

ROYAL CANADIAN AIR FORCE JOURNAL

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The *ROYAL CANADIAN AIR FORCE JOURNAL* is an official publication of the Commander Royal Canadian Air Force (RCAF) and is published quarterly. It is a forum for discussing concepts, issues and ideas that are both crucial and central to air and space power. The *Journal* is dedicated to disseminating the ideas and opinions of not only RCAF personnel, but also those civilians who have an interest in issues of air and space power. Articles may 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. This journal is therefore dedicated to the expression of mature professional thought on the art and science of air warfare and is central to the intellectual health of the RCAF. It serves as a vehicle for the continuing education and professional development of all ranks and personnel in the RCAF as well as members from other environments, employees of government agencies and academia concerned with air-force affairs.

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ROYAL CANADIAN AIR FORCE JOURNAL



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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.

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ITEM	WORD LIMIT*	DETAILS
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- For the Summer issue: **30 April**
- For the Fall issue: **30 July**

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EDITOR-IN-CHIEF'S MESSAGE



As the commander of the Royal Canadian Air Force Aerospace Warfare Centre (RCAF AWC), it is with great pleasure that I assume the duties of Editor-in-Chief for the *Royal Canadian Air Force Journal*. The *RCAFJ* is a well-founded publication that reinforces and promulgates our collective professional air and space power mastery. I have enjoyed the articles and opinions offered by this very relevant publication over the years of my employ with the RCAF. It is now my privilege to take up the torch and progress the *RCAFJ* as the leading publication offered by our institution. I strongly encourage all of you to participate in writing and healthy academic debate, and I look forward to reading your submissions.

By way of brief introduction, I joined the Canadian Armed Forces in 1985 and graduated from the Royal Military College of Canada (RMC) in Kingston, Ontario, in 1989, receiving my pilot's wings in 1990. Posted to the tactical aviation community, I served with 430e Escadron tactique des hélicoptères in Valcartier, Quebec, and 427 Tactical Helicopter Squadron / Special Operations Aviation Squadron in Petawawa, Ontario. My deployments included: Somalia, with the Canadian Airborne Battle Group; a peacekeeping tour in Haiti with the United Nations; and operations in Afghanistan, where I commanded.

I have held various staff positions at both tactical and strategic levels, including Strategic Joint Staff, Chief of Force Development, the Pearson Peacekeeping Centre as well as the Canadian Nuclear Safety Commission.

Academically, I hold bachelor's and master's degrees from RMC as well as a Master of Arts in International Affairs from the Norman Paterson School of International Affairs at Carleton University.

I have accumulated over 2,500 flying hours, mostly on the CH135 Twin Huey and CH146 Griffon, which include a respectable amount of night-vision-goggle experience operationally and as an instructor.

I am married with four children.

I look forward to working with the staff of this esteemed publication. This journal is ultimately a reflection of RCAF culture and brings to the forum what we think about historically, our future prospects and, most importantly, who we are now. The articles and opinions presented by the members of the RCAF—as well as their feedback—demonstrate the high quality of our membership. This is **your** journal, and I welcome and openly solicit the ideas and papers from all members of the RCAF, both military and civilian.



Colonel Michael Ward

Commander RCAF AWC /

Editor-in-Chief, *Royal Canadian Air Force Journal*

EDITOR'S MESSAGE

This fall 2020 issue of the *Royal Canadian Air Force Journal* provides an assortment of articles that may not seem typical of those normally provided for the air power enthusiast—at least not in the short run. A portion of these articles were taken from the Air and Space Power Operations Course (ASPOC) 1901, as they provide a coherent theme for this issue of the journal. Firstly, the junior officers who make up the ASPOC student body are well suited to leading this organization into the future; secondly, their breadth of knowledge is impressive. Other articles for your reading pleasure are from air power enthusiasts and academics.

In “Deep-Learning Artificial Intelligence as a Force-Multiplier in Kill-Chain Decision Making,” Captain Nick Villa tackles the continuing challenges of autonomous systems within the kill chain, being on the threshold of deep learning as well as the distinctions between higher artificial-intelligence capabilities. This paper discusses command and execution functions, cyber concerns as well as ethical and legal considerations.

