carrier-English.pdf.

15. Keaney and Cohen, *Gulf War Air Power*, 21.

16. Putney, *Airpower Advantage*, 355.

17. Ibid.

18. Keaney and Cohen, *Gulf War Air Power*, 21, 23.

19. Ibid., 20, 22–23; and Canada, DND, A-GA-007-000/AF-008, *Air Force Vectors,* 27.

20. Keaney and Cohen, *Gulf War Air Power Survey*, 20–21.

21. Ibid., 21, 23–24.

22. Ibid., 1, 21.

23. Canada, DND, A-GA-007-000/AF-008, *Air Force Vectors,* 27.

24. Keaney and Cohen, *Gulf War Air Power*, 3, 10, 19; and Putney, *Airpower Advantage*, 345.

25. Keaney and Cohen, *Gulf War Air Power*, 19.

26. Putney, *Airpower Advantage*, 346.

27. Ibid.; and Keaney and Cohen, *Gulf War Air Power*, 16.

28. Putney, *Airpower Advantage*, 359.

29. Colonel Phillip S. Meilinger, ed., *The Paths of Heaven: The Evolution of Airpower Theory* (Maxwell Air Force Base, AL: Air University Press, 1997), 374, accessed March 1, 2017, http://www.au.af.mil/au/aupress/digital/pdf/book/b_0029_meilinger_paths_of_heaven.pdf.

30. "Strategic Airlift Operations for the Gulf War: An Assessment of Operational Efficiency," *RAND Research Brief* (June 1993), 1, accessed March 1, 2017, http://www.rand.org/pubs/research_briefs/RB15.html; and "Gulf War 20th: Desert Shield Airlift Set Records: A Look Back on the 20th Anniversary of Operations Desert Shield / Desert Storm," Robert F. Dorr, DefenseMediaNetwork, accessed March 1, 2017, http://www.defensemedianetwork.com/stories/desert-shield-airlift-set-records/.

31. Keaney and Cohen, *Gulf War Air Power Survey*, 4.

32. Ibid.

33. "Gulf War 20th."

34. Ibid.

35. David C. Meggett, "Evolution of Recovery: Personnel Rescue for a New Environment" (thesis, Naval Postgraduate School, 2007), 7, accessed March 1, 2017, http://calhoun.nps.edu/bitstream/handle/10945/3095/07Dec_Meggett.pdf?sequence=1.

36. Ibid.

WISHFUL THINKING?

AIR INTEGRATION, DIEPPE, 19 AUGUST 1942

By Major William March, CD, MA

On Wednesday, 19 August 1942, approximately 6100 soldiers, the majority of them Canadian, supported by a naval force of several hundred vessels of varying size and almost 1000 aircraft launched Operation (Op) JUBILEE, a combined "raid in force," against the German-occupied French port of Dieppe.[1] The goal was to take and hold the port for a period of time (approximately eight hours); destroy facilities; gather information and intelligence, including a naval Enigma machine; and withdraw. Overhead, the Royal Air Force (RAF)[2] was tasked to provide an aerial umbrella that would protect the assault force; provide close air support; and finally, bring the German Air Force, the Luftwaffe, into open combat where it could be destroyed. It was a combined operation on a grand scale and was to last, from start to finish, mere hours.[3]

It was a failure. Over 60 per cent of the ground forces involved in the attack were killed, wounded or captured. The Royal Navy (RN) lost another 550 personnel and took a severe pounding as they provided invaluable support to the troops involved. Virtually none of the objectives of the raid were achieved. At the time, the only bright spot was deemed to be the performance of the RAF. They had provided an almost perfect air shield over the invasion force and decisively defeated the Luftwaffe. However, many post-war authors and historians have noted that the Luftwaffe actually lost far fewer aircraft than the RAF (48 to 106), and there has grown a sense that the RAF could have done much more to support the ground forces.[4] Yet in the face of an unmitigated military disaster, the British Government and the RAF trumpeted air power's success at Dieppe. In broad terms, this article will examine if this was "wishful thinking" on their part and how Op JUBILEE influenced air-land doctrine.

There were very good reasons for a raid on this scale to be mounted. The first half of 1942 had not been good for the Allies, with reverses in the Far East, the Middle East and the Atlantic. German successes in Russia were of particular concern. There was tremendous pressure to mount some sort of "second front" to bolster morale and relieve some of the pressure on Russia. A major invasion was out of the question, but a large raid was deemed feasible.[5]

Photo: DND
Dieppe Raid, 19 August 1942. With their eyes turned towards the coast of Occupied France, these Canadians prepare for their assault landing at Dieppe. In a few minutes, they reached the shore and with Tommy gun, Bren, and rifle and bayonet, they dashed forward to take up their pre-arranged positions. The picture shows Canadians on board one of the craft that carried them to the shoreline.

There were many precedents for this type of action, the most recent of which had been the raid on the St. Nazaire, Op CHARIOT, in March 1942, which had resulted in the destruction of a valuable dry dock, albeit with heavy casualties to the attacking force.[6]

Why Dieppe? An invasion of occupied Europe would require the Allies to obtain harbour facilities, so in a way, it made sense to attack a port. However, the size of a port required to supply several armies dwarfed the facilities of a town the size of Dieppe. Still, Dieppe was the right size to potentially yield valuable intelligence and to provoke a response by the Germans if attacked and held. Furthermore, it was within range of RAF fighters, an important consideration as several senior Air Force commanders were strong supporters of the raid.[7] Even if a German defeat would not result in enemy resources being transferred from the Russian Front, it would provide visible proof that Britain was making a real effort to support the Soviet Union.

Photo: DND
Dieppe from the Western headland. German photos probably taken on the afternoon of the raid. WWII, Dieppe France.

The RAF was cognizant of its role in support of combined operations. However, it tempered its responsibilities in this area with the need to ensure that the autonomy of the air forces was never in doubt. From the perspective of senior RAF commanders, the primary goal in a combined operation was to establish and maintain air superiority. With this accomplished, the RAF would be free to undertake its secondary, but extremely important, role of providing direct support to ground forces through what we call today close air support or battlefield interdiction. To maintain RAF integrity, the air forces assigned these tasks would be commanded by a senior air officer. This approach was reflected in the 1938 *Manual of Combined Operations.*[8]

In the months leading up to the Dieppe raid, the RAF had responded to demands by Combined Operations Headquarters, headed since October 1941 by Lord Louis Mountbatten, for air staff to assist in integrating air elements into combined-operations training and planning actual missions. Although the training was just commencing in earnest by the summer of 1942, it focused primarily on medium-day-bomber and fighter-bomber units, as they would provide close air support. Fighter units, whose focus would be on air superiority, were deemed not to require as much formal training in combined operations.[9]

Doctrinally, air support for combined operations would be "fighter heavy," which fit in well with the RAF's desire to bring the Luftwaffe to battle and diminish enemy forces through attrition. This supported the aggressive policy that the RAF had been pursuing in the West via fighter sweeps and escorted day bomber raids.[10] The Luftwaffe's resources in the West were extremely limited, as most of their aircraft were heavily engaged on the Eastern Front; therefore, the RAF's plan of action meant that the enemy could choose when, or if, to fight.[11] German aircraft accepted battle during these incursions only when the felt they had an advantage or if the target was deemed important enough to defend. The Allies hoped that the assault on Dieppe would force Germany's hand and bring the Luftwaffe into combat where it could be decisively defeated.

In April 1942, planning began for an assault on Dieppe, scheduled for the first week of July. Code named "RUTTER," the operation envisioned a landing force seizing and holding Dieppe for a predetermined period of time and then withdrawing in good order. RAF support, although still predominantly fighter oriented, included the provision of heavy bombers to attack designated targets the evening prior to the invasion, smoke-laying aircraft to blind the defenders, direct attack

on gun positions and hard points, reconnaissance of inland approaches to the port as well as airborne landings to seize flanking gun batteries.[12]

Almost from the beginning, the use of heavy bombers was a contentious point. Combined operations doctrine called for the use of heavy bombers only if they were readily available, there were clear targets and their use did not remove the element of surprise. As well, there was reluctance on the part of Prime Minister Churchill to rescind earlier directives that limited bombing which could result in French civilian casualties.[13] Combining this doctrine and these directives with the need to hit targets near the seashore—without causing extensive damage to the town in order to permit the invading force's freedom of movement—required a level of precision beyond what the bombers were capable of in 1942. Therefore, their use was removed from the plan. As it turned out, less than stellar rehearsals and bad weather led to the cancellation of RUTTER.[14]

Primarily for the political and strategic reasons already mentioned, the attack on Dieppe was resurrected in July as Op JUBILEE. The plan was virtually unchanged except for the substitution of sea-borne commandos in place of airborne forces and the addition of a diversionary attack by United States Army Air Corps bombers on the German airfield at St. Abbeville-Drucat.[15]

Photo: DND
The battlefield shown out-
lined in a map of Dieppe.

DIEPPE

Overall command of the air forces engaged at Dieppe would rest with Air Marshal Tafford Leigh-Mallory, the Officer Commanding 11 Group, part of Fighter Command. He would have fifty squadrons of day fighters for air superiority, six fighter squadrons for close support, two squadrons of day bombers, two squadrons of Hurricane fighter-bombers, four army co-operation squadrons for tactical reconnaissance and three squadrons to lay smoke. In total, almost 1000 aircraft were at his disposal. He would exercise command from the bunker at RAF Station Uxbridge, while his eyes and ears forward would be Air Commodore Adrian Trevor Cole onboard His Majesty's Ship (HMS) CALPE, an RN destroyer that also housed Major-General Roberts (who commanded the land force) and Naval Captain J. Hughes Hallett (who led the naval force).[16] A second RN destroyer, HMS BERKELEY, coordinated defensive support to the assault fleet and served as a secondary command and control platform.

In rough terms, air support for JUBILEE was provided in three layers: high-level squadrons, primarily concerned with air superiority, were controlled from Uxbridge; low-level squadrons, tasked to protect the ships, were controlled from the destroyer HMS BERKELEY; and close-air-support units were controlled from the CALPE. Orders and requests were issued by, or through, the senior air staff present. Air intelligence estimated that the Luftwaffe had approximately 250 aircraft, primarily fighters, with which to oppose the assault. Luftwaffe bombers were available, but it would take time for them to move to the attack from their normal operating bases.[17]

In accordance with existing procedures, air reconnaissance was provided by Mustang aircraft from the fledgling Army Co-operation Command. Their primary task was to keep a look out for German reinforcements approaching Dieppe, which would then be attacked by day bombers. As the Mustangs roamed far beyond Allied fighter cover, they suffered disproportionate losses. Once they completed their sorties, they were to check in with CALPE on the way back to England. Upon landing, the information they gathered was relayed to Uxbridge via land line.

Close air support was provided by Hurricanes and select Spitfire squadrons, plus light bombers from No. 2 Group. The bombers were directed to attack specific gun positions, as well as lay smoke, while Spitfire squadrons were on call to attack targets as requested by ground forces. Hurricane fighter-bombers were directed to attack strong points on the waterfront using bombs and cannons. Their attacks were heaviest during the initial landing and withdrawal, deemed to be the two most dangerous times for the operation, and these were launched at predetermined times. However, the fighter-bombers returned periodically throughout the operation, as requested by the force commander on CALPE, and were to check in with the controller on board for employment.

The close air support had mixed results. The smoke was effective in blinding German gunners but had the unexpected result of making it more difficult for the commanders to see what was happening ashore. Attacks were delivered with great bravery, but accuracy was lacking, and the weight of ordnance was insufficient to silence German positions. There was no way for the ground forces on the beach to communicate directly with the attacking aircraft, nor were there trained air force personnel (as there was for naval gunfire) with the troops to assist in calling down air strikes. Requests for support were relayed via the CALPE and could take up to an hour to action.[18] The aircraft engaged in close support suffered primarily from enemy, and friendly, anti-aircraft fire. A post-operation report diplomatically pointed out that RN air recognition needed to be improved.[19]

Wishful Thinking? Air Integration, Dieppe, 19 August 1942

On average, there were between three and six fighter squadrons over the beach at any time, with the highest numbers present for the landing and withdrawal. They were divided into "low squadrons" that operated between 600 and 1500 metres (2000 to 5000 feet) to protect the ships and beaches by attacking enemy aircraft that made it past the Spitfire squadrons above. High squadrons operated at about 3000 metres (10,000 feet) and were to engage the enemy aircraft as they approached. Except for the occasional hit-and-run attack by a German aircraft, the RAF fighters achieved and maintained air superiority. However, despite the number of squadrons involved, the Germans could, and did, have the initiative and at times outnumbered the defending fighters. Had more enemy aircraft been available, or if their intelligence had been better in identifying times at which the fighter cover was the weakest, they could have overwhelmed the defenders.

Photos: DND
19 August 1942. Canadian members of RCAF Spitfire (401) Squadron, overseas. This group of pilots of a famous Canadian Spitfire squadron, which was commanded by Squadron Leader Keith Hodson of London, Ontario, was photographed on the day of the Dieppe assault as the pilots waited for their aircraft to be refuelled in between flights. Shown in the group are, from **left to right:** Flight Sergeant Ed Gimbel of Chicago, Illinois; Flight Lieutenant Jim Whitham of Edmonton, Alberta; Flight Sergeant Bob Reesor of Peace River, Alberta; and Pilot Officer B. "Scotty" Murray of Halifax, Nova Scotia. **Opposite page:** Dive Bombers off Dieppe. Canadians in landing craft off Dieppe underwent a terrific dive bombing barrage. Photograph taken by an official Canadian military photographer who accompanied the raiding force shows some near misses.

Only one major vessel was sunk during the Dieppe raid, the BERKELEY, as German attacks had been successfully broken up or deflected.

At that time, the RAF's performance was lauded as the one success during the raid. Estimates of enemy aircraft destroyed or damaged, even though they turned out to be incorrect, seemed to point to a great victory for Fighter Command. Air intelligence sources estimated that 96 enemy aircraft had been destroyed, 39 probably destroyed and a further 135 damaged.[20] Given the estimated 250 combat aircraft the Luftwaffe was believed to have on hand to contest the raid, in one day's combat, the RAF had virtually destroyed the German Air Force in Occupied France. German records captured after the war paint a different picture, listing 48 aircraft destroyed and 24 damaged.[21] Still, the disparity in losses aside, the RAF deserved the praise, as it had done its job in accordance with its doctrine and to the best of its ability.[22]

Much has been written about the lessons that can be derived from Dieppe and many, including some of the primary commanders, stated that information and experience gained during Op JUBILEE were instrumental in the success of the Normandy landings in June 1944.[23] It may be argued that landings in the Pacific, North Africa, Sicily and Italy offered the same, if not better lessons; however, an in-depth analysis is beyond the scope of this article. Instead, here are a few observations on the RAF's performance at Dieppe.

Sometimes an air force actually reads, and applies, its own doctrine. This is what the RAF did at Dieppe. Still, a case could be made that this doctrine, developed during a prolonged period of peace without adequate testing, was flawed—especially with respect to command and control. Unfortunately, the perceived success of the RAF at Dieppe meant there was little incentive to change existing doctrine and may have complicated the establishment of the

successful tactical air force programme for Normandy.[24] Indeed, in his final report on the operation, Leigh-Mallory wrote that Dieppe

> proved conclusively that the existing Fighter ground control organization, although primarily designed for defensive purposes, provides all the facilities required for the direction of offensive operations within normal fighter range.
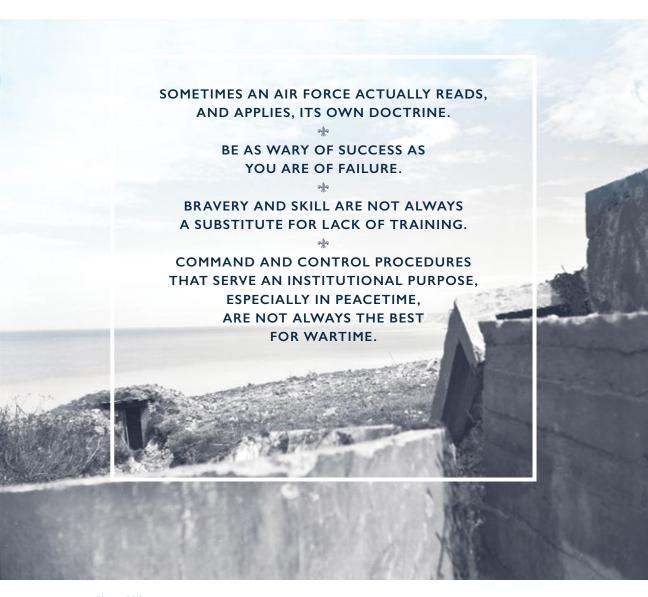>
> To summarize—the system of control from the Group, though Sectors, and through the Headquarters Ships [sic], adequately met all requirements. The excellent communications and flexible control facilities of the normal Fighter organization at home proved most efficient for such combined operations.[25]

Be as wary of success as you are of failure. Given the scope of the disaster, there was a need to focus on a "win." The perceived victory of the RAF over the Luftwaffe contributed to the acceptance of unrealistic claims on the amount of damage the enemy had sustained. If the numbers had been correct, almost two thirds of the Luftwaffe's strength in Western Europe had been damaged or destroyed, yet they managed to mount a series of attacks in the days following Dieppe and subsequent Allied fighter sweeps did not report a lessening of German activity.[26] The inconsistencies were explained away rather than being a cause for re-examining the outcome of the raid.

Bravery and skill are not always a substitute for lack of training. Dieppe was mounted before changes to combined-operations training could be fully implemented, but there was still a somewhat lax approach to close-air-support training undertaken by the RAF. Within the fighter community, this combined-operations training was virtually non-existent, as the doctrinal approach indicated that it would be business as usual for this force.[27] In fact, many of the squadrons only learned of the raid, and their role in it, the night prior to their first sortie.

Command and control procedures that serve an institutional purpose, especially in peacetime, are not always the best for wartime. The rather fractured command process implemented at Dieppe where control was divided between two ships and Uxbridge, with a predetermined support schedule, may have kept the unity of RAF command intact, but it was extremely inflexible and time consuming. Hence, when the Land Force Commander wanted to withdraw his forces from the beaches at 1030 hours, he was advised to wait an extra half hour to permit the support aircraft to fly to their home bases, re-arm and return because the RAF had planned for an 1100 hour withdrawal.[28]

Given the level of combined-operations doctrinal development, the air combat / decisive air-victory focus of the RAF and the relative lack of formal practice between combined-operations land and air forces (especially Fighter Command), air-land integration at Dieppe was little more than "wishful thinking." Nevertheless, to a very great extent, the policies and procedures put in place represented the best that could be expected for interservice cooperation in 1942, albeit from a United Kingdom–Western Front point of view (a much more successful air-ground organization was taking root in Africa). The RAF had succeeded in supporting a major landing and, according to the pundits of the day, had won an outstanding victory. Still, it was fortunate that the D-Day invasion would not be attempted for almost another two years, permitting the continued weakening of a determined enemy and the inculcation of experience gained in other theatres of war. Following the path that led to "victory" in the skies over Dieppe might have led to a much more difficult experience for the soldiers and sailors that assaulted the Normandy beaches in 1944.

> SOMETIMES AN AIR FORCE ACTUALLY READS,
> AND APPLIES, ITS OWN DOCTRINE.
>
> ⚜
>
> BE AS WARY OF SUCCESS AS
> YOU ARE OF FAILURE.
>
> ⚜
>
> BRAVERY AND SKILL ARE NOT ALWAYS
> A SUBSTITUTE FOR LACK OF TRAINING.
>
> ⚜
>
> COMMAND AND CONTROL PROCEDURES
> THAT SERVE AN INSTITUTIONAL PURPOSE,
> ESPECIALLY IN PEACETIME,
> ARE NOT ALWAYS THE BEST
> FOR WARTIME.

Photo: DND
The sea and coastline stretching north from Dieppe, with parts of a wrecked German blockhouse in the foreground.

Major Bill March, a maritime air combat systems officer, has spent over 39 years in uniform. He is currently a member of the Air Reserve, serving as the Royal Canadian Air Force (RCAF) Historian within the Directorate of RCAF History and Heritage.

ABBREVIATIONS

DHH	Directorate of History and Heritage
HMS	His Majesty's Ship
Op	operation
RAF	Royal Air Force
RN	Royal Navy
UKNA	United Kingdom, National Archives

NOTES

1. In World War II, a "combined" operation involved forces from two or more of the military services (army, navy and air force), while a "joint" operation involved forces from the military services of two or more countries.

2. Units and personnel from the Royal Canadian Air Force, the other Commonwealth air forces and many Allied nations participated in the air battle over Dieppe. However, except for the Americans, they all did so under the auspices of the RAF.

3. There are numerous books available that examine the raid on Dieppe; however, readers should be aware, given the nature of the action and the losses incurred, that some of the books come equipped with an emotional bias. For a cross section of available titles see Denis Whitaker and Shelagh Whitaker, *Dieppe: Tragedy to Triumph* (Toronto: McGraw-Hill Ryerson, 1992); Terrence Robertson, *Dieppe: The Shame and the Glory* (Boston: Little, Brown and Company, 1962); Brian Loring Villa, *Unauthorized Action: Mountbatten and the Dieppe Raid* (Oxford: Oxford University Press, 1989); Brereton Greenhous, *Dieppe, Dieppe* (Montreal: Art Global, 1992); and C. P. Stacey, *Official History of the Canadian Army in the Second World War*, vol. 1, *Six Years of War: The Army in Canada, Britain and the Pacific* (Ottawa: Queen's Printer, 1955), 310–412.

4. Given the rich historiography associated with Op JUBILEE, it is interesting that there is only one book that deals with the air battle: Norman Franks, *The Greatest Air Battle: Dieppe, 19 August 1942* (London: Grub Street, 1992). The text is narrative in nature and provides only limited analysis.

5. For a general discussion highlighting reasons for the raid see Whitaker and Whitaker, *Dieppe: Tragedy to Triumph*, 23–35; or Jacques Mordal, *Dieppe: The Dawn of Decision* (Toronto: Ryerson Press, 1962), 72–87.

6. For more information about the raid, see Jon Cooksey, *Operation Chariot: The Raid on St. Nazaire* (Barnsley, United Kingdom: Pen and Sword, 2004).

7. Terry Copp, "The Air over Dieppe: Army, Part 9," *Legion Magazine* (1 June 1996), accessed February 27, 2017, http://legionmagazine.com/en/index.php/1996/06/the-air-over-dieppe/.

8. United Kingdom, National Archives (UKNA), AIR 10/1437, *Manual of Combined Operations (1938).*

9. For an excellent overview of the training engaged upon, see Ross Wayne Mahoney, "The Royal Air Force, Combined Operations Doctrine and the Raid on Dieppe, 19 August 1942" (master's thesis, University of Birmingham, 2009), accessed February 27, 2017, http://etheses.bham.ac.uk/445/1/Mahoney09MPhil.pdf.

10. The different RAF offensive fighter operations were given specific codenames. A "Rodeo" was a fighter sweep from squadron to wing strength; a "Ramrod" was an attack by bombers on a specific target with fighters along for protection, and a "Circus" involved a bomber formation as "bait" while the accompanying fighters dealt with enemy aircraft. For additional detail, see Hugh Halliday, *The Tumbling Sky* (Stittsville, ON: Canada's Wings, 1978), 10–11. In very many ways, Op JUBILEE could be considered a Circus.

11. Williamson Murray, *Strategy for Defeat: The Luftwaffe 1933–1945* (Montgomery, AL: Air University Press, 1983). Approximately 180 German aircraft were within range of Dieppe at the time of the raid.

12. Canada, Department of National Defence, Directorate of History and Heritage (DHH), Report No. 100, Historical Officer Canadian Military Headquarters, "Operation 'JUBILEE': The Raid on Dieppe, 19 Aug 42. Part I: The Preliminaries of the Operation," 8.

13. Ibid., 9.

14. Stacey, *Official History of the Canadian Army*, 338–40.

15. Ibid., 340–48.

16. It had been decided that the operation would be "jointly" commanded by these three senior officers with no one in overall control. DHH, Historical Report No. 100, 8.

17. For a complete overview of the RAF's organization for Dieppe, including the command and control arrangements, see UKNA, AIR 25/204, "Report by the Air Force Commander on the Combined Operation Against Dieppe – 19 August 1942."

18. DHH, Historical Report No. 108, "Operation 'JUBILEE': The Raid on Dieppe, 19 Aug 42. Part II: The Execution of the Operation," 17 Dec 43, 61. The delay in message traffic would range from a few minutes to over an hour. See also DHH File 594.013(D1), "The Dieppe Raid (Combined Report)," October 1942, Appendix B to Annex 7, "Detailed Chronological Air Narrative."

19. UKNA, AIR 16/784, "Dieppe Report: Covering Letter by Air Force Commander," 5 September 1942, 3.

20. Franks, *Greatest Air Battle*, 190.

21. Ibid.

22. Within the British War Cabinet, the Foreign Secretary remarked on the "notable achievement of the Royal Air Force." UKNA, CAB/65/31/18, War Ministry (42), 115th Conclusions, Minute 1, Confidential Annex (20th August, 1942 – 6:00 p.m.), 2.

23. For example, Captain Hughes-Hallett, who commanded the naval forces at Dieppe; the Chief of the Imperial General Staff, General Sir Alan Brooke; and no less a personage than Churchill himself have stated at various times that the Dieppe raid was essential to the success of a full-scale invasion of France, DHH, Historical Report No. 159, "Operation 'JUBILEE': The Raid on Dieppe 19 Aug 42, Additional Information on Planning," 5 October 1946. For detailed examinations of potential lessons garnered from Dieppe, see DHH, History Report No. 128, "The Operation at Dieppe, 19 Aug 42 – Some New Information," 20 November 1944; Stacey, *Official History of the Canadian Army*, 387–412; and Nigel Jones, "What We Learned … from the Dieppe Raid," *Military History* 26, no. 5 (January 2010): 17.

Wishful Thinking? Air Integration, Dieppe, 19 August 1942

45

24. Again and again, the extent of the RAF's "victory" over the Luftwaffe became the "official" view of the Dieppe raid, and no one was more vigorous in trumpeting this point of view than Churchill, who stated in Parliament that "This raid, apart from the information and reconnaissance value, brought about an extremely satisfactory air battle in the west, which the Fighter Command [sic] wished they could repeat every week." Reported in DHH, Historical Report No. 109, "Operation 'JUBILEE': The Raid on Dieppe, 19 Aug 42, Part III: Some Special Aspects," 17 December 1943, 14.

25. DHH File 75/283, "The Dieppe Raid – Report by the Air Force Commander," 4.

26. Indeed, by the day after the attack (20 August), the Luftwaffe had replaced or repaired the majority of its lost and damaged aircraft. DHH SCR II 322, Luftflotte 3 Headquarters, "British Large-scale Landing Operation at Dieppe – Second Appreciation," 28 August 1942.

27. For an overview of the training provided, see Mahoney , "Royal Air Force, Combined Operations Doctrine," 80–88.

28. DHH, Historical Report No. 101, "Operation 'JUBILLEE': The Raid on Dieppe, 19 Aug 1942. Part II: The Execution of the Operation. Section 1: General Outline and Flank Attacks," 11 August 1943, 56.

Photo: DND
The battle over, captor and captive share a cigarette.
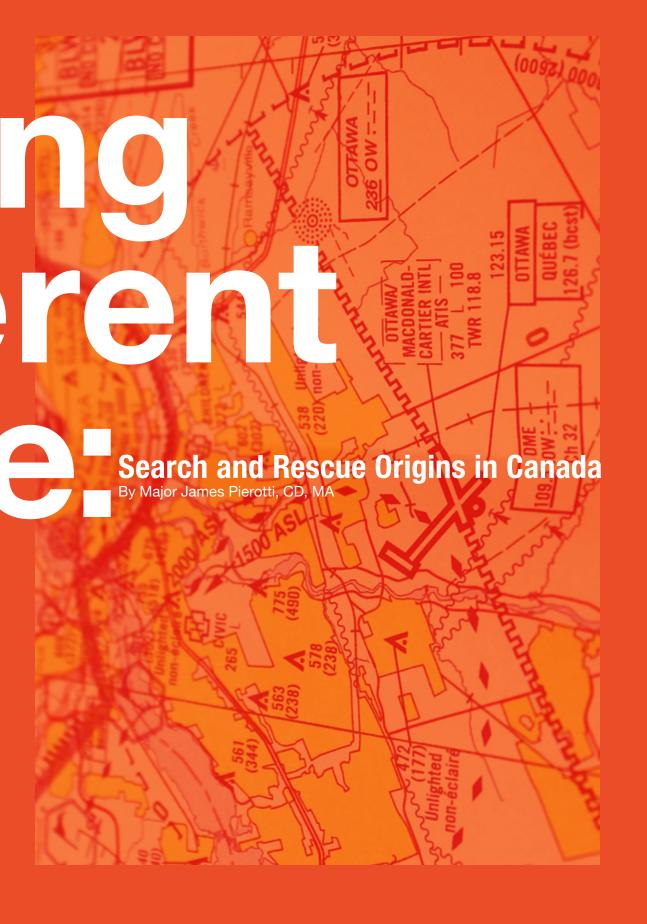
Charting a Diffe Course
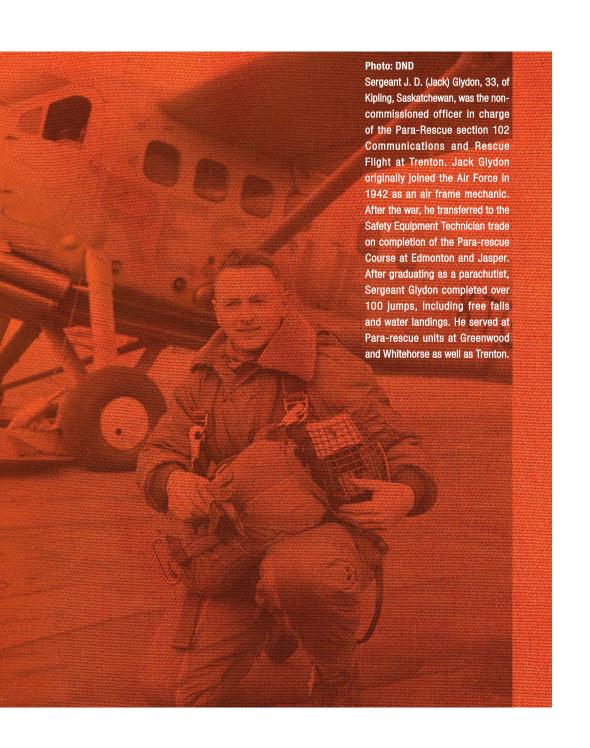
AUTHOR'S NOTE:
The following article is informed by my master's thesis. It sought to identify the rationale behind the Canadian government's decision to assign the aviation search and rescue (SAR) mandate to the Royal Canadian Air Force (RCAF) on 18 June 1947 and why it then added the maritime SAR mandate to RCAF responsibilities on 26 June 1950. The thesis discovered that the RCAF proved reluctant to embrace the civilian and domestic SAR responsibilities until after 1958. At the present time, when the SAR community acknowledges 70 years of military SAR in Canada, it is useful to understand why the system developed the way it did and what lessons the past holds for the future. This article was written to inform air force readers of not only the struggles that were endured along the rough road to an effective domestic-rescue capability in Canada but also how the military component of rescue was overlooked.

ng
erent
e:

Search and Rescue Origins in Canada
By Major James Pierotti, CD, MA

Sergeant J. D. (Jack) Glydon, 33, of Kipling, Saskatchewan, was the non-commissioned officer in charge of the Para-Rescue section 102 Communications and Rescue Flight at Trenton. Jack Glydon originally joined the Air Force in 1942 as an air frame mechanic. After the war, he transferred to the Safety Equipment Technician trade on completion of the Para-rescue Course at Edmonton and Jasper. After graduating as a parachutist, Sergeant Glydon completed over 100 jumps, including free falls and water landings. He served at Para-rescue units at Greenwood and Whitehorse as well as Trenton.

The year 2017 marks 70 years of SAR services provided by Canada's air force. As anniversaries can be a time of reflection, this milestone is an opportunity to rediscover the origins of rescue systems in Canada, which included a planned combat role during the Second World War as well as the current civilian domestic-rescue role for aviation and maritime emergencies. For reasons that will be explained, the Government of Canada assigned the civil-aviation SAR mandate to the RCAF on 18 June 1947, and maritime rescue was added to the air forces' responsibilities on 26 June 1950. This article examines these and other major developments of Canada's SAR system between 1939 and 1962, and it makes the case for the SAR organization's military importance to the RCAF. It is proposed that a reflection of Canadian SAR history would benefit from exploring three fundamental questions about the rescue system's development in Canada. First and foremost, why is a rescue system necessary? Second, how did Canada develop the basics of the rescue system recognized today? Third, does a historical examination of Canada's rescue system offer insight into the SAR service of today? The answers to these questions could help the RCAF to employ the SAR organization more effectively in civilian and military roles.