Chief Warrant Officer (CWO) Gino Collard's “Is the Visible Minority Representation Target Set by *SSE* Realistic?” provides a very interesting take on some of the issues surrounding the policy for visible-minority inclusion in the Canadian Armed Forces (CAF). Why are the recruitment efforts not as successful as anticipated? What ingredients of the marketing strategy should change and how? CWO Collard was imbedded in industry in a fellowship programme based in Toronto, so his meaningful insights are well drawn from first-hand experience and observations.

As *Strong, Secure, Engaged: Canada's Defence Policy* articulates, the CAF is directed to increase women enrolled in the military from 15% to 25%. “Integration of Women into the Canadian Armed Forces: A Balanced Force versus the Right Person for the Right Job,” from Captain Kelly Heath, provides an interesting view into why this policy is challenged to succeed and introduces the dangers of tokenism. This is the second article in a socio-political vein within this edition of the journal. It takes a humanistic approach in its analysis and looks at ways that specific changes may break barriers.


“Once There Was an Arrow,” by Walter O. Gordon, examines aspects of the Canadian aviation engineering marvel the Avro Arrow. From the Arrow's inception until its demise, this article provides interesting linkages to the industry as a whole during the Arrow's short lifespan and the devastation to the Canadian aeronautical

industry when the project abruptly ended. There is also discussion of the political intrigue surrounding the cancellation and destruction of the Arrow; it is a very interesting read.

Reviews of two books are also published within this issue of the journal, each offering a thought-provoking take. The first, *A History of the Mediterranean Air War 1940–1945: Volume Four: Sicily and Italy to the Fall of Rome, 14 May, 1943 – 5 June, 1944*, by authors Christopher Shores and Giovanni Massimello, is reviewed by Chris Buckham. It is the last in a series of four volumes on the subject. The standout feature of the book is the profound detail given in the account of Mediterranean operations of this period. The second book reviewed is *Upheaval: How Nations Cope with Crisis and Change* by Jared Diamond. Lieutenant-Colonel James Pierotti's review describes how the author relates the outcomes of personal crises to six global crises and some of the limitations from national-crises selection.

Enjoy the read.

Sic Itur Ad Astra

A handwritten signature in purple ink, appearing to read 'D. Williamson', with a stylized flourish at the end.

Major Derrek Williamson, CD, P.Log



Altair CU-163301, a medium-altitude, long-endurance unmanned aerial vehicle (UAV) awaits testing on the tarmac in 5 Wing Goose Bay. The aircraft will conduct intelligence, surveillance and reconnaissance (ISR) activities over Baffin Island and Atlantic Canada.

DEEP-LEARNING ARTIFICIAL INTELLIGENCE AS A FORCE MULTIPLIER IN KILL-CHAIN DECISION MAKING

By Captain Nick Villa, CD, MBA, PMP



INTRODUCTION

Warfare in the early twenty-first century has changed from conventional state-on-state conflict to grey-area hybrid warfare and counter-insurgency operations. Non-state forces operating in urban environments have blurred the parameters of the traditional battlefield and have necessitated the use of increasingly precise weaponry to mitigate collateral damage to the non-combatants in the area of operations.

UASs have become critical assets in nonconventional warfare, as they improve real-time intelligence, surveillance and reconnaissance and can expedite kill-chain decision making.

The employment of unmanned aircraft has increased to assist in countering the strategies employed by insurgents and to augment existing military tactics. “Unmanned aerial vehicles (UAVs) have been referred to as drones, remotely piloted vehicles (RPVs), remotely piloted aircrafts (RPAs), and other terms, which describe aircrafts that fly under the control of an operator [without a pilot on board]. They are most often called UAVs, and when combined with ground control stations and data links, form unmanned aerial systems (UASs) or lethal autonomous weapons systems (LAWS).”¹ The remainder of this article will use the term UAS when referring to these types of aircraft.