In order to answer these questions, rescue developments before and during the Second World War will be described briefly to outline how the RCAF initially built a rescue capability. Subsequently, domestic responsibilities for the RCAF will demonstrate why it was assigned both aviation and maritime rescue as well as how the RCAF responded to these developments. The tide turns to effectiveness will then show that the RCAF struggled with its SAR service in the 1950s and that the struggles were largely resolved by the Department of Transport's (DoT's) 1962 formation of the Canadian Coast Guard (CCG). Once assistance had been obtained from the DoT for the maritime-rescue mandate, the RCAF settled into its leadership role of the SAR service. The RCAF has successfully led the SAR organization ever since, but it will be noted that the military role within Canada's SAR service appeared neglected after the war, and this is a theme that remains relevant today. Throughout this article, it will be argued that Canada charted a different course from allied combat rescue during and after the war. Rather than maintaining a balanced rescue capability for civilian requirements as well as domestic and deployable military needs, the RCAF focused on the civilian responsibilities of SAR just in Canada.

RESCUE DEVELOPMENTS BEFORE AND DURING THE SECOND WORLD WAR

Prior to the war, a domestic-rescue service in Canada for air and marine emergencies was all but non-existent. "Calls for help could be received by the Royal Canadian Mounted Police (RCMP), the Navy, the Army, the Air Force, Municipal Police and commercial or civilian organizations."[1] On land, whether an emergency required response to a crashed aircraft or for community assistance, the RCMP typically coordinated rescues using resources from any available organization.[2] At sea,

a mix of volunteers and paid staff of the Canadian Life-Saving Service provided a limited rescue service for mariners in Canadian oceanic areas and on the Great Lakes.[3] There was negligible rescue regulation at the national and international levels.[4]

The Royal Canadian Navy (RCN) paid for the Canadian Life-Saving Service, but as a long-term result of the Great Depression of the early 1930s, the service went largely neglected in the years immediately before the war.[5] Maritime rescue before the war was dominated by funding problems, as this activity could not compete against the build-up of a military force to prepare for war. Once the war started, the RCN neglected the rescue service altogether, as it needed to focus its efforts on the deep-sea battle.[6]

The RCAF's pre-war rescue role was limited to its own seaplanes at five units across the country.[7] The RCAF owned a total of 88 vessels to support seaplane operations, and four were high-speed rescue vessels capable of 35 knots [64.8 kilometres per hour] for prolonged distances.[8] These four vessels, expanded to six newer ones in 1941, comprised the only real rescue capability for aviators and mariners in the first years of the war.[9] This very limited capability was solely acquired and maintained for seaplane-rescue purposes.[10]

The onset of the Second World War, however, significantly changed the perceptions of rescue requirements in Canada and abroad. Setting an example, Germany already had an established rescue service operating in the English Channel when it decided to initiate hostilities against the United Kingdom (UK) to destroy the latter's air force. The German Luftwaffe had created the *Seenotdienst* for air sea rescue (ASR) in the spring of 1935 because "the early Luftwaffe could ill afford the unnecessary loss of trained aircrews as it played catch-up with the air forces of its potential enemies."[11] In order to recover aircrew during operations against the UK, by May 1940, each of the seven zones had two He-59 seaplanes paired with rescue boats ready for cross-Channel flight operations, each with its own rescue coordination centre.[12] The Germans had solid preparations in place to minimize the loss of human capital from air-combat operations. The British noticed this service during July 1940, as German aviators were scooped from the sea after sorties against the Royal Air Force (RAF) at the beginning of the Battle of Britain.[13] During the battle, the RAF learned that its existing rescue services were insufficient. In just two days, 20 and 21 July, 21 aircraft were shot down and crashed into the sea, with only 6 of 40 aircrew recovered from the sea.[14] The losses were unsustainable.

In **1941,** the chance of being rescued from the sea increased from 20% to 35% — an **IMPROVEMENT OF** **75%.**

Charting a Different Course: Search and Rescue Origins in Canada

In August 1940, the RAF hastily established a sea-rescue service with a mixture of Royal Navy Lifeboat Institution rescue vessels, Royal Navy ships and RAF high-speed rescue vessels, all supported by any available aircraft.[15] Unfortunately, continuing losses showed the inadequacy of the service, as 260 more aircrew perished in October alone.[16] For future operations, the UK was determined to recover a higher percentage of downed aircrew from the sea, and this determination would later affect all Allied rescue development.

The RAF established an ASR service within a new flying-control organization in February 1941. By June 1941, the ASR system was interconnected "almost into one 'press-button' chain," and telephones linked Naval and RAF coastal units throughout the country.[17] By November of that year, rescue aircraft and vessels were established at locations throughout the UK.[18] The chance of being rescued from the sea increased from 20 per cent to 35 per cent and would continue to improve over the course of the war. An immediate increase from 20 to 35 per cent may not sound like much, but it was a 75 per cent improvement. It made a significant difference because hundreds of aircrew would ditch into the sea each month, and with the improvement, dozens of those aviators would return to fly combat missions who otherwise would have perished.[19] For Allied nations, the RAF firmly established ASR as a critical component of air-combat operations to ensure the long-term viability of a fully engaged air force.

Although the RAF's flying control and embedded ASR were well established by mid-1941, the RCAF had not taken any similar action by late 1941 because of the expected expense of setting up flying-control facilities in Canada and because the British Air Ministry "had not defined any long term policy regarding training of flying control officers."[20] However, RCAF views on both flying control and ASR would change as war approached Canadian shores.

In October 1941, German U-boat submarines were creating havoc off Newfoundland in daring raids against Allied shipping close to RCAF air stations, suggesting a German invasion was possible.[21] On the West Coast, the disaster at Pearl Harbor in December 1941 hinted that invasion was also possible from Japan. The Canadian government had no choice but to prepare for war in Canada due "to an atmosphere of near panic in British Columbia."[22] The RCAF prepared domestic defences for war in Canada, whether the threat of invasion was realistic or not.

In March 1942, Air Force Headquarters (AFHQ) decided that domestic defences urgently required flying-control procedures and an ASR system, so that known deficiencies could be corrected before the existing system proved ineffective in combat along Canada's shores.[23] There was no coincidence that the RCAF saw an urgent need to revisit flying control and rescue in Canada after the public and government became concerned about invasion. The Battle of Britain in 1940 had already established that combat operations over water needed a well-organized control-and-rescue capability. If the fight did transition onto Canada's shores, an ASR service would give the RCAF an important resource to enhance aviation fighting efforts while assisting with national sovereignty by retaining as much air-combat capability as possible.

The RCAF published flying control and ASR procedures in August 1942, in a first attempt to follow the proven British example.[24] There were problems with a few of the first procedures, so Canadian Air Publication (CAP) 342, *Orders and Instructions for RCAF Flying Control and Air Sea Rescue Service* was issued in May 1943 to tighten up flying-control procedures and issue detailed ASR guidance.[25] Changes from the initial version of ASR included: a requirement for commands to provide aircraft in the ASR role, authority for groups to assume responsibility for searches with marine craft within 200 miles [322 kilometres] of shore, and coordination with the RCN to provide "maximum effort" for searches further out to sea.[26] RCAF commands on each coast developed their own procedures, which included providing rescue for "civil planes passing through Command areas" and "ships in distress."[27] Prophetically, the first Canadian steps in the development of ASR included procedures for domestic rescue, due to the lack of any other rescue capability in Canada during the war. Even as the RCAF was developing a rescue capability in the summer of 1942, German U-boats had their operational areas reassigned away from Canada.[28] The reduced threat to Canada was further reinforced by the defeat of wolf packs of German submarines in late 1943, which removed some of the impetus for rescue in a combat environment.[29] Moreover, "the Battle of Midway in June 1942 effectively eliminated any threat to British Columbia."[30] With enemy submarines operating further out to sea, the threat receded, and the need for combat rescue services was reduced. The change of submarine operational areas meant that RCAF antisubmarine missions and naval-combat operations took place outside of the 200 mile [322 kilometre] radius of RCAF high-speed rescue vessels. As a result, the limited number of rescue vessels became underutilized, as RCAF aircraft typically operated too far out to sea for the vessels to assist in their rescue.

It did not go unnoticed that the RCAF's high-speed rescue vessels were largely unused. Given the few resources available due to the war effort, the DoT had not been able to offer sufficient assistance to civilian mariners on either coast, so a letter between ministers was sent to request possible standing ASR assistance from the RCAF in the Bay of Fundy and along the west coast of Vancouver Island.[31] The Department of National Defence for Air responded that they would assist, and that is how the air force became increasingly involved in domestic rescue.[32]

As important as sea rescues were to RCAF aircrew, crashes on land required a rescue response as well. The North West Staging Route between Edmonton and Alaska, used by American aircraft en route to Alaska and then Russia, was a vast area where many crashes took place. Land-rescue parties, however, simply took too long to effect a rescue once search aircraft found survivors from crashes along that route, so there were many casualties that could have been saved if rescuers had arrived sooner.[33] The civilian manager of 2 Air Observer School in Edmonton, retired Great War flying ace Captain Wilfrid "Wop" May, had to supply crews for these searches, and he came to believe that parachute-equipped rescuers could jump out of aircraft at the crash site, stabilize crash survivors and clear an area near the site of the crash from which the survivors could be safely extracted

by aircraft.[34] The parachute-rescue capability was incorporated into the air force's ASR capabilities in Canada by June 1944, as it provided a necessary land-rescue ability that had previously been completely lacking.[35] However, parachute rescue was not a capability that enhanced the combat-rescue service for the RCAF, as it was intended to assist crashed American aviators in an area where there was no enemy threat.[36] In general, the RCAF had felt it necessary to build an effective ASR system during the war, but when the threat receded, the system it had developed was designed for domestic rescues rather than a wartime combat role.

The end of the war in Europe, May 1945, meant a realignment of resources for the continued war against Japan. In Canada, this meant bringing some squadrons home, disbanding many others and sending some squadrons into the Pacific theatre.[37] As one of the eldest squadrons still in service, 404 Squadron was selected for conversion to Canada's first dedicated ASR squadron to support Allied forces in the Pacific.[38] However, Japan surrendered before the deployment happened, so the ASR squadron was never formed. Canada never did take that final step to forming a dedicated ASR squadron; this can be viewed as a missed opportunity to develop rescue along the combat examples of the British and Americans. The final statistics of the war would later indicate that ASR worldwide had saved 13,269 lives, of which 8,604 were British and Allied aircrew.[39] Americans, in particular, had ASR squadrons all over the globe by mid-1945, as solid proof that the new standard for air-combat operations required a combat-rescue capability.[40] These statistics establish the basic reason rescue systems were first created: because the recovery of aircrew put enough people back in cockpits to win battles. As an extension, it can be argued that rescue systems remain important to national sovereignty by maintaining air-combat capability while waging a war on one's own doorstep. The RCAF learned those lessons, but only haphazardly, as the Canadian ASR that had developed for domestic non-combat rescue and events would conspire against the air force's efforts to maintain only a military rescue role.

Photo: DND
A para-rescue jump team prior to boarding a Dakota to go on a mercy mission. Left to right: Corporal R. E. Crawford of Calgary, Alberta; Leading Aircraftman J. F. Bourdon of Montreal, Quebec; Nursing sister Flying Officer E. R. Kelly of Summerside, Prince Edward Island; and Leading Aircraftman C. L. Hegadoren of Peterborough, Ontario.

DOMESTIC RESPONSIBILITIES FOR THE RCAF

Before the war ended, initial international post-war planning for aviation took place in Chicago in December 1944. This storied meeting created the Provisional International Civil Aviation Organization (PICAO) and laid the foundation for aviation-based post-war economic growth.[4] As the combat-rescue systems devised by the RAF, and later the United States, had forever changed the expectations of anyone involved in aviation, the resulting document stated that "each contracting State undertakes to provide such measures of assistance to aircraft in distress in its territory as it may find practicable."[42]

In Canada, the pre-war lackadaisical approach to rescue was long gone even before the Chicago meeting; it was replaced by a deep understanding within the RCAF that rescue services were a new national and international requirement. The RCAF called a meeting in November 1944 to discuss the "amalgamation of the marine services of the various departments into one government marine service" and was aimed at creating a coast guard.[43] In attendance were the Departments of Transport, Mines and Resources, and Fisheries as well as the RCN and RCMP.[44]

The DoT challenged the need for a new organization, as it "doubted if air-sea rescue work could be classed as a national responsibility."[45] The RCMP, RCAF and RCN, however, were convinced that one rescue organization was essential, and if a new organization was not possible, they agreed that the RCMP "would take over air-sea rescue if necessary."[46] The RCMP's offer to assume responsibility for rescue was welcomed, as it would relieve the air force "of an obligation which has developed since the outbreak of war and will continue to exist in the post war period."[47] In the aftermath of the meeting, the Canadian Cabinet considered a coast guard service but concluded that "the establishment of a Coast Guard to provide new services offers no apparent advantage."[48] The RCN and RCAF disagreed with this assessment, but there was not yet sufficient national interest for a new organization, leaving the air force with the only limited rescue capability.[49]

Throughout the autumn of 1945, discussions took place on the transfer of the rescue capability from the RCAF to the RCMP. One of the changes that occurred during this time was the name, as Air Sea Rescue was no longer accurate due to the inclusion of land-rescue capabilities, so "following the lead of PICAO, it is proposed that hereafter the rescue organization be referred to as the Search and Rescue Service."[50] The domestic nature of the proposed new service factored considerably into the transfer of the rescue service to the RCMP.

Photo: DND
RCAF Para-Rescue personnel in Jasper (ground training).

The RCMP—with assistance from the DoT, RCAF and RCN—developed a robust proposal for a post-war SAR service. The plan included an increase of 1,066 personnel for the police, plus 38 aircraft and 44 vessels were to be transferred from the RCN and RCAF to be based at police locations across the country.[51] The total cost of this proposal was $5,859,370.[52] The price tag was considered a necessary expense by the organizations directly involved in SAR matters, but it was a very large sum of money in the post-war environment. Canada's finances, like many other nations after the war, were a mess. Minister of Finance James Lorimer Ilsley was particularly concerned about Canada's fiscal health due to "defence expenditures several times larger than before the war; increases in the normal overhead costs of government; and 'vastly increased' expenditures on social security and social welfare activities."[53] Minister of Justice Louis St. Laurent, who had been an advocate for his RCMP's SAR proposal, bowed to the resistance during the first discussion on post-war rescue and asked his fellow Cabinet members on 28 December 1945 if the SAR service required to meet PICAO requirements "might be carried on adequately and with less expense under the auspices of the Navy and/or the Air Force."[54] The RCMP proposal for SAR remained on the table for the month it required the Cabinet Defence Committee to consider the military options, but effectively, the RCMP proposal was finished.

Cost concerns were understandable explanations for the failed RCMP proposal, but there was another key factor. The Cabinet wanted to use the military for peacetime domestic services. Undersecretary of State A. D. P. Heeney clarified that although the Department of National Defence was "known to be reluctant to undertake such additional responsibilities of a non-military nature [specifically SAR]," there was still "considerable goodwill to be maintained by co-operating closely with civil departments in such matters."[55] Based on both cost savings and a desired civilian role for the military, the Cabinet Defence Committee decided on 10 January 1946 "that an adequate rescue organization for aircraft in distress could be provided by existing services in cooperation and that the Department of National Defence for Air should undertake responsibility for necessary coordination to this end."[56] Thus, the RCAF became the lead organization for SAR in Canada.