UASs have become critical assets in nonconventional warfare, as they improve real-time intelligence, surveillance and reconnaissance and can expedite kill-chain decision making.² The kill chain is a military term for the inclusive set of all actions involved with observing, tracking, targeting and eliminating a target. “The six steps of the kill chain are abbreviated as F2T2EA and include: 1) Find, 2) Fix, 3) Track, 4) Target, 5) Engage (implying that a decision was made), and 6) Assess.”³

Just as UASs grew to meet the changing battle conditions of counter-insurgency warfare, the integration of artificial-intelligence (AI) technology and machine learning with these systems also expanded in scope and capability. “AI refers to any device that can perceive its environment and take action to maximize its chance of successfully achieving its goal.”⁴ Machine learning is one technique among many in AI that focuses on how computers can learn to perform tasks based on data. Machine learning is commonly divided into two problems: supervised learning, where the computer learns from labeled examples, and unsupervised learning, where the computer learns from unlabeled examples.⁵ Many of the biggest early successes in AI machine learning have been in the supervised format, which is limited by the quality of its programming and size of labelled data sets,⁶ as outlined below:

Constructing a pattern-recognition or machine-learning system AI system required careful engineering and considerable domain expertise to design a feature extractor that could transform the raw data (such as the pixel values of an image) into a suitable internal representation from which the learning subsystem, often a classifier, could detect or classify patterns in the input.⁷



The CU-170 Heron UAV is a one tonne aircraft that can conduct operations in excess of 24 hours with a maximum speed of more than 100 knots (180 km/h) and at altitudes of up to 10,000 metres.

However, AI technology is on the cusp of breaking through to a higher level of autonomous warfare with “deep learning,” which falls under the field of unsupervised learning. Humans and animals both practise unsupervised learning, discovering the structure of the world by observing it rather than being given the name of every object.⁸ Deep learning follows a similar premise,

The deep-learning algorithm performs a task repeatedly, making slight adjustments each time with the goal of improving the outcome.

where artificial neural networks—algorithms inspired by the human brain—learn from large amounts of data. The deep-learning algorithm performs a task repeatedly, making slight adjustments each time with the goal of improving the outcome. It would negate the conventional system of laboriously hand-designing a comprehensive feature extractor if good features could be learned automatically using a general-purpose learning procedure. This is the key advantage of deep learning.⁹

The term “deep learning” stems from the fact that neural networks have many deep layers of programming that enable learning.¹⁰ Simply put, a deep-learning platform has two sub-AI programs, a builder and a tester, operating in a cycle of self-observation and correction. The builder writes modifications to its program that are then verified against the tester. The tester, which operates on the general-purpose learning procedure, provides positive or negative feedback, and the builder rewrites improvements into the programming accordingly. As this cycle of trial-and-error machine learning happens simultaneously and at many sub-layers of programming, it therefore becomes impossible to examine how an AI of this nature could arrive at a specific decision at one instance in time.

What distinguishes deep learning from other forms of supervised machine learning, then, is that it conducts end-to-end learning with useful representations of the raw data that are learned along with the actual classifications. Conversely, traditional machine-learning techniques could “only” learn the classifications.¹¹

AI has begun to outpace the cognitive limitations of humans, and with further advancements in deep learning, that gap is widening. It is therefore imperative for any modern air power capability to adopt these emerging technologies in order to stay relevant. Deep learning artificial intelligence is a force multiplier¹² in UAS kill-chain decision making. The focus of this article is to examine how AI improves surveillance and data processing and assists decision making in UASs while also promoting centralized command and decentralized execution. Consideration will be paid to the ethics and accountability of incorporating autonomous AI into aerial-based combat, technological vulnerabilities from cyber threats to deep-learning UASs as well as the contrast of judgment between AI and a human operator. The scope of this research will focus on deep-learning AI as a component of air power and will not address deep-learning AI at a technical level, nor will it explore applications beyond the realm of air power.

CONSIDERATIONS IN FAVOUR OF DEEP-LEARNING AI

UASs function without exposing human weapon operators to the risks of grievous injury, death or capture.