Throughout 1946, the RCAF restarted training of parachute-rescue personnel, and it formalized its first rescue coordination centre (RCC) in Halifax on 1 January 1947.[57] On 2 June 1947, the Cabinet was made aware that the SAR organization developed by the RCAF would cost $1,762,000 and required 142 additional personnel for the RCAF's organization and 10 personnel for the RCN to upgrade oceanic communications.[58] The RCAF plan for SAR required 942 fewer personnel and saved $4 million from the RCMP's proposal, so on 9 April 1947 and in anticipation that Cabinet would agree, the Cabinet Defence Committee ordered the RCAF to take immediate responsibility for aviation SAR in Canada.[59] Cabinet approved the organization on 18 June 1947, and the new RCAF system expanded rapidly across the country.[60]

The expansion of the SAR system to include maritime rescue required much less time and discussion. The expansion started with the United Nations–sponsored International Convention for the Safety of Life at Sea held in London, June 1948, to improve the safety of marine transportation. The convention's agreement added Regulation 15, which required contracting governments "to ensure that any necessary arrangements [were] made for coast watching and for the rescue of persons in distress at sea round its coasts."[61] Maritime rescue, like aviation rescue, was now internationally mandated.

An Interdepartmental Committee of Search and Rescue (ICSAR) was convened in 1949 to determine how Canada would provide maritime rescue. ICSAR included the Canadian Maritime Commission, Mines and Resources, Ministry of Justice, Ministry of Fisheries, Ministry of Finance,

National Health and Welfare, Department of National Defence and DoT.[62] The committee discussed, again, the possibility of a coast guard, but the need was no longer as obvious. Air Vice-Marshal (A/V/M) Slemon spoke on behalf of the RCAF and, with unanimous agreement from the other participants, conceded that "operating experience indicated that the present disposition of search and rescue facilities was satisfactory."[63] With the surprising lack of interest from the RCAF, there was no general support for a coast guard, so the matter was shelved.[64] Out of ideas for options, ICSAR proposed expanding the existing aviation SAR mandate of the RCAF to include maritime rescue. The proposal for maritime SAR gave the RCAF direct tasking authority over any government vessel for marine emergencies, and Cabinet approved the plan on 26 June 1950.[65] This maritime-rescue solution was announced to the public on 21 July 1950, which explained that the RCAF's RCCs in Halifax, Trenton and Vancouver were given full tasking authority over 234 government-owned vessels, for maritime SAR purposes only.[66] The RCN had concerns about specific details, so the following year, Cabinet changed the wording slightly on the SAR directive to mollify the RCN.[67] Aside from the RCN's problem with direct tasking authority, all members of ICSAR agreed that the RCAF approach to SAR was the most cost-effective response to international requirements.[68] With little discussion and no other options considered, the RCAF became responsible for domestic maritime SAR in Canada.

Photo: DND
H-21 Vertol helicopter conducting a hoisting operation with a rescue crash boat.

It is difficult to understand the apparent lack of RCAF effort to avoid the maritime SAR mandate, given its strong support for a coast guard prior to 1949. Indeed, the official RCAF policy on any civilian commitment was "to reduce these non-combatant commitments to the minimum acceptable and while they must be provided for, they should not be permitted to assume priority or scale of effort which would detract from combat efficiency."[69] The policy continued with "restricted peacetime appropriations together with the obvious fact that these activities do not contribute to operational efficiency, [which] clearly shows the desirability of being rid of them."[70] Make no mistake; the RCAF was not a willing volunteer for domestic SAR services.

Arguably, the RCAF might have believed that an amalgamated SAR service would have been easier to pass on to another organization, especially if a Canadian coast guard was created later. If maritime and aviation SAR were all part of one system, then it could be a fair assumption that the transfer of SAR to another organization would likely have included both components, and

the RCAF would have rid itself of all aspects of SAR.[71] The 1950 Plan G document for the future direction of the RCAF stated that the RCAF wished to be rid of SAR and other "non-operational commitments," but it also stated "the aim at present will be to seek a method of being relieved of as many non-combatant commitments as possible."[72] Amalgamating aviation and maritime SAR into one organization available to be transferred to another organization was one possible way of being relieved of the SAR service. In the interim, the maritime mandate had been formally assigned to the RCAF, and military resources would be involved in maritime rescues. In an effort to replace old equipment and maximize new SAR equipment's uses, the air force announced to the International Civil Aviation Organization (ICAO) that it intended to replace its high-speed rescue vessels with helicopters as the primary shore-based resources.[73] ICAO, however, responded that the reduction of vessel support was unacceptable:

> By no means will the helicopter entirely eliminate the present methods and equipment used in the saving of life and property at sea. Rather, it will serve as an indispensable assistant to (a) the surface vessel and its boats, (b) the shore lifeboat station, and (c) the conventional fixed wing aircraft. It possesses certain inherent limitations that restrict its use under all conditions.[74]

The rebuke from ICAO did nothing to convince the RCAF to change its plans.[75] The RCAF proceeded to disband the marine squadrons of high-speed rescue vessels as part of "a new policy in regard to marine operations, which envisages the reduction of our marine branch to the status of range patrol and local crash duty only."[76] The RCAF may be forgiven its tough-love policy towards maritime rescue, as the expansion of the rescue requirement came with no additional funding. The government was quite content to use existing resources under the authority of the RCAF and to ignore calls for a Canadian coast guard, so the air force could hardly be expected to prioritize the maritime-rescue role. The RCAF was left with a purely domestic requirement in oceanic and Great Lake areas, in a mandate where the air force had no expertise and insufficient resources to adequately perform or coordinate oceanic rescues. Conspicuously absent in the discussions on maritime rescue was DoT, which would eventually have to own up to its responsibility for a service more important to transportation safety than the military's defence of the nation. Until that happened, however, RCAF resources and effort specifically for the maritime mandate were minimized in the broader hope that the entire SAR mandate could later be transferred to another governmental organization. The reality was that rescue requirements had morphed from the original RCAF goal of recovering aircrew to support a war effort, to a civil and domestic responsibility. Cost effectiveness and the government's desire to use the military in a domestic capacity were the basic reasons behind these developments, but they reinforced an RCAF focus away from military rescue activities.

THE TIDE TURNS TO EFFECTIVENESS

The RCAF's development of domestic rescue had been a government requirement, and it had come about with a surprising lack of wartime planning for SAR forces within the RCAF in the 1950s.[77] Consider the United States Air Force's (USAF's) use of helicopters for combat SAR in Korea, 1950. USAF successfully used helicopters on the battlefield to save 996 men from enemy territory over the course of the Korean War.[78] Consider also that the RAF ASR service had already proved the importance of combat rescue during the Battle of Britain. Both British and American forces provided post-war combat-rescue services as well as assistance in domestic rescue.[79] The RCAF, by contrast, relied on allied capabilities for the combat applications of SAR and failed to include the capability

in any war planning until 1960.[80] Within the RCAF, the military applications of SAR operations had been gradually weaned out of air force policy in the 1940s due to a required focus on domestic rescue, and that trend would continue over the following decade.

The 1950s intensified the RCAF's activities in domestic rescue, as SAR operations increased dramatically. In the first year of SAR operations in 1947, there had only been 50 missions, which had been an insignificant drain on RCAF resources at that time.[81] However, after the maritime SAR mandate had been added to the RCAF SAR duties, the number of missions in 1950 increased to 252 with a resulting 4,667 hours flown by RCAF aircraft.[82] Throughout the mid-1950s, the hours further increased to 8,000 hours flown per year with an annual cost to the RCAF of $6 million. A peak of 8,737 hours for SAR in 1955 shows how high the demand really was, especially when compared to the approximately 2,400 hours used annually by the RCAF for SAR in 2014, which is a contrast that highlights the incredible strain on the RCAF in the 1950s.[83] The RCAF had originally utilized nine air stations for SAR purposes, but by the end of the 1950s, the RCAF had reduced the SAR organization to five locations with rescue aircraft and crews. These few resources proved insufficient, so the RCAF was forced to rob aircraft from other mission requirements to assist in the SAR mandate.[84] In fact, between 1956 and 1958, the use of other RCAF aircraft for SAR missions was so prevalent that aircraft assigned to primary SAR duties accounted for only half of the hours flown on SAR missions.[85] It is not clear how large an impact SAR missions were having on other RCAF responsibilities, but the growth of aircraft SAR requirements had to be contained. Something had to change.

One change that the RCAF initiated was the standardization of aircraft launch times for SAR operations. The 1958 version of the CAP 342, outlining SAR orders, called for SAR aircraft "to be maintained on a thirty minute standby basis during normal working hours and are to be on a one hour standby basis during off-duty hours and holidays."[86] This standard, however, raised concerns because it had not taken into account existing manning levels at SAR units. It was discovered that the rescue units across the country were badly undermanned, and to resolve the issue, AFHQ would need to establish 100 new positions for SAR or add another hour to the off-duty launch time regulation to match the existing personnel establishment.[87] In line with the 1950 policy to minimize resources for SAR, the Chief of the Air Staff (CAS) chose to reduce the SAR launch times, after hours and on holidays, to two hours.[88] The rationale used by the CAS for limiting the launch times of SAR aircraft, thereby avoiding personnel increases, is important enough to be quoted at length:

> It will be noted that the protection of air traffic is the only RCAF SAR responsibility calling for the establishment and maintenance of primary facilities at rescue units. It is on the basis of the air requirement that unit equipment is scaled and personnel establishments determined. The responsibility with respect to marine cases is primarily one of coordination. It follows from the considerations noted above that the state of readiness maintained at rescue units is dictated by the air situation. The protection afforded to marine craft is, in a sense, a by-product of this arrangement.[89]

This CAS policy leads one to believe that a clear division between aviation and maritime SAR had developed. The RCAF had assumed full responsibility for aviation military and domestic rescue, but it resisted any increase in maritime-rescue involvement. Another change was made to meet

the rescue needs of the RCAF's fighter aircraft. A study concluded that new helicopters should be purchased that would form a base rescue capability at locations where the RCAF flew jet aircraft because some fighter bases were nowhere near a SAR station.[90] The intriguing nature of this proposal is that these helicopters were separated from the SAR system, as they had been recommended as a stand-alone capability at each station.[91] Rather than augmenting the civilian SAR system any further, the air force focus was on the separation of military and civilian rescue systems in order to relieve some of the strain. It should be noted that the base-rescue-flight proposal did not proceed in the time covered by this study; although, there are three such units in operation today.[92] One can only assume that this project was considered, and subsequently pursued, so that there would be some RCAF rescue aircraft that could not be hijacked by civilian rescue needs. The RCAF desperately needed assistance with the rescue role, so it limited SAR growth and attempted another transfer of SAR altogether. Air Commodore Lipton, the Chief of RCAF Operations, called a meeting with DoT in 1959 to discuss the "possible passing of [the SAR] role to the DoT from the RCAF."[93] The RCAF wanted to know if "there was some part of the search and rescue operation which could be taken over by the Department of Transport, and to determine what would be involved if the [DoT] were called upon to take over the whole search and rescue responsibility."[94] DoT argued that it would take several years to expand its organization enough to take on the responsibility and that the RCAF was already set up for SAR purposes, so it refused to take over the whole mandate.[95] The meeting did not resolve any of the RCAF concerns, but it appeared to have planted seeds of change, at least in the maritime domain.

Change came quickly. The first change was made by DoT when experienced mariners were hired by DoT in 1959 to provide maritime-rescue expertise in the RCCs.[96] Second, multiple SAR vessels had been ordered by DoT in 1958 to provide an expanded surface-vessel rescue capability on both coasts. Third, in 1960, SAR cutters were ordered to add more rescue resources on both coasts and on the Great Lakes.[97] These vessels would operate from locations where there was a known high incidence of maritime rescue needs to fill in the gaps formed by government vessels, which were by no means guaranteed to be anywhere near where they were needed most for rescues, due to their daily departmental work.[98] The DoT and the new SAR patrol cutters resolved many of the concerns of the existing system for maritime rescue. The RCAF also took proactive steps to improve the system after 1959, as new aircraft specific to SAR were planned for purchase. At the beginning of 1950, there had been five RCCs and nine air stations operating a total of 34 aircraft and helicopters for multiple mission types including SAR and six high-speed rescue vessels at two marine stations.[99] At the end of the 1950s, there were four RCCs, five air stations operating a total of 25 aircraft and helicopters, and no rescue vessels capable of operating any distance from the stations to which they belonged.[100] In order to maximize the capability of the few resources assigned to SAR, the 1959 RCAF acquisition plan included the purchase of SA-16B Albatross and CH-113 Labrador helicopters that were to be used solely for SAR purposes.[101] These aircraft had much improved range and overall capabilities, provided a long-term commitment to the SAR role and finally phased out the Lancaster bombers and Canso seaplanes that were left over from the Second World War. This commitment modernized and strengthened the aviation SAR capability within the RCAF.

In addition, the RCAF rediscovered a limited wartime role for SAR forces. The RCN brought the issue forward in 1960 by requesting RCAF consideration to assigning SAR forces to the RCN over the Atlantic area.[102] The CAS, Air Marshal Hugh Campbell, informed the RCN that he was opposed to breaking up the command and control structure of the SAR organization because the SAR responsibility extended all over the country and commonality was critical for other government departments to work with the system.[103] However, subsequent discussion determined that the

1950 //
Cabinet assigns maritime SAR responsibilities to the RCAF.

1948 //
Maritime rescue is mandated internationally.

1947 //
The RCAF formalizes its first RCC.

Cabinet approves the RCAF as Canada's lead SAR organization.

1945 //
ASR saves **13,269** lives worldwide during World War II; **8,604** were Allied aircrew.

Following PICAO's lead, Canada's Air Sea Rescue becomes the Search and Rescue Service.

1944 //
The RCAF incorporates para-rescue capability into the ASR system in Canada.

1942 //
The RCAF establishes an ASR system.

1940 //
During the Battle of Britain, the RCAF identifies the requirement for ASR.

command and control could change during wartime, recognizing that the RCN would be the lead agency in oceanic areas during a war.[104] One aspect of the wartime plans should be kept in mind: Canada only envisaged SAR forces being used to rescue personnel from Canadian waters and territory, and not for deployed rescue like the systems of the RAF and USAF.[105] The RCAF's SAR system had become a completely domestic service, and it had just been clarified that wartime use would only be within Canadian territorial areas.

The final significant change to SAR organization in Canada was the formation of the CCG in 1962. This organization provided all components of the maritime-rescue system; although, the RCAF retained command and control of the overall SAR organization.[106] The CCG relieved the RCAF of the need to coordinate the maritime missions and reduced the demand for rescue aircraft. This met the RCAF's aims of minimizing its contributions to domestic rescue, so it settled with this minor victory and embraced the remaining aviation SAR mandate. The Air Council agreed "that both civil and military SAR requirements in Canada and the seaward approaches should continue to be met by a single SAR organization; [and] that the RCAF SAR organization is to be retained at its present level of establishment to meet Canadian SAR requirements."[107] The 1950s' crescendo of challenges for the SAR community was overcome by the decisions described above, and the RCAF has been able to manage the domestic SAR system effectively ever since.

The development of the Canadian SAR system was successful, but one can conclude that the basic wartime requirement for combat rescue activity was all but neglected until 1960 in the pressing need to develop a SAR system for Canada from scratch. Even with the wartime planning included in 1960, RCAF SAR resources were not envisaged for use outside of Canada. Since the period covered in this study, the Americans and the British have gone on to considerable effort to maintain a combat-rescue capability, and it appears that the RCAF planned to use those systems in deployed operations rather than create its own.[108] Even now, Canada's wartime rescue plans are limited to the following doctrine: "Canadian dedicated SAR forces may be employed worldwide in support of Canadian military operations at the discretion of the Commander Royal Canadian Air Force. This might include the employment of complete SAR formations or specific personnel or sub-units for the duration of a mission or operation."[109]

With only the above few words for the military employment of RCAF resources assigned normally to domestic rescue, we can surmise that the RCAF does not have a robust plan for the employment of SAR forces in future conflicts. Unfortunately, Canadian history has shown that the domestic pressures on the

RCAF to maintain an effective system for Canadians has been a large responsibility and will require the concentration of the few forces assigned to the SAR role. That there are few aircraft available in the RCAF for rescue is a strong argument against using those resources in a combat role, but surely the personnel flying those aircraft could provide greater allied interoperability, either in operations or just in policy development. The combat component of rescue in Canada may not have been a priority since 1942, but the military component of rescue, at least using personnel resources, is worth thinking about for the future.

CONCLUSION

Returning to our three questions, we have now seen that rescue systems are necessary for wartime air combat, both to aid in the long-term fight for national sovereignty as well as to effectively support deployed air-combat operations. It is equally clear that international treaties require Canada to maintain a robust domestic-rescue capability for both aviation and maritime emergencies. Combined, the wartime and peacetime components of rescue form the necessities of a national SAR system even though the focus in Canada has traditionally been only on the domestic needs. Both of these components are worthy of consideration.