The ability of deep-learning AI to process vast amounts of data and carry out intelligence, surveillance and reconnaissance missions autonomously promotes centralized control through decentralized execution and can force-multiply kill-chain decision making. Ease of deployment, precision, time on station and the ability to gather high-quality aerial imagery in volume are the most obvious tactical advantages of utilizing UASs in the kill chain. More importantly, however, UASs function without exposing human

weapon operators to the risks of grievous injury, death or capture.¹³ By removing the immediate and mortal threat to the human operator, the focus of the main effort shifts to optimizing the kill chain through advanced technologies like deep-learning AI, as evidenced here:

The tighter coupling of surveillance and the decisions to kill, as is found in weaponized drones, places new and unique cognitive demands upon drone operators. In traditional air operations, which largely separated the gathering of intelligence from the use of lethal force, operators were able to focus on specialized tasks and avoid the distractions and demands of related tasks. A target was a target, and a pilot's job was to correctly identify it and destroy it. Selecting the target was usually someone else's job. A drone pilot, in consultation with the sensor operator and mission intelligence coordinator, must now consider whether a potential target is in fact a correct and valid target.¹⁴



The MQ-9 is the first hunter-killer UAV designed for long-endurance, high-altitude surveillance.

Given the technological trend of data collection, it is a certainty that data collected from sensors across the operating environment will continue to increase in scope and scale. For example, “a MQ-9 Reaper [remotely piloted aircraft system] is capable of collecting the equivalent of up to 20 laptops’ worth of data in one mission, all of which is transferred back to the remote operator for analysis via satellite links.”¹⁵ The vast amount of inputs and data generated from UAS platforms still need to be analysed by a competent individual before they can become of any value. Thus, a bottleneck forms at the human capacity to process the sheer volume of information created from UAS operations in an appropriate amount of time,¹⁶ such that:

Deep-learning AI has the capacity to sift through and categorize vast amounts of data to provide decision makers with the best information possible

There is simply too much data and insufficient time and resources to process it effectively to achieve maximum value of collect. AI algorithms specifically designed to categorize, evaluate, and rapidly interpret data in structured and unstructured data sets will enable intelligence analysts to increase efficiency in the assimilation and determination of the value of collected information within the operational theatre. This new process, driven by AI algorithms, will undoubtedly enable the decision-making process of military commanders by providing them with the information and intelligence needed to make the best possible decision in what will no doubt be a fluid, fast-paced environment.¹⁷

Deep-learning AI has the capacity to sift through and categorize vast amounts of data to provide decision makers with the best information possible in real time. Therefore, a UAS operating in theatre could perform the first four stages of the kill chain (find, fix, track and target) autonomously without input or supervision from its controller. Once a target has been identified, only the relevant information and indicators would be transmitted to a human decision maker for consideration and approval to engage.

A corollary benefit of deep-learning AI in a shared network is the instant transmission of information among all the other assets in the network. Comparatively, humans do not have this ability. If an experienced aviator is shot down and killed during a mission, it would be a great loss of human capital and experience, and others would not gain the knowledge of the situation leading into the encounter. If the same happened to an autonomous UAS in a deep-learning AI network, the relevant information, flight parameters and circumstances leading up to the event would be captured and transmitted instantly to other UASs on the same network. In this way, networked deep-learning AI is a force multiplier of organizational learning and possibility for real-time adaptation to changing circumstances.

Deep-learning AI makes it possible to streamline the overall effectiveness of mission kill-chain planning and execution. From a tactical perspective, AI could be programmed to autonomously determine optimal aerial-asset allocations, search patterns or surveillance by adapting to environmental changes in real time. An example could involve the loss of global-positioning-system capabilities in a UAS during a surveillance mission. The defective UAS would automatically



Bombardier Jean-Francois Paré (far left), a member of the artillery flies the CU-161 Sperwer UAV from a mobile ground control station while Bombardier Karin Khoudja (foreground) operates the Sperwer's high-tech camera.

ized control and decentralized execution. Control, and engagement decision authority, would be centralized on the mission commander or UAS operator in a control hub. The decentralized execution of air operations would be performed simultaneously by the UAS at different locations across the theatre, akin to having interconnected subordinate pilots that report back to command. Through deep learning, AI is able to provide a means in to overcome the human limitations of processing large quantities of sensor data, optimizing the early stages of the kill chain, promoting real-time battlefield adaptation and holding true to the centralized control but decentralized execution of airpower.

Cyber-security vulnerabilities, ownership of AI decision accountability and the argument that human judgment cannot be replaceable are the main issues when considering the weaponization of deep-learning AI.

learning AI system would be the digital linkages between all the network components. Consider if an attacker or unauthorized entity managed to successfully cause loss of integrity, availability

return to its home base via networked triangulation off other supporting UASs while simultaneously rerouting others to cover its sector. "AI and machine learning can optimize Automatic Target Recognition (ATR) problems using UAS where the optimal number of drones, payloads, along with path planning, can be prescribed using multi-objective evolutionary algorithms."¹⁸ The sum of these deep-learning UASs cover the functions of the kill chain, making it possible for several aircraft to operate under the supervision of a single operator. As the UASs carry out missions autonomously, mission-commander workloads are reduced until such time as a decision to engage is required. This structure holds true to the fundamental tenet of air power: central-

CONSIDERATIONS AGAINST DEEP-LEARNING AI

Although the argument for the use of deep-learning AI is strong, there are counter arguments against the general acceptance of an autonomous offensive aerial-weapon system: cyber-security vulnerabilities, ownership of AI decision accountability and the argument that human judgment cannot be replaceable are the main issues when considering the weaponization of deep-learning AI.

The key weakness to any networked system is its potential vulnerability and resulting consequences when compromised. The greatest weak point in a deep-

or confidentiality on the network or system consisting of the AI UAS, the operator interface or the communication link. The hostile party may exploit vulnerabilities in the system network to take control of the UAS. Crashing the aircraft would end the operation and sabotage the mission. More threateningly, the attacker could override the commands to authorize harm against innocent civilians or friendly military forces. Situations exist where an attacker could gain access to sensitive or confidential information. In the worst circumstances, the attacker could back trace the location of the operator or the corresponding military facility, compromising their physical security to future terrorist initiatives.¹⁹

Employing AI in the kill chain raises a question of liability: who is responsible for the actions of an autonomous UAS?

“Cyber-security for [AI] robotic platforms is considered a big challenge because it requires an interdisciplinary effort. ... Different studies on the cyber-security of the robotic platforms generally target one or more of the following aspects: physical processes, computational resources, communication capabilities, operating systems, robotic libraries or middlewares, robotic

applications and sensory information.”²⁰ With such a broad range of technological disciplines to guard against, any approach to adopting deep-learning AI in a weapon system must also encompass a significant investment in a cyber-defence plan and the infrastructure to support. To fall short in any single cyber-security discipline puts the entire system at risk. It therefore becomes important to note that deep-learning AI in a kill-chain capacity should not be pursued unless the adopter is equally committed to the long-term sustainment of leading cyber-security protocols as well.

Technology that increases the scope of autonomous weapon-systems operation exacerbates the problem of determining the accountability for consequences of the operation of these systems.²¹ Employing AI in the kill chain raises a question of liability: who is responsible for the actions of an autonomous UAS? Who would be responsible, the AI, the programmer or the commanding officer?

A defining characteristic of any legitimate military is its controlled application of force, up to and including lethal force, on behalf of its nation or state. Although AI offers new technical possibilities, the fundamental importance of this characteristic remains unchanged.²² “To hold that someone is morally responsible is to hold that they are the appropriate locus of blame or praise and consequently for punishment or reward. A crucial condition of the appropriateness of punishment or reward is the conceptual possibility of these treatments.”²³

By the nature of its design, it is inevitable that a truly autonomous deep-learning AI could make choices other than those originally intended by its programmers. By learning from experience and its surroundings the AI will base future decisions on those considerations. It would not be possible to constrain unsupervised learning without degrading the overall level of autonomy. The more autonomous the AI, the more capacity it has to make choices outside the spectrum of predicted or encouraged responses.²⁴

In the context of a present-day legal framework, there is no mechanism for holding an AI or inanimate object accountable for its actions. Without a significant change to this understanding and framework, the implication of accountability then falls to the AI’s programmer or commanding officer. “It is possible to delegate authority, but not accountability. Military commanders as

It is accepted that machine learning has surpassed the processing and solving powers of the human mind; however, it cannot replace human judgment and intuition.