We have seen how the Government of Canada applied pressure on the RCAF to develop domestic SAR in Canada and why the RCAF was assigned both aviation and maritime-rescue roles. The government proved unwilling to authorize either a coast guard earlier than 1962 to take on all aspects of SAR or to assign SAR to an RCMP that, back in 1945, had a robust plan for the delivery of aviation and maritime rescue. Therefore, the RCAF had little choice but to neglect the deployment component of rescue activities as it struggled with government direction to develop and manage a civilian and domestic-rescue capability. This neglect is understandable given the struggles to provide sufficient resources for all of Canada's aviation- and maritime-rescue needs, but current doctrine suggests that the reintegration of deployed combat rescue policy has not been given the attention that American interest in rescue activities suggests may be appropriate.

A historical examination of Canada's rescue system has offered insight that the military delivery of rescue has not resulted in a balanced approach to military and domestic-rescue policy. Clearly, the military rescue roles have been on the back seat nearly since the time the rescue system was first developed. In Canada, the lack of a serious threat to our shores since 1943 has resulted in the domestication of the rescue system to the extent that there exists no standing plans to provide support to coalitions in deployed air-combat missions. Rather than suggesting that the RCAF "might include the employment of complete SAR formations or specific personnel,"[110] as outlined earlier in RCAF doctrine, perhaps future doctrine could outline what the RCAF can specifically offer in policy and personnel resources to support deployed forces in any coalition combat operation with Canada's military.

The simple fact is that military members provide much of the domestic SAR service in Canada, with all due acknowledgement of the important rescue role of the CCG, and the expertise of people wearing military uniforms could be exploited to enhance coalition rescue activities in the future. Our SAR personnel have experience from other RCAF communities, they are very tactically capable, and they could bring a lot of expertise to a fight using skill sets developed in the domestic-rescue role. With 70 years of SAR provided by the RCAF, perhaps it is time to develop specific doctrine to employ air force rescue personnel in future coalition rescue positions and to chart a course more aligned with our allies. Our history in rescue activities suggests that Canada is long overdue in acknowledging the need to assist with coalition combat-rescue activities.

Major James Pierotti is an Air Combat Systems Officer currently posted to the Canadian Forces Aerospace Warfare Centre. He has five tours within the SAR community, either flying the CC130 Hercules in the SAR role or within a joint rescue coordination centre (JRCC). He has operational experience as the Chief of Combat Rescue in Kabul, Afghanistan, September 2008 to April 2009, with the International Security Assistance Force. He commanded JRCC Victoria from July 2009 to July 2012. His earlier experience was in tactical airlift on the CC130 Hercules and as an electronic warfare officer on the CT133 Silver Star.

Photo: DND
High, straight-on front view of
Lancaster aircraft used for SAR.

ABBREVIATIONS

A/V/M	air vice-marshal
AFHQ	Air Force Headquarters
AMAS	Air Member for Air Staff
ASR	air sea rescue
CAP	Canadian Air Publication
CAS	Chief of the Air Staff
CCG	Canadian Coast Guard
CJOC	Canadian Joint Operations Command
DHH	Directorate of History and Heritage
DoT	Department of Transport
EAC	Eastern Air Command
F/L	flight lieutenant
ICAO	International Civil Aviation Organization
ICSAR	Interdepartmental Committee on Search and Rescue
JRCC	joint rescue coordination centre
LAC	Library and Archives Canada
PICAO	Provisional International Civil Aviation Organization
RAF	Royal Air Force
RCAF	Royal Canadian Air Force
RCC	rescue coordination centre
RCMP	Royal Canadian Mounted Police
RCN	Royal Canadian Navy
SAR	search and rescue
UK	United Kingdom
USAF	United States Air Force
W/C	wing commander
WAC	Western Air Command

NOTES

1. The Para Rescue Association of Canada, *That Others May Live: 50 Years of Para Rescue in Canada* (Astra: The Para Rescue Association of Canada 1994), 10.

2. Library and Archives Canada (LAC), RG24-D-1-c, Vol. 8164, File Part 1-2, 1700-27 SUB 1, Organization and Administration – Air, Sea, Search and Rescue Services, Interdepartmental Committee on SAR, Vol. 1, 30 November 1945, "Minutes of Meeting, Interdepartmental Committee on Search and Rescue."

3. Clayton Evans, *Rescue at Sea: An International History of Lifesaving, Coastal Rescue Craft and Organizations* (London: Conway Maritime Press, 2003), 209.

4. A detailed search was made for documentation of rescue services in the late 1930s in RCMP and DoT files, but nothing was found.

5. Evans, *Rescue at Sea,* 208.

6. Ibid. The RCMP was involved in maritime rescue before and during the war, but RCMP assistance to the Canadian public was very limited during the war because most of their vessels had been transferred to the RCAF and RCN.

7. J. E. Vernon, "RCAF Marine Craft," *4th Annual Air Force Historical Conference: 80 Years of Maritime Aviation in Canada,* 12 Wing Shearwater, Nova Scotia, August 24th – 25th 1998, 103 and 106.

8. Geoff D. Pilborough, *The Royal Canadian Air Force Marine Squadrons,* vol. 1, *1935–1945* (Edmonton: Canimpex, 1996), 62.

9. Hugh A. Halliday, "The Role of the Boats: Air Force Part 46," *Legion Magazine* (30 August 2011).

10. "Royal Canadian Air Force Operations Records Books: C-12156 – Eastern Air Command Headquarters 1 May 1940 to 30 September 1944," Canadiana.org, accessed November 8, 2016, http://heritage.canadiana.ca/view/oocihm.lac_reel_c12156/1?r=0&s=1.

11. George Galdorisi and Tom Phillips, *Leave No Man Behind: The Saga of Combat Search and Rescue* (Minneapolis: Zenith Press, 2008), 29.

12. Ibid.

13. Jon Sutherland and Diane Canwell, *The RAF Air Sea Rescue Service: 1918–1986* (Great Britain: Pen & Sword Books, 2005), 31.

14. Ibid.

15. Ibid., 32.

16. Ibid.

17. Ibid.

18. Directorate of History and Heritage (DHH), AIR 20/4018, 31 October 1945, "RAF Costal Command Headquarters History of Flying Control."

19. Sutherland and Canwell, *RAF Air Sea Rescue,* 45.

20. DHH, 181.009 (D4389), RCAF File S202-85-2, Western Air Command (WAC) No. 2 Group Standing Orders for ASR Jun to Sep 42, 1 June 1942, "Memorandum on the Establishment of Flying Control and Aircraft Safety Services in Canada." There is no name attached to this memorandum, but

it is likely that AFHQ staff officer Flight Lieutenant (F/L) R. J. Lehman produced it, as it was embedded with a host of other letters and memorandums with his signature. Flying-control officers—not pilots or navigators, as is common today—provided rescue expertise.

21. W. A. B. Douglas, *The Creation of a National Air Force,* vol. 2, *The Official History of the Royal Canadian Air Force* (Canada: University of Toronto Press, 1980), 484.

22. Ibid.

23. DHH, 181.009 (D4389), RCAF File S202-85-2, WAC No. 2 Group Standing Orders for ASR Jun to Sep 42, 1 June 1942, "Memorandum on the Establishment of Flying Control and Aircraft Safety Services in Canada."

24. LAC, RG24-E-1-b, Vol. 5421, 67-16-2, Sea Rescue Services – Liaison with Royal Canadian Navy, Memorandum to AMO from Air Member for Air Staff (AMAS) A/V/M N. R. Anderson, 3 August 1942, "Flying Control, Aircraft Safety and Sea Rescue Services."

25. DHH, 81/301, CAP 342, *Orders and Instructions for RCAF Flying Control and Air Sea Rescue Service,* May 1943.

26. Ibid., 33. There were two commands in Canada, and each command had two groups responsible for the various air stations.

27. LAC, RG24-E-1-c, Vol. 17870, Orders, Instructions, Directives – SAR, Letter to CAS, attention DDFC, from Air Officer Commanding (AOC) WAC, signed by F/L J. M. H. Langford, 3 May 1943, "WAC ASR Services." It is not known what official Eastern Air Command (EAC) policy on ASR was in 1943, but it is clear that EAC responded to civilian marine emergencies on a regular basis.

28. Douglas, *Creation of a National Air Force,* 519.

29. Ibid., 568.

30. Ibid., 342.

31. LAC, RG24-E-1-c, Vol. 18113, Search and Rescue – Policy, File 976-1, 10 November 1943, Letter without title from Deputy Minister DoT to Deputy Minister of National Defence (Air).

32. LAC, RG24-E-1-c, Vol. 18113, Search and Rescue – Policy, File 976-1, Enclosure to Letter to Air Officer Commanding Western Air Command from CAS, 26 December 1943, "Air Sea Rescue Services."

33. "The Chronicles of W. R. (Wop) May: RCAF Rescue Service," accessed November 8, 2016, http://www.wopmay.com/current/adventures/rcafRescue.htm.

34. Para Rescue Association of Canada, *That Others May Live,* 14.

35. LAC, RG24-E-1-b, Vol. 3411, File Part 1-3, 466-1-5, Air/Sea Rescue Services – Parachute Rescue Personnel and Equipment Policy, Vol. 1, Memo to AMAS from DAC Wing Commander (W/C) H. B. Norris, 1 June 1944, "Parachute Rescue Personnel and Equipment."

36. LAC, RG24-E-1-c, Vol. 18113, Search and Rescue – Policy, File 976-1, Letter to DDFC from AMAS /Director of Air Transport Command, Group Captain Leigh, 4 April 1944, "Air Rescue Development."

37. Brereton Greenhous et al., *The Crucible of War 1939–1945,* vol. 3, *The Official History of the Royal Canadian Air Force* (Toronto: University of Toronto Press, 1994), 117.

38. Ibid.

39. Peter Whittle and Michael Borissow, *Angels without Wings: The Dramatic inside Stories of the RAF's Search and Rescue Squadrons* (Great Britain: The Angley Book Company, 1966), 36.

40. Galdorisi and Phillips, *Leave No Man*, 110.

41. David MacKenzie, *Canada and International Civil Aviation 1932–1948* (Toronto: University of Toronto Press, 1989), 192.

42. ICAO, *Convention on International Civil Aviation* (Chicago: 7 December 1944), 11.

43. LAC, RG24, Vol. 8164, File Part 1-2, 1700-27 SUB 1, Memorandum to D. of P. from Assistant/Director of Plans Commander F. A. Price, 23 November 1944, "2nd Meeting of the Inter-Departmental Committee on Water Services."

44. Ibid.

45. Ibid.

46. Ibid.

47. LAC, RG24-E-1-c, Vol. 18112 Search and Rescue – Organization and Administration 1945–1954, Letter to Hon. D. Abbott from Hon. C. Gibson, 8 June 1945, untitled.

48. LAC, RG-2, Vol. 124, Cabinet Documents, 9 February 1949, "Document No. 890." This document refers to, and details, a 17 July 1945 report on the suggested formation and subsequent rejection of a Canadian coast guard.

49. LAC, Cabinet Documents, RG-2, Vol. 124, Document No. 890 from 9 February 1949, "Re: Proposed Formation of a Canadian Coast Guard Service." This document discusses a 1945 meeting on the coast guard proposal.

50. LAC, RG24, Vol. 8164, File Part 1-2, 1700-27 SUB 1, circa January 1946, "Proposed Plan – National and International Commitments for Search and Rescue Throughout Canada."

51. LAC, RG2-B-2, Vol. 103, File T-30-1, Territorial Waters and Districts – Official – Air Search Rescue, Canadian Coast Guard, Prepared by Chairman Squadron Leader R. J. Lehman, 30 November 1945, "Meeting Four of the Interdepartmental Committee on Post-War Air Sea Rescue."

52. Ibid.

53. Colin Campbell, "J. L. Ilsley and the Transition to the Post-War Tax System: 1943–1946," *Canadian Tax Journal* (2015), 13.

54. Canadian Joint Operations Command (CJOC) Historical Files, "Cabinet Defence Committee Minutes for 10 January 1946," 2.

55. LAC, RG2-B-2, Vol. 103, File T-30-1, Territorial Waters and Districts – Official – Air Search Rescue, Canadian Coast Guard, Privy Council Office – Air Search Rescue, 8 January 1946, "Cabinet Document D-30."

56. CJOC Historical Files, "Cabinet Defence Committee Minutes for 10 January 1946," 2.

57. LAC, RG24-E-1-c, Vol. 18113, Search and Rescue – Policy, File 976-1, Letter to CAS from Air Officer Commanding No. 10 Group, Air Commodore F. G. Wait, 26 June 1947, "SAR Coordination Centre."

58. LAC, Cabinet Documents, RG-2, Vol. 66, 2 June 1947, "Document No. 468."

59. DHH, R. L. Raymont fonds 73/1223, Memorandum to Distribution List from CAS, signed by Squadron Leader R. B. Inglis, 9 April 1947, "Air Force: SAR Arrangements." This document summarizes Cabinet Defence Committee guidance from 31 March 1947.

60. LAC, Cabinet Conclusions, RG-2, Privy Council Office, Series A-5-a, Vol. 2640, No. 5435, 18 June 1947, "National Defence – Air Search and Rescue Service."

61. International Maritime Organization, *International Convention for the Safety of Life at Sea, 1948* (London: 10 June 1948), 206.

62. LAC, Cabinet Conclusions, RG-2, Privy Council Office, Series A-5-a, Vol. 2643, No. 8464, 17 February 1949, "Search and Rescue Coast Guard Service."

63. LAC, RG24-D-1-c, Vol. 8164, File Part 1-2, 1700-27 SUB 1, Interdepartmental Committee on SAR, Vol. 1, Minutes of meeting prepared by W/C A. H. Newsome of the PCO, 30 March 1949, "Interdepartmental Committee on Search and Rescue."

64. After February 1949, until after the Coast Guard is formed in 1962, a coast guard is not discussed in Cabinet.

65. LAC, Cabinet Documents, RG2, Vol. 124, Doc. No. 147–50, 22 May 1950, "Re: Search and Rescue Service."

66. LAC, RG24-D-1-c, Vol. 8164, Unnamed Newspaper Clipping, Canadian Press, Ottawa, 21 July 1950; and LAC, Cabinet Documents, RG2, Vol. 124, Doc. No. 147–50, 22 May 1950, "Re: Search and Rescue Service."

67. CJOC, SAR Historical File, 12 July 1951, "Cabinet Directive Circular No. 22."

68. LAC, Cabinet Documents, RG2, Vol. 124, Doc. No. 147–50, 22 May 1950, "Re: Search and Rescue Service."

69. DHH, 96/24, Air Force Headquarters fonds, Box 9, *RCAF Plan G, 1 Sep 50 Revision,* 4.

70. Ibid., 8. This statement is in specific reference to the SAR organization and support to the North West Staging Route.

71. This line of argument is given more evidence and analysis in my thesis.

72. DHH, 96/24, Air Force Headquarters fonds, Box 9, *RCAF Plan G, 1949,* 3.

73. In 1946, ICAO was no longer a Provisional entity.

74. LAC, RG24-E-1-c, Vol. 18113, SAR – Policy, File 976-1, Letter to the Chief of the Naval Staff from CAS, 17 February 1952, "SAR – Provision of Surface Rescue Vessels."

75. LAC, RG24-E-1-c, Vol. 18113, SAR – Policy, File 976-1, Cover page and minutes to Chairman of ASR Facilities W/C J. Woolfenden, from Deputy Director RCN Plans and Operations Commander R. C. Chenowith, 15 April 1952, "Minutes of ASR Meeting."

76. LAC, RG14-E-1-c, Vol. 18113, SAR – Policy, File 976-1, Letter to ICAO from Deputy Minister for Air C. M. Drury, 1 April 1952, "Disbandment of Marine Squadrons."

77. AFHQ planning documents from 1947 to 1959 were analysed, and not one of them contained any wartime consideration for SAR forces.

78. Robert F. Futrell, *The United States Air Force in Korea: 1950–1953,* rev. ed. (Washington, DC: Office of Air Force History, USAF, 1983), 572.

79. Galdorisi and Phillips, *Leave No Man,* 109; and Sutherland and Canwell, *RAF Air Sea Rescue,* 135–37.

80. LAC, RG24-E-1-c, Vol. 18117, SAR – Operations, File 976-100, Memo to CAS from Chief of the Naval Staff Vice-Admiral H. G. DeWolf, 15 July 1960, "Responsibility for SAR."