individuals, the Canadian Armed Forces as an institution, and Canada as a country cannot evade the responsibility to apply force in accordance with the laws of armed conflict.”²⁵

The military employment of deep-learning AI, therefore, involves a risk that humans can be held accountable for the actions of machines whose decisions they did not control. The more autonomous the systems are, the higher the risk those individuals are expected to assume. If a deep-learning AI is choosing its own targets, it is difficult to argue that a human should be responsible for any collateral damage that may ensue.²⁶

From an ethical perspective, AI does not have the capacity to fully understand the value of human life or fathom the moral consequences of killing. It is accepted that machine learning has surpassed the processing and solving powers of the human mind; however, it cannot replace human judgment and intuition. Although humans are fallible, the core values from which decisions are derived define whether choices are ethically moral or accepted.

“When we talk about analytic versus intuitive decision-making, neither is good or bad. What is bad is if you use either of them in an inappropriate circumstance.”²⁷ During military indoctrination, soldiers are taught the importance of sound reasoning. Throughout the formative years of early training, the military also imprints on these soldiers the ethics and accepted values of their respective nations.



Master Bombardier Jean-Francois Latulippe (right) and Bombardier Nicolas Blanchet (left), both from 5^e Régiment d'artillerie légère du Canada, place the UAV on the launch platform at Kandahar Airfield, Afghanistan.

On the one hand there is the thermal imaging that provides a view into a mysterious and hidden world of relative temperatures. And thus these drone technologies offer a vision that contains more than the human alone could ever see. On the other hand we can see that the lived world of human experience, material practices, social interactions, and cultural meanings that they are observing are difficult to properly interpret and fully understand, and that even the highest resolution camera cannot resolve the uncertainties and misinterpretations.²⁸

The advantage a competent, human decision maker has over AI is intuition, which can be further divided into generalization and induction abilities. The human mind is continually engaged in unsupervised learning, much like the deep-learning AI, with the culmination of this learning stored in the subconscious mind. When intuition, or a gut feeling, drives a decision, thin-slicing has been involved. “Thin-slicing refers to the ability of our unconscious to find patterns in situations and behavior based on very narrow slices of experience.”²⁹ When the unconscious engages in thin-slicing, it is performing an automated, accelerated version of pattern recognition, reducing multifaceted problems down to their simplest elements for an immediate decision.³⁰ Malcom Gladwell asserts that “truly successful decision-making relies on a balance between deliberate and instinctive thinking.”³¹ By the time a military commander reaches the career point where they are responsible to make kill-chain decisions, they will have built enough of an ethical foundation and garnered enough relevant experience to make the best decision within their abilities.

At best, deep-learning AI can provide only a utilitarian solution based on the parameters of its programming and understanding of the mathematically learned world. Naturally, this advocates for using AI in specific, high-volume, repetitive tasks until the technical ability to address more complicated, abstract tasks is developed in the future.³² For this reason, the kill-chain decision to engage a target should be made by a human operator who can provide a layer of insight and context that AI is not yet capable of considering.

Militaries around the world have recognized the advantages of autonomous AI and will continue to adopt this technology in order to gain advantage on the battlefield.

ANALYSIS

The majority of maturation in the field of deep learning and unmanned systems is occurring in the private sector, heavily backed by commercial capital to meet the demands of civilian business across multiple industries.³³ Militaries around the world have recognized the advantages of autonomous AI and will continue to adopt this technology in order to gain advantage on the battlefield. “Technology, whether it be computerized analytical tools, battlefield sensors, or unmanned aviation, is a reality and it would be irresponsible not to harness it to win wars.”³⁴

Deep-learning UASs have considerable potential to improve efficiency and effectiveness across the six steps of the kill chain (F2T2EA). “Advancements in machine-learning are producing algorithms that vastly outperform humans in terms of bulk [information] gathering, processing power and pattern recognition. If step one is defined as data collection, then it stands to reason that the human brain, equipped with its many flaws and limitations, would be ineffective compared



MQ-9A was designated "Reaper" by the US and Royal Air Force, but has become the widely used name for any Predator B equipped with weapons. Image from General Atomics Aeronautical.

to AI.”³⁵ Simultaneously, as the data is collected, it can be processed to dynamically classify and prioritize high-value targets.³⁶ These actions culminate at a critical junction in the kill chain; the decision point to engage an identified target. This decision is often pivotal to the success of the operation and can have mortal consequences. The responsibility to deliver lethal kinetic effects cannot be fully appreciated by an AI that does not understand the intrinsic value for a human life. “The lived world of human experience, material practices, social interactions, and cultural meanings that [UASs] are observing are difficult to properly interpret and fully understand, and that even the highest resolution camera cannot resolve the uncertainties and misinterpretations.”³⁷ Therefore, at the decision point in the kill chain, a competent human operator or commanding officer should be the one to authorize target engagement by a UAS. This is reflective of the fact that military combat judgments require the integration of knowledge from multiple sources, a task that humans still perform better than AI.³⁸ Consequently, it is crucial for machine-learning AI to produce outputs that are understandable for the human decision maker to interpret and act upon.

The cyber threat is inherent to all digital technologies: the more valuable the asset or capability, the greater the threat to its security.

When dealing in lethal force or the potential to render collateral damage upon the innocent, there must be a system of accountability to prevent abuses of power. The legal framework for AI responsibility, both domestically and internationally, has not yet evolved to match the expanding boundaries pushed forward by this emerging technology.

Until such time that an adequate method is established for attributing responsibility to fully autonomous AI decision making, the

accountability needs to be held by a human decision maker. The Government of Canada has made early progress in this field with its affiliation to the Montréal Declaration for a Responsible Development of Artificial Intelligence. The declaration's objectives include developing an ethical framework for the development and deployment of AI.³⁹

The cyber threat is inherent to all digital technologies: the more valuable the asset or capability, the greater the threat to its security. "To remain relevant, effective, and lethal in the future operating environment [modern militaries] must actively embrace the potential benefits AI technology present immediately or risk falling behind the advancing technology curve."⁴⁰ Discounting deep-learning AI on the basis of heavy costs of security and requirement to persistently support it is a short-sighted position and can be dispelled against the evidence provided.

AI technology will continue to expand in scope and scale, across all industries, for decades to come. The assertion that deep-learning AI is a force multiplier in UAS kill-chain decision making holds true in that it can greatly improve overall efficiency and reduce the amount of human risk involved. However, fully autonomous UASs should not be authorized to carry out the full spectrum of the kill chain without human oversight.

CONCLUSION

Based on the evidence presented, it is clear that the future battlespace is changing and that using deep-learning AI in the kill chain will be an enabler required to operate at the speed and efficiency necessary to sustain success. The AI ability to process vast amounts of information and expedite the kill chain promotes centralized control and decentralized execution through autonomous UASs. However, the benefit of deep-learning AI in UASs comes with the associated cost and persistent threat of cyber security, which cannot be ignored. Furthermore, the realm of legal accountability for AI is in its infancy. Traditional lines of responsibility are blurred by conflicting interpretations of who should be liable when AI makes unpredicted decisions autonomously. Regardless of how effective autonomous AI becomes in kill-chain performance, it is essential that a human decision maker still maintains the final authorization to engage targets. The strengths of deep-learning AI in UAS should not be seen as replacements for the human elements of the kill chain; instead they should be seen as a force multiplier to enhance the overall propagation of air power.

Captain (Capt) Nick Villa most recently flew with 443 Maritime Helicopter Squadron (443 [MH] Sqn) and was fortunate enough to fly operationally for six years. While at 443 (MH) Sqn, he became a qualified CH124 maintenance test pilot and the unit's Flight Safety Officer. Concurrently, Capt Villa completed a Master of Business Administration through the Royal Military College of Canada as well as a master's certificate in Project Management from the University of Victoria and earned the internationally recognized Project Management Professional (PMP) designation. Following the 2018 retirement of the CH124 Sea King helicopter, Capt Villa was posted to the Directorate of Air Strategic Management in Ottawa and is now actively involved in Royal Canadian Air Force business planning, analytics and corporate reporting.