81. DHH, 79/631, RCAF SAR Operations 1947–1970, DIS Files 1-14, SAR Ops 1947, File 1, "RCAF SAR Operations 31 March 47 to 31 March 48."

82. G. Y. Smith, *Seek and Save: The History of 103 Rescue Unit* (Erin, Ontario: The Boston Mills Press, 1990), 23. The hours flown for SAR in 1950 may have been even higher as the RCAF had demonstrated inconsistency in how it accounted for all flying hours in the late 1940s and early 1950s.

83. Department of National Defence, Canadian Armed Forces and Department of Fisheries and Oceans, Canadian Coast Guard, *Federal Search and Rescue Operational Governance Committee Annual Report 2014* (Ottawa: Canadian Joint Operations Command, March 2015), 22.

84. LAC, RG24-E-1-c, Vol. 18114, SAR – Policy, 976-2, Letter to CAS from Air Officer Commanding Transport Command Group Captain Z. L. Leigh, 9 October 1959, "SAR Aircraft – 111 KU Winnipeg, Utilization on Other than SAR Missions."

85. LAC, RG24-E-1-c, Vol. 18114, SAR – Policy, 976-2, details were not obtained, 10 February 1959, "DoT – RCAF Meeting on SAR Operations in Canada."

86. LAC, RG24-E-1-c, Vol. 18114, SAR – Policy, File 976-1 Vol. 5, Memorandum to Chief Ops from A/DTRO W/C J. G. Showler, 28 May 1958, "SAR – Standby Policy."

87. Ibid.

88. LAC, RG24-E-1-c, Vol. 18114, SAR – Policy, File 976-1 Vol. 5, Letter to Maritime Air Command, Transport Command, Tactical Air Command, and Air Defence Command from CAS, signed by W/C J. G. Showler, 11 June 1958, "SAR – Standby Commitment." The launch posture remains in effect to this day.

89. LAC, RG24-E-1-c, Vol. 18114, SAR – Policy, File 976-2, Letter to 5 Air Defence from CAS, signed by W/C J. G. Showler, 24 June 1958, "SAR – Standby Commitment."

90. LAC, RG24-E-1-c, Vol. 18128, File No. 978-7-3, SAR – Crash Rescue Assistance by Others, SAR – Techniques and Procedures – Crash Rescue – Helicopters, 7 May 1958, "Report for Base Rescue – Ambulance Helicopters."

91. LAC, RG24-E-1-c, Vol. 18128, File No. 978-7-3, SAR – Crash Rescue Assistance by Others, SAR – Techniques and Procedures – Crash Rescue – Helicopters, 18 June 1958, "Extract from the Minutes of the 22/58 Air Council Meeting."

92. 439 Squadron in Bagotville, Quebec; 444 Squadron in Goose Bay, Labrador; and 417 Squadron in Cold Lake, Alberta, are the base rescue units still in operation today.

93. LAC, RG24-E-1-c, Vol. 18114, SAR – Policy, File 976-1 Vol. 5, SAR Policy, DoT and RCAF Meeting headed by A/V/M de Niverville, the Director of Air Services for the RCAF, and R. W. Godwin, the Assistant Director General of Air Services, for DoT, 10 February 1959, "DoT – RCAF Meeting on SAR Operations in Canada."

94. Ibid.

95. Ibid.

96. LAC, RG24-E-1-c, Vol. 18114, SAR Operations – Marine and Aircraft Cases, File 976-4, Letter to W/C Showler from DoT, 13 July 1960, "Report from Marine Coordinators."

97. LAC, RG12, Vol 8906-81, "SAR Vessel for British Columbia 1957–1965"; LAC, RG12, Vol. 8906-78, "SAR Vessel for East Coast 1957–1964"; and LAC, RG12, Vol. 8906-109, "Proposed Patrol Cutter for SAR 1960–1967."

98. LAC, RG24-D-1-c, Vol. 8164, File Part 1-2, 1700-27 SUB 1, Interdepartmental Committee on SAR, Vol. 1, Minutes of meeting prepared by W/C A. H. Newsome of the PCO, 30 March 1949, "Interdepartmental Committee on Search and Rescue."

99. DHH, 79/631, RCAF SAR Operations 1947–1970, DIS Files 1–14, SAR Ops 1940, File 3, circa early 1950, "RCAF Press Release No. 7615."

100. E. D. Bryson and N. D. Bray, "An Evaluation of the Future RCAF Search and Rescue Requirement," *Department of National Defence, Chief of Operational Requirements, DRDC CORA* (Ottawa: February 1964).

101. DHH, 181.004 (D23), RCAF Programme of Activities, 1963–1968 with amendments; and LAC, RG24-E-1-c, Vol. 1849, STOL Transport/SAR 1959–1961, 24 November 1959, "Standard of Preparation – Vertol 107 Model II-1 Helicopter"; and 24 July 1959, "Operational Characteristics for a Short Range, STOL, Transport/SAR Aircraft."

102. LAC, RG24-E-1-c, Vol. 18117, SAR – Operations, File 976-100, Memo to CAS from Chief of the Naval Staff, 25 April 1960, "Responsibility for SAR."

103. LAC, RG24-E-1-c, Vol. 18117, SAR – Operations, File 976-100, Memo to Chief of the Naval Staff from CAS, 27 June 1960, "Responsibility for SAR."

104. LAC, RG24-E-1-c, Vol. 18113, SAR – Policy, File 976-0, Vol. 8, 16 March 1961, "Report to the Chiefs of Staff Committee by the Joint Planning Committee on SAR."

105. Galdorisi and Phillips, *Leave No Man Behind,* 213; and Sutherland and Canwell, *RAF Air Sea Rescue,* 145.

106. Thomas Appleton, *Usque Ad Mare: A History of the Canadian Coast Guard and Marine Services* (Ottawa: DoT, 1968), section on SAR.

107. LAC, RG24-E-1-c, Vol. 18117, SAR – Operations, File 976-100, 4 October 1961, "Supporting Data for Air Council Meeting: Review of the SAR Organization."

108. RAF and USAF combat rescue is the topic of Galdorisi and Phillips, *Leave No Man Behind.*

109. Department of National Defence, B-GA-404-000/FP-001, *Canadian Forces Aerospace Move Doctrine* (Astra: Canadian Forces Aerospace Warfare Centre, 2011), 48. Note that the only time that the RCAF deployed SAR forces was in 2011 for Operation JAGUAR to assist Jamaica with domestic rescue.
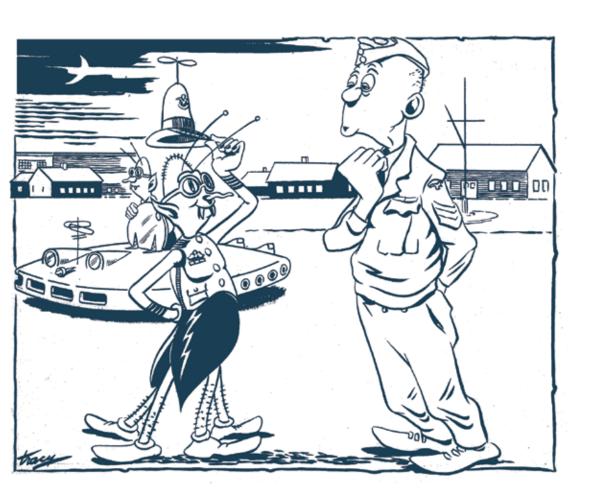
110. Ibid.

SEPARATING "SPACE"

from AEROSPACE

A CASE FOR CANADIAN ARMED FORCES SPACE DOCTRINE

By Major Matthew Thompson, USAF, MAS, MDS

As this original cartoon from the 1950s
by Warrant Officer Class 1 Ray Tracy
shows, space has been an RCAF concern
for more than six decades.

Despite the modern way of warfare's critical dependency on space-based capabilities, CAF aerospace doctrine makes virtually no mention of space effects, operations or basic principles. This runs counter to the very nature of doctrine. The aim of this article is to highlight this issue and to advocate for CAF to develop robust space-operations doctrine.

Space-based capabilities have significantly altered military operations over the last 60 years. Today's technology-driven, asymmetrical way of warfare is virtually impossible without integrating and applying space-based capabilities. Canada—with a relatively small, yet technically advanced and highly capable military—benefits greatly from such asymmetrical advantages. In truth, Canada has participated in military space operations for decades; operates military satellites; regularly consumes satellite intelligence, surveillance and reconnaissance (ISR) products; employs space-enabled weaponry; uses global positioning system (GPS) data; and has an operational, military space operations centre Despite this, CAF aerospace doctrine contains almost no focused discussion on space operations or the employment of space capabilities. In effect, it is mistitled "air power" doctrine. Space is an inherently distinct environment and should be doctrinally recognized accordingly. Space is also inherently joint because of its global nature and the strategic effects it provides for all environments and operating environments, across the spectrum of military operations. This calls for CAF space doctrine to exist outside the "aerospace" umbrella.

This article will advocate for CAF to develop robust, organic, distinct space-operations doctrine because of unique space attributes, current CAF military space capabilities and reliance as well as increasing CAF space development and integration. United States (US) and United Kingdom (UK) space doctrine significantly inform this article, which will first address the nature of space doctrine and the absence of space in CAF doctrine. Next, the article will address the need for distinct CAF space-operations doctrine and Canada's growing prominence in military space operations. Lastly, the article will make some recommendations for CAF space-doctrine development.

RECOGNITION OF SPACE AS A
SIGNIFICANT AND DISTINCT FORCE MULTIPLIER

Space-based capabilities—such as environmental monitoring, communications, precision navigation and timing (PNT), missile warning and ISR—have fundamentally altered the way modern militaries conduct warfare. US Joint Publication (JP) 3-14, *Space Operations* emphasizes the impact that space capabilities have as "significant force multipliers when integrated into military operations."[1] To facilitate effective integration, it contends that "joint force commanders and their staffs should have a common and clear understanding of how space forces contribute to joint operations and how military space operations should be integrated with other military operations."[2] Similarly, US Army doctrine highlights the criticality of integrating space into intelligence preparation of the battlespace (IPB) "to provide the G2 [intelligence staff] with a highly detailed analysis of the space medium and its capabilities and effects within the battlespace."[3] The UK's joint *UK Air and Space Doctrine* document urges "a greater focus on space power, prompted by [their] growing dependence on space services, to enable military operations and for [their] wider national security."[4] It later states, "About 90% of the UK's military capabilities *depend on space*."[5] [emphasis added] This statement can be applied to virtually any modern, technologically advanced military, CAF included.

Space is different than air, land and sea operating environments. Its physical nature, orbital mechanics, absent geographical boundaries, environmental considerations (like space weather, solar effects and orbital debris) and electromagnetic-spectrum dependency significantly alter space-system design, control and employment.[6] Space's uniqueness provides strategic attributes like *global perspective*, *global access*, *global presence* and *strategic depth*, which create additional strengths such as *versatility*, *ubiquity* and *persistence*.[7] These characteristics necessitate distinct space doctrine to account for such considerations and advocate for distinct military space mission areas. US space mission areas include: *space force enhancement*, *space support*, *space control*, *space force application* and *space situational awareness*.[8] Space power enables joint functions of *objective*, *offensive*, *mass*, *economy of force* and *unity of command*, to name a few, but do so differently than air, land or sea power.[9]

CURRENT CAF DOCTRINE FAILS TO ADEQUATELY ADDRESS SPACE

Despite inherent differences between space and other environments, CAF aerospace doctrine places very little emphasis on space systems or effects. One could likely replace the word "aerospace" with "air power" or "aircraft" without noticeably changing its meaning. For example, B-GA-401-000/FP-001, *Canadian Forces Aerospace Command Doctrine* lists 12 aerospace operations, 9 operations-support activities and 8 mission-support activities. Some, such as *electronic warfare, meteorology, intelligence* and *communication and information systems* should have clear space-operations implications, but only 1 of the 29 activities, *offensive and defensive space,* has a distinct space reference.[10] It then defines detailed roles, responsibilities and organizational relationships for the RCAF but does not once mention the space mission area, even when discussing the North American Aerospace Defence Command or operating in a coalition environment.[11]

Due to the vital role of satellites in the sense function, B-GA-402-000/FP-001, *Canadian Forces Aerospace Sense Doctrine* should address space more prominently than other CAF aerospace doctrine publications. However, the following is the *entirety* of its space discussion, and it is found near the end of the publication:

> **Space-based systems.** Satellites typically can carry limited payloads comprising either multispectral, electro-optical/infrared (EO/IR), radar, and/or [electronic intelligence] ELINT sensors. Their strength is their wide coverage and ability for unimpeded over flight of denied territory. Their weaknesses include potentially discontinuous coverage, sensitivity to surface weather (for EO/IR systems), and difficulty in detecting irregular forces.[12]

This rudimentary paragraph leads the reader to expect further discussion on space-based ISR platforms. Unfortunately, there is none, despite Canadian assets like RADARSAT or the fact that many US and commercial intelligence products used by CAF come from satellites. B-GA-405-000/FP-001, *Canadian Forces Aerospace Shield Doctrine* makes no mention of space, and its description of how Shield mitigates the vulnerabilities inherent in aerospace characteristics is exclusively focused on aircraft and airbases.[13] B-GA-403-002/FP-001, *Aerospace Electronic Warfare Doctrine* makes a passing reference to space systems but provides no amplification.[14] The reality that there is only one paragraph dedicated to space systems in the eight CAF aerospace doctrine publications is striking.[15] Ultimately, little emphasis is placed on space in CAF "aerospace" doctrine. Current doctrine, though robust and of significant value for air power applications, pays little attention to the "space" component of "aerospace."

SPACE AND AIR POWER DOCTRINE
SHOULD BE SEPARATE AND DISTINCT

CAF must develop space doctrine, separated from air power, for the same reasons that air power doctrine is distinct from sea and land doctrine. CAF aerospace doctrine blends the air and space environments into "aerospace," which it defines as "the environment that surrounds the Earth and extends through the air into space from the Earth's surface."[16] A flaw in combining air and space into one term is revealed in the next sentence: "This environment is *unique* and demands a *distinct and considered approach* to operations within it."[17] [emphasis added] Space is as distinct an environment from air, as sea is to land and land is to air. The greatest similarity between air and space is that neither of them is sea or land. As such, space demands a distinct and considered approach to operations, just as air, sea and land do.

Early on, the US military thought in a similar manner as current CAF doctrine but has since ceased using the term "aerospace." The United States Air Force (USAF) Air University *Space Primer* proposes that, in the absence of comprehensive space theory, air and sea models could be used as a baseline for developing space doctrine and strategy but that "the assumption that air and space power are inextricably linked—that the same theories which apply to airpower also apply to space power—is faulty."[18] It criticizes early thinkers for considering space forces as "simply 'high-flying air forces.' For example, USAF space doctrine was first established merely by replacing the word 'air' with the coinage 'aerospace' in the literature."[19] CAF doctrine falls into this same trap; it simply assumes that air and space are linked, and that precepts pertaining to one are valid for the other. Furthermore, the doctrine defines "aerospace power" as "that element of military power applied within or from the air and space environments to achieve effects above, on, and below the surface of the Earth," but fails to identify air and space power differences, the unique effects that they offer as well as their specific challenges.[20]

CANADA'S GROWING PROMINENCE
IN MILITARY SPACE OPERATIONS

Perhaps CAF does not require distinct space doctrine because it does not possess or employ robust, organic space capabilities. This premise is incorrect and ignores the fact that CAF heavily employs space capabilities, has for a long time, is developing Canadian military space capabilities and is strengthening partnerships with friendly space forces. Canada signed the Combined Space Operations (CSpO) memorandum of understanding between the "Five Eyes" (FVEY) nations in September 2014, an effort to move from cooperation, to collaboration and, ultimately, integration of FVEY military space capabilities and operations centres.[21] It would behoove Canada to have space doctrine to inform its participation in such an enterprise. Also, Canada may not have the international reputation of a "leading space nation" like the US, Russia or China, but within the FVEY and North Atlantic Treaty Organization (NATO) communities, Canada boasts the longest history of military space operations and some of the most robust space capabilities after the US. Andre Dupuis, president of Space Strategies Consulting Ltd. and former Director of Space Requirements, Department of National Defence, states that within FVEY, "Canada has perhaps the most robust space-operations capability [behind the US]."[22] In fact, the Polar Epsilon project, leveraging RADARSAT data, provides the Royal Canadian Navy (RCN) with unparalleled near real time ship positions and "the most accurate and reliable maritime surveillance picture of any country in the world."[23]

CAF has been actively growing its space organizations for years. The Department of National Defence (DND) appointed a Director General (DG) Space position, a brigadier-general, who reports

directly to the Commander RCAF and oversees space strategy, strategic plans, operations, readiness, requirements and all out of Canada (OUTCAN) space operations (approximately 35 positions in the US).[24] The Canadian Space Operations Cell (CanSpOC), established in 2012, operates 24/7 and provides space support to CAF operations worldwide. Its 24 personnel provide GPS dilution of precision predictions, space-weather satellite impacts, space situational awareness and collision avoidance support, real-time downloading and processing of satellite imagery via the Unclassified Remote-sensing Situational Awareness (URSA) system, and more.[25] CAF also deploys two-person joint space support teams (JSSTs) to integrate with and "educate brigades in all regions on space capabilities that will benefit their specific operations."[26] This is all done without dedicated CAF space doctrine. The future CAF space operational concept, adapted from a DG Space Strategic Plans and Readiness presentation, is in Figure 1.

► CanSpOC connects sources and users of space effects
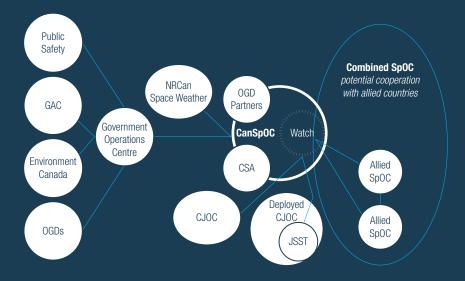
► Link with combined SpOC is key

Figure 1. CAF space operational concept[27]

CAF is actively developing, investigating or contributing to the following satellite capabilities:[28]

    a.   a follow-on to the Sapphire system, which detects and tracks orbiting space objects as a contributor to the US Space Surveillance Network;

    b.   the RADARSAT Constellation Mission of three satellites that will aid RCN and civil authorities via highly accurate maritime and Arctic surveillance;

    c.   a multisatellite Arctic communications constellation;

    d.   enhanced military satellite communications through the Protected Military Satellite Communications (PMSC) project; and

    e.   the production of a new US Wideband Global SATCOM (WGS) satellite to increase access to secure global communications.

DND also supports the Canadian Space Agency's (CSA's) constellation of polar communications and weather (PCW) satellites, which will "provide continuous communication services and weather observation throughout the Arctic."[29]

Doctrine should, ideally, inform procurement, as stated in B-GA-400-000/FP-000, *Canadian Forces Aerospace Doctrine:* "Doctrine is also instrumental in establishing priorities for procurement and acts as a critical sounding board for testing and evaluating new concepts and policies."[30] Developing space systems without space doctrine equates to getting a capability without knowing its intended purpose or how it should be integrated in the larger CAF effort. Sound space doctrine would provide a guidepost, as well as justification, for CAF members working on space projects at the National Defence Headquarters. An additional danger is the possibility of developing space systems in accordance with *someone else's* doctrine (i.e., the US) or possibly according to their needs, vice capabilities in line with Canada's needs and the *Canada First* Defence Strategy (*CFDS*).

THE RIGHT SPACE DOCTRINE FOR CANADA

CAF should initially develop a single-volume "Canadian Forces Space Operations Doctrine" that baselines off of existing space doctrine from allies—specifically US, UK and Australia—but is informed by documents like the *CFDS* and existing Canadian space policy. The doctrine should recognize the distinct and unique character of space operations, outline CAF "space mission areas," describe command and control of space forces, identify the role that space plays in the military functions (i.e., Command, Sense, Act, Shield, Sustain and Generate) as well as explain how Canadian military space capabilities and personnel should be integrated into joint operations as necessary force multipliers in the future security environment. This publication could be very similar to the *Canadian Forces Aerospace Doctrine* in size, scope and style, with great effect.

As space inevitably becomes further integrated into joint CAF operations, the need for greater understanding will only grow. To that end, CAF should develop a primer, much like the *UK Military Space Primer* or Air University's AU-18, *Space Primer,* that could be disseminated throughout defence forces and civil agencies to increase awareness and understanding of space operations in a Canadian context as well as the critical role they play in the modern CAF. Topics like the effects of space weather on GPS or communications, space mission areas, organizations like CanSpOC and the function of JSSTs should be addressed. This publication would be informative, not authoritative.

CONCLUSION

Canada has a long history of conducting military space operations and utilizing military space effects, is currently growing and institutionalizing military space operations in CAF and is a founding CSpO member nation. Despite this natural evolution of Canadian space power, CAF aerospace doctrine places virtually no emphasis on the space environment, space-based effects or the integration of space into CAF operations across the spectrum of military operations. This places CAF space forces, policy makers and procurement officials in a doctrinal no-man's-land, without the foundational guideposts that are "essential to the effective functioning and evolution of military forces."[31] CAF should embrace this opportunity to develop focused and robust space-operations doctrine. This doctrine should be based on space doctrine from the US, UK and Australia; be appropriate for Canadian military aspirations and national values; and be written with a view to enhancing understanding and integration of space capabilities into joint CAF operations.

Major Matthew Thompson, a career USAF space-operations officer, is on exchange with CAF at CANSpOC in Ottawa. His assignments have included satellite command and control at the 1st Space Operations Squadron, Schriever Air Force Base; offensive space control at the 76th Space Control Squadron, Peterson Air Force Base; and staff positions in space situational awareness and combined space operations at Headquarters USAF, the Pentagon. He deployed to Operation ENDURING FREEDOM in 2011 and 2012 and holds a Master of Aeronautical Science degree in Space Studies from Embry-Riddle Aeronautical University (2011) and a Master of Defence Studies from the Royal Military College of Canada (2016).

ABBREVIATIONS

CAF	Canadian Armed Forces
CanSpOC	Canadian Space Operations Cell
CFDS	*Canada First Defence Strategy*
CJOC	Canadian Joint Operations Command
CSA	Canadian Space Agency
CSpO	Combined Space Operations
DG	director general
DND	Department of National Defence
EO	electro-optical
FVEY	Five Eyes
GAC	Global Affairs Canada
GPS	global positioning system
IR	infrared
ISR	intelligence, surveillance and reconnaissance
JCS	Joint Chiefs of Staff
JDP	Joint Doctrine Publication
JP	Joint Publication

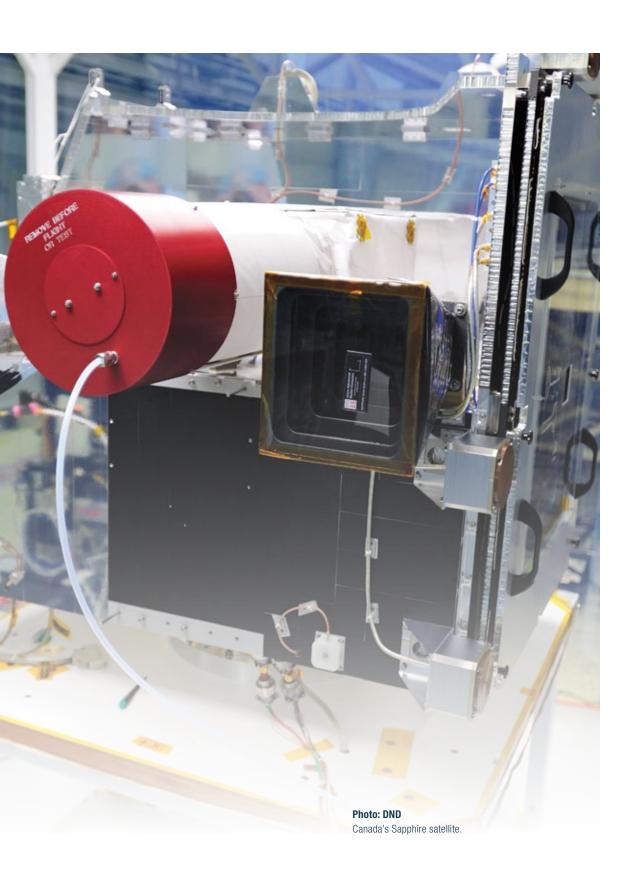| **JSST** | joint space support team |
MoD	Ministry of Defence
NRCan	Natural Resources Canada
OGD	other government department
RCAF	Royal Canadian Air Force
RCN	Royal Canadian Navy
SpOC	Space Operations Centre
UK	United Kingdom
US	United States
USAF	United States Air Force

NOTES

1. US, Joint Chiefs of Staff (JCS), JP 3-14, *Space Operations* (Washington, DC: Joint Chiefs of Staff, 29 May 2013), I-1, accessed February 28, 2017, http://www.dtic.mil/doctrine/new_pubs/jp3_14.pdf.

2. Ibid.

3. US, United States Army, FM 3-14, *Space Support to Army Operations* (Washington, DC: Headquarters US Army, 18 May 2005), A-3.

4. UK, Ministry of Defence (MoD), Joint Doctrine Publication (JDP) 0-30, *UK Air and Space Doctrine* (Shrivenham, Wiltshire: Development, Concepts and Doctrine Centre, July 2013), vi, accessed February 28, 2017, https://www.gov.uk/government/uploads/system/uploads/attachment_data/file/223495/jdp_0_30_uk_air_and_space_doctrine.pdf.

5. Ibid., 5-1.

6. US, JCS, JP 3-14, *Space Operations*, I-8–I-9.

7. UK, MoD, JDP 0-30, *UK Air and Space Doctrine*, 5-7–5-8.

8. US, USAF, AU-18, *Space Primer* (Maxwell Air Force Base, AL: Air University Press, September 2009), 63–64, accessed February 28, 2017, http://space.au.af.mil/au-18-2009/au-18-2009.pdf.

9. US, JCS, JP 3-14, *Space Operations*, I-3–I-6.

10. Canada, DND, B-GA-401-000/FP-001, *Canadian Forces Aerospace Command Doctrine* (Ottawa: DND, March 2012), 14–16, accessed February 28, 2017, http://www.publications.gc.ca/pub?id=9.694928&sl=0.

11. Ibid., 18–37.

12. Canada, DND, B-GA-402-000/FP-001, *Canadian Forces Aerospace Sense Doctrine* (Ottawa: DND, August 2012), 45, accessed February 28, 2017, http://www.publications.gc.ca/pub?id=9.696383&sl=0.

13. Canada, DND, B-GA-405-000/FP-001, *Canadian Forces Aerospace Shield Doctrine* (Ottawa: DND, February 2012), 13–15, accessed February 28, 2017, http://www.publications.gc.ca/pub?id=9.695557&sl=0.

14. Canada, DND, B-GA-403-002/FP-001, *Canadian Forces Electronic Warfare Doctrine* (Ottawa: DND, March 2011), 1–3, accessed February 28, 2017, http://www.publications.gc.ca/pub?id=9.694273&sl=0.

15. Canada, DND, B-GA-400-000/FP-000, *Canadian Forces Aerospace Doctrine* (Ottawa: DND, December 2010), accessed February 28, 2017, http://www.publications.gc.ca/pub?id=9.693870&sl=0; Canada, DND, B-GA-401-000/FP-001, *Canadian Forces Aerospace Command Doctrine*; Canada, DND, B-GA-402-000/FP-001, *Canadian Forces Aerospace Sense Doctrine*; Canada, DND, B-GA-403-000/FP-001, *Canadian Forces Aerospace Shape Doctrine* (Ottawa: DND, March 2014), accessed February 28, 2017, http://publications.gc.ca/pub?id=9.698832&sl=0; Canada, DND, B-GA-403-002/FP-001, *Canadian Forces Electronic Warfare Doctrine*; Canada, DND, B-GA-404-000/FP-001, *Canadian Forces Aerospace Move Doctrine* (Ottawa: DND, November 2011), accessed February 28, 2017, http://publications.gc.ca/pub?id=9.695067&sl=0; Canada, DND, B-GA-405-000/FP-001, *Canadian Forces Aerospace Shield Doctrine*; and Canada, DND, B-GA-406-000/FP-001, *Canadian Forces Aerospace Sustain Doctrine* (Ottawa: DND, February 2011), accessed February 28, 2017, http://publications.gc.ca/pub?id=9.672663&sl=0.

16. Canada, DND, B-GA-400-000/FP-000, *Canadian Forces Aerospace Doctrine*, 25.

17. Ibid.

18. US, USAF, AU-18, *Space Primer*, 31.

19. Ibid.

20. Canada, DND, B-GA-400-000/FP-000, *Canadian Forces Aerospace Doctrine*, 18.

21. "An Overview of Canadian Military Space in 2014 – Part 1," Andre Dupuis, SpaceRef Canada, accessed February 28, 2017, http://spaceref.ca/military-space/an-overview-of-canadian-milspace-in-2014---part.html.

22. Ibid.

23. Ibid.

24. Ibid.; and Major Nathan Burgess, "Space Transitions to the RCAF," *InForm*, no. 27 (January 2017), accessed February 28, 2017, http://w08-ttn-vmweb01/CFAWC/en/inform/inform.asp?Form=Y&ID=48 (Defence Wide Area Network only).

25. "Supporting Operations through Space," Alycia Coulter, Canada, DND, accessed February 28, 2017, http://www.forces.gc.ca/en/news/article.page?doc=supporting-operations-through-space/ht6x4r56.

26. Ibid.

27. Patrick Perron, "Space Weather Situational Awareness and Its Effects upon a Joint, Interagency, Domestic, and Artic Environment," *Canadian Military Journal* 14, no. 4 (Autumn 2014): 24, accessed February 28, 2017, http://www.journal.forces.gc.ca/vol14/no4/page18-eng.asp.

28. Jane's, "Strategic Weapons Systems, Canada," Jane's Sentinel Security Assessment - North America (18 March 2015), https://www.ihs.com/products/janes-weapons-strategic-systems/canada.html (site discontinued).

29. Ibid.

30. Canada, DND, B-GA-400-000/FP-000, *Canadian Forces Aerospace Doctrine*, 1.

31. Ibid.

Photo: DND
Canada's Sapphire satellite.

BOOK
REVIEWS

BOMBING TO WIN:
AIR POWER AND
COERCION IN WAR
By Robert A. Pape

COMD RCAF'S
READING LIST

Ithaca and London: Cornell University Press, 1996
408 pages
ISBN 978-08-0148-311-0

Review by **Major Levon Bond, MA**

From the time it was realized that aircraft could release bombs well beyond an adversary's fielded forces, air power advocates have adamantly maintained that strategic bombing against an adversary's vital weak points could be used to coerce said adversary into submission. This idea has been tested numerous times in various forms since the First World War. It has proved both successful and disappointing, depending on the variables at play in the application of air power and the political factors involved.

It was not until Robert A. Pape's 1996 study that the principle of coercion via air power as a decisive instrument of warfare was thoroughly examined on its own. After scrutinizing numerous instances in which coercive air power was applied, he concluded that there are several variables that determine the success or failure of a coercive bombing campaign and that these variables are not easy to define and quantify in each application.

Like so many military endeavours, whether an adversary will succumb to the use of overwhelming force via air power is difficult to predict and also to isolate among the various factors that drive decision makers. Yet, Pape has found that coercive bombing campaigns are far more likely to disappoint than fulfil the prosecutor's hopes. He observed that there is a pervasive tendency to overestimate the destructive power of one's own air-launched weapons and a parallel tendency to underestimate an adversary's will to persist despite taking a pounding from the air.

Pape's *Bombing to Win: Air Power and Coercion in War* is an outline of one of the key limitations of strategic air power, but within that limitation, the entire value of strategic air power is questioned. He unpacks some of the key strategic air campaigns of the 20th century and shows how they did not work as effectively as anticipated. Pape examines five air campaigns in some detail—Germany (1942–45), Japan (1944–45), Korea (1950–53), Vietnam (1965–72) and Iraq (1991)—and argues that in each case the strategic air campaign on its own was not able to coerce an adversary into surrender. Using history as the template, he forecasts that similar strategic air campaigns in the future will be met with similar disappointments.

Pape places himself squarely on the side of tactical air power, arguing that it has been the most effective when coupled with ground operations. He maintains that the historical record has shown that strategic targeting has not provided the debilitating "knockout blow" that strategic air power advocates claim to be the war-winning formula. Efforts to disable an adversary using targeted strikes at vital weaknesses have been costly in terms of personnel and resources, as several full-scale bombing campaigns have shown, resulting in a similar attritional manner of warfare that strategic bombing was designed to avoid. He claims it is not until the pressures of combined air and ground operations are sufficient to demonstrate that additional resistance is either futile or too costly that air power has been decisive.