ABBREVIATIONS


AI	artificial intelligence
UAS	unmanned aerial system
UAV	unmanned aerial vehicle

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A photograph of a person wearing a military helmet and looking out of a cockpit window, overlaid with a red tint. The person is looking down at some papers or a console inside the cockpit.

Integration of Women into the Canadian Armed Forces: A Balanced Force vs. the Right Person for the Right Job

By Captain Kelly Heath

It has been almost two years since *Strong, Secure, Engaged: Canada's Defence Policy (SSE)* directed the Canadian Armed Forces (CAF) to increase the proportion of women enrolled in the military from 15% to 25%. The CAF is meant to realize this change by 2027, equating to 1% increases each year over the ten-year timeline.¹ A top priority for the government is having a balanced force that accurately represents Canada. However, achieving this goal will not be an overnight process. What shape does a balanced force take, and how do we determine full integration? Is it simply a number on a page and the ability to say we did it, or is it having the right people in the right positions to provide Canada with a force that can defend our nation, both at home and abroad?

When *SSE* was published, Canada was a world leader for the proportion of women in the CAF. We are at the forefront of military gender integration, with women making up 15% of our military members across all occupations and the North Atlantic Treaty Organization (NATO) average at 11%,² yet we must do more. There has been much discussion on how to effectively achieve this directive, focusing on considerations such as retention, recruitment, gender-based training, reserved occupational positions / line numbers and even special-selection lists. Affirmative-action policies have affected positive changes, advancing the rights of women and expanding their opportunities within society. However, there are certain occupations that this approach may not benefit.³ The CAF is unique in its job responsibilities, which must consist of leaders who have earned their positions based on the breadth of their knowledge, skills, experience and credibility, not on their gender.

History provides a great understanding of the timeline that led to a force comprising 15% women. Women have been a part of the CAF and contributed to the force's history and heritage for more than one hundred years; the integration of women into the military dates back to 1901. However, there are perceived barriers to employment equity for women within the CAF.⁴ The removal of occupational restrictions after the 1988 Canadian Human Rights Tribunal was a pivotal moment and the starting point for integration. It took until March 8, 2000, to remove all employment restrictions for women, with the last being integration into submarine crews.⁵ Since then, one could argue the only real restrictions women face are their level of desire to join the military and their willingness to endure the career's demands.

Sylvia A. Hewlett and Carolyn B. Luce discuss extreme jobs and their requirements, which include, but are not limited to, a combination of the following: extended hours; unpredictable workflow; fast-paced work under tight deadlines; open availability; large amounts of travel; and work-related events outside of regular work hours.⁶ The CAF has a very distinct obligation to defend the citizens of our country from any potential threats and provide defence beyond Canadian borders. A military career requires a significant amount of commitment, responsibility and self-sacrifice. It is mentally as well as physically demanding, and oftentimes requires its members to prioritize work (long deployments, temporary-duty requirements, etc.) over obligations at home. It is very easy to conclude that employment within the CAF qualifies as an extreme job.

The Canadian labour force consists of approximately 50% women,⁷ which does not reflect the CAF's current state nor its directed goal of 25% by 2027. The implications of this can be examined through Kareem Negm's concepts of tokenism and token groups. The idea of tokenism implies that a small group, when looked at within the proportions of a much larger organization, will be susceptible to and influenced by the domination of the larger group. As such, the organization often reflects a culture similar to that of the larger group.⁸ Based on this theory, some suggest that this token representation is a very real cause for the smaller presence of women in the military compared

Women have been a part of the CAF and contributed to the force's history and heritage for more than one hundred years; the integration of women into the military dates back to 1901.



Members of the force protection team for the Canadian Medical Emergency Response Team fall back to the CH-147 Chinook helicopter during pre-deployment training for Task Force Mali in Wainwright, Alberta, May 16, 2018.

to the civilian work environment. To overcome it, as well as to determine what a balanced force looks like and whether it can be achieved, one must look at the perceived and actual barriers to recruitment and retention.

As previously discussed, all formal barriers relating to policy and the ability of women to serve in the military have been removed—so why is it still a male-dominated organization? One of the challenges of increasing the number of women in the military and creating a balanced