Written 20 years ago, Pape's argument is due for a revision given the significant shifts in the use of air power since the First Gulf War and Operation DESERT STORM. His academic focus, however, has shifted from air power to terrorism. Since moving back to the University of Chicago in 1999, Pape has focused his research efforts on understanding terrorism and has written two controversial books on the subject, *Dying to Win: The Strategic Logic of Suicide Terrorism* (2005) and *Cutting the Fuse: The Explosion of Global Suicide Terrorism and How to Stop It* (2010). Nevertheless, he did provide a brief update of his views on bombing and coercion in a 2004 article in *Foreign Affairs* entitled "The True Worth of Air Power." In it, he maintains the same line of argument as *Bombing to Win,* in that he claims the success of subsequent air campaigns is due to air power's ability to weaken the adversary's ground combat capabilities to the extent that friendly ground forces are largely required for mop-up operations.

One of his claims that has been verified over the last 20 years is that coercion via air power has little effect in asymmetric wars since there are no strategic targets of vital national interest in counter-insurgency. Air power in counter-insurgency operations is limited to close air support with occasional use for interdiction targets. Pape would find the lack of coercive effect during more than two years of the air campaign against the Islamic State of Iraq and the Levant (ISIL) perfectly consistent with his historical analysis. ISIL cannot be effectively coerced because it is fighting a battle for its very existence in a zero-sum game. Despite the operational success of the decapitation campaign against ISIL and other Islamic terrorist groups such as al-Qaeda, Pape points out that the loss of insurgency leadership rarely produces a significant change in the course of an adversary's campaign. The continued regeneration of leadership among al-Qaeda and ISIL validates his point.
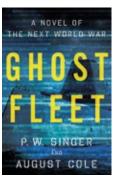
The main challenge to Pape's argument—and one that he acknowledges—is that it is difficult to accurately discern the true reasons why certain political and military leaders have been willing to capitulate. Pape's historical analysis relies on deduction in most cases, as the antagonists have not clearly articulated the cause of their change in behaviour. Since his first premise is that coercion has not been decisive, he assembles evidence to support this position, while brushing aside or overlooking indicators to the contrary. The Imperial Japanese leadership, including the emperor, capitulated six days after the second atomic bomb devastated Nagasaki on August 9, 1945, which has led most historians to believe that the atomic weapons were decisive in changing Japan's willingness to continue its futile resistance. Pape, on the other hand, contends that although the atomic bombs were devastating, they were not a significant departure from the other methods of destroying cities up to that point, namely the firebombing campaign, and that the real reason for Japan's surrender was the threat of invasion by the United States and the efficacy of the naval blockade. This is one of the more manifest cases in his book of tailoring the evidence and the explanation of the facts to fit the theory rather than building a position that rests on clear evidence.

Nevertheless, the main tenets of his argument hold, insofar as the few instances in which it can be said that strategic bombing has been effective at coercion have come at such extraordinary costs of human life and destruction that they are no longer considered tolerable under current legal, ethical and political standards for acceptable use of force. He does not focus on the legal and ethical debates; rather, he simply contends that coercion does not work. Yet, by combining the moral, legal and efficacy components of the position, a stronger argument would be that coercion does not work well enough to be an acceptable political instrument given the legal and ethical challenges that carry more weight in 21st century warfare than they did in 20th century warfare.

Major Levon Bond is the 1 Wing A2 in Kingston, Ontario. He is a PhD candidate in the War Studies programme at Royal Military College. His previous graduate work includes a Master of Arts in War Studies and a Graduate Certificate in Air Power from American Military University. His most recent deployment was on Operation IMPACT Roto 0, where he worked for the Air Task Force Coordination Element as the Target Engagement Authority's Intelligence advisor.

ABBREVIATION

ISIL   Islamic State of Iraq and the Levant

GHOST FLEET: A NOVEL OF THE NEXT WORLD WAR
By Peter W. Singer and August Cole

Boston: Houghton Mifflin Harcourt, 2015
416 pages
ISBN 978-054470505-0

Review by **Major David Johnston, CD**

Although most readers of military affairs snub the fiction section of their library, this prescient novel about the next world war may well reverse this trend. As a staple on most United States (US) military reading lists, *Ghost Fleet* is relevant for anyone studying the future of naval and air power. Even more persuasively, the authors answer the question of what a future world war with China and Russia would look like, along with how the future synchronization of cyber and space might play out in the operational environment.

August Cole is an author of both fiction and non-fiction and self-identifies as a future analyst. With connections to the United States Military Academy, *Wall Street Journal* and Atlantic Council, his curriculum vitae in the world of writing is extensive. Peter W. Singer brings his extensive experience in cyber and defence issues. Together their perspective is powerful.

Ghost Fleet tells the story of World War III from the perspective of American, Chinese and Russian soldiers, sailors, airmen and air women. With an unexpected Chinese raid on Hawaii, the world is thrown into chaos. Russia and China assault the US with a full-scale repeat of the attack on Pearl Harbor. This attack is synchronized with distributed denial-of-service on computer networks; satellites being destroyed, thus eliminating a global-positioning capability; and a complete shutdown of all command and control systems. Many of the themes in *Ghost Fleet* are relevant to the contemporary operating environment, not to mention the future security environment. The focus on the battle in the Pacific makes one wonder how *Ghost Fleet* could be so highly predictive about the current US and Chinese posturing in the South China Sea. Fourth-generation fighter aircraft and stealth ships square off, with control being shared between human decision makers and computer algorithms.

With the creation of real-time cyber commands in the US, Canada and other allied nations, the requirement for nations to study, fight in and dominate the cyber domain is reinforced through a number of examples used in this novel. One can't help but consider that the concept of *cyber superiority* may be as pertinent today as air superiority has been in decades past. Beyond the cyber domain, coupling the cyber and space domains, along with energy weapons, is gaining real-time relevance.

For readers and practitioners of contemporary military affairs, this novel also recounts a storyline that turns insurgency on its head. In a Chinese-occupied Hawaii, a number of US insurgent networks conduct harassing and spoiling attacks against their occupiers, an interesting twist on the current paradigm of both who the insurgent is and how they should be countered. And, for admirers of the past, Cole and Singer include strong references to military history, with respectful nods to Alfred Thayer Mahan, the Doolittle Raid and others. One can forgive the frequent quoting of Sun Tzu.

This thriller of a novel appears to have uncanny predictive power for present and future conflict. It is a gripping storyline for fans of Tom Clancy or Clive Cussler but will equally interest military professionals for its integration of cutting-edge technology and future warfare concepts. At times, it strays into a far-off realm better reserved for science fiction, with its descriptions of autonomous swarms of attack drones and *The Matrix*-style computer networks, but these forays are both limited in scope and often rendered plausible by the storyline. Beyond this, *Ghost Fleet* includes some touching references to the realities of family life in the military. This novel is highly recommended to Canadian military professionals for both personal enjoyment and professional development.

Major David Johnston is a Princess Patricia's Canadian Light Infantry officer serving in Canadian Special Operations Forces Command. He is currently pursuing a master's degree in defence analysis at the US Naval Postgraduate School in Monterey, California.

ABBREVIATION

US   United States

By Lieutenant-Colonel Kevin Kozak, CD

Air

Mobility Releases:

THE RCAF'S CANARY IN A COAL MINE

Could the recent and ongoing spate of releases from within the ranks of air mobility pilots be the RCAF's canary in a coal mine for a growing retention problem affecting not just air mobility pilots but also RCAF aircrew writ large?

In 1913, physiologist John Scott Haldane, while working as director of a mining research laboratory, first proposed the plan "of making use of a small warm-blooded animal [a mouse or very small bird] as an indicator of carbon monoxide."[1] This concept was quickly adopted, and well into the 20th century, coal miners would bring canaries into their mines as an early-warning signal of toxic gases. Today, the idiomatic expression "a canary in a coal mine" is often used when something is identified as a potential early-warning sign of trouble or distress.

In February 2017, an email was circulated among a number of air mobility squadron commanding officers (COs) that noted the significant number of pilot releases, specifically at the major rank, over the preceding few months. While pilot releases—especially within the ranks of our multi-engine pilots—are not new, it was noted that the community was now at a point where there were not even enough captains who could be legitimately upgraded to acting-while-so-employed major status to fill the empty slots expected during the annual posting season owing to a predicted net loss of 18 pilot majors from within the community. Perhaps most disconcerting, it was noted that 60 per cent of Air Mobility Advisory Group (AMAG) new winged grads (NWGs) were releasing after their initial engagement.

Troubling statistics to be sure, but are they indicative of a bigger problem, or do they represent a single-year statistical abnormality? Do they correspond simply to increased opportunities in a growing civilian aerospace sector, or do these recent releases correlate to something more ominous, such as a growing problem with retention that has finally caught up to us? The data points certainly appear to suggest the latter. In fact, while this article considers retention from mainly a pilot vantage, it is not the only aircrew occupation in the Royal Canadian Air Force (RCAF) showing signs of trouble; air combat systems officer officially became the worst-manned air-officer classification in February 2017, when it sunk to 90 per cent of trained strength vice preferred manning level (PML), 1 per cent lower than pilot.

And yet, the challenge in proving that we have an institutional retention problem has been that, as a professional organization, we simply don't fail. Over the last several years, despite an operational pace unmatched in decades, the RCAF has continued to deliver. Unfortunately, this continued mission success has been carried on the backs of our best and brightest. And as already undermanned units and formations have continued to divest personnel to support new capabilities, doing more with less has become almost an established philosophy. Yet, in doing so, the RCAF has not had to officially come to terms with its aircrew personnel pressures, after all, "if it ain't broke, don't fix it!"

Fortunately, without glaring examples of RCAF failures, senior Air Force leaders are becoming increasingly aware of the problem. In December 2016, Commander 1 Canadian Air Division (Cdn Air Div) met with 8 Wing COs in a town-hall forum to discuss pilot retention issues within the AMAG community. In February 2017, at the Combined Commanders Training Session at 1 Cdn Air Div, retention issues were discussed, with concerns noted not just within the pilot classification but across the RCAF. And, at the end of March, a town hall was hosted by the 8 Wing Commander with all Trenton-based pilots to ensure that their retention concerns were heard. The meeting culminated in a briefing note to Commander 1 Cdn Air Div.

Unfortunately, as the RCAF has only begun to acknowledge that there may be a problem with aircrew retention, we are likely miles away from addressing many of the core issues. As just one example, at 147 pilots below PML and with expected unprecedented growth by Canadian commercial carriers as well as a projected global demand for 617,000 pilots over the next 20 years,[2] RCAF pilot retention, especially within AMAG, will be a problem that gets worse before it gets better.

So why am I writing an article about aircrew retention in the *Royal Canadian Air Force Journal?* First, as a concerned witness to the many talented and impressive individuals who have decided to leave the RCAF in recent years, this is a discussion that we need to have—across all ranks and classifications/trades—today, not tomorrow.

Second, while retention and exit surveys suggest that many of the challenges affecting aircrew retention are institutional (from increased pressure due to under-manning, wages that do not keep up with inflation, increased bureaucracy and "civilization" of policy, or the negative impacts that recurring postings have on families and professional spouses), I believe there are many possible retention strategies that can be implemented in short order by the RCAF. However, without discussion across the Air Force about what retention strategies will help, I'm concerned as a tactical leader that if policies are enacted without involving individuals who are in close proximity to the affected groups, we may exacerbate the problem; discussion across our wings, squadrons and headquarters may help to change or develop the narrative.

Third, I note that whereas the RCAF has only recently begun discussing this problem, it is not a problem that we face alone. In the United States (US), Air Force leadership has sounded the one-bell alarm declaring a "national aircrew crisis"[3] based on "26 years of high operational tempo, commercial industry's demand for pilots and cultural issues that affect the quality of life and service for our airmen."[4] Sounds familiar, doesn't it? In fact, many authors across the border have considered US military pilot retention; in January, *Business Insider* considered United States Marine Corps' retention in their article "Pilot Retention is in a Death Spiral—Here's How the Marines Can Fix It"; Mike Benitez wrote an article in online blog *Task & Purpose* entitled "Here's 2 Solutions to the Air Force's Pilot Retention Problem"; and Nate Jaros penned "USAF Pilot Retention: Throwing Money at Problems." While none of these articles can specifically deal with the uniqueness of our RCAF problem, there are potential lessons that can be learned from our allies' experiences with retention strategies, and the RCAF would do well to study them.

Of course, writing this article enables me to offer some ideas that I believe are worth being considered by RCAF leadership for speedy implementation to address aircrew retention:

- **Extend the restricted release timeline for NWGs by three years, from seven to ten**. This change will not likely reduce our intake numbers, but guarantees our force those experienced second-and even third-tour captains and majors who are so desperately needed.

- **Balance positive and negative retention policies**. My sense from the tactical level is, with retention already in a challenged state, rolling out policies that may be perceived as punitive without accompanying positive measures may have the unintended consequence of draining the experience pool even more.

- **Increase administrative support to our line units**. Since returning to 435 Squadron, I have noted a significant increase in additional work required to achieve the same results. The cumulative effect of new policies such as contracting requirements, bureaucratization of old processes, or simply inheriting tasks which were previously done by logisticians and resource-management support clerks has significantly detracted from job satisfaction.

- **Create an aircrew-specialist option for aircrew officers who want to become technical experts and not necessarily the next Chief of the Defence Staff**. While this option has been talked about for as long as I have been in the RCAF, other air forces have implemented it in the same time with success. The Royal Australian Air Force (RAAF) Officer Aviation Specialist Scheme enables captains and majors wishing to stay in one location for an extended period of time to do so and fly at the fixed rank of captain. RAAF colleagues note that these specialists provide continuity and tactical expertise, with few drawbacks.

- Perhaps most importantly, **Air Force leaders need to set realistic expectations for our operational capacity given our current manning predicament**. Maintaining full operational capacity with only 90 per cent of the requisite manning means our members are constantly surging. We are burning them out.

Longer-term suggestions include:

- **Consider paying aircrew in accordance with their qualifications**. A three-year captain struggling to upgrade within their speciality should not be making the same as a three-year captain who has worked hard to become a strong aircraft captain or crew commander.

- **Incorporate aircrew allowance into aircrew pay scales**. Nothing is more demotivating than to get promoted and posted into a staff job for less money per year.

Finally, I believe that there are initiatives that those at the tactical level can take to improve retention by fostering the work-life balance within their own units. Personally, I've made it a mission to attempt to reduce "Queep" (the United States Air Force [USAF] term roughly translated as the additional duties and requirements often levied by higher headquarters that offer little value to the mission), set realistic professional-development expectations for officers, honour release days, and attempt to balance operational tempo with current manning realities by saying "no" more often to surge lines of tasking. However, I know there are things that we could be doing better—I'm interested in suggestions for the tactical leader on playing a bigger role in retention.

We would do well as an institution to address the canary in *our* coal mine and consider what we can do to improve aircrew retention today, not tomorrow. After all, if we cannot retain the best and brightest, we won't be left with the best but simply the best of what's left.

Lieutenant-Colonel Kevin Kozak is an air mobility pilot and the current Commanding Officer of 435 Transport and Rescue Squadron based in Winnipeg. He considers himself lucky to have both flown the CC130 Hercules in each of its three roles (search and rescue, air-to-air refuelling and tactical air transport) and eaten many fine meals while flying the CC144 Challenger.

ABBREVIATIONS

AMAG	Air Mobility Advisory Group
Cdn Air Div	Canadian Air Division
CO	commanding officer
NWG	new winged grad
PML	preferred manning level
RAAF	Royal Australian Air Force
RCAF	Royal Canadian Air Force
US	United States
USAF	United States Air Force

NOTES

1. N. Duin and J. Sutcliffe, *A History of Medicine: From Prehistory to the Year 2020* (London: Simon and Schuster, 1992).

2. Boeing, "2016 Pilot & Technician Outlook," accessed May 2, 2017, http://www.boeing.com/resources/boeingdotcom/commercial/services/assets/brochure/pilottechnicianoutlook.pdf.

3. "Air Force Official Details 'National Aircrew Crisis,'" Karen Parish, US Department of Defense, March 29, 2017, accessed May 2, 2017, https://www.defense.gov/News/Article/Article/1134560/air-force/.

4. Ibid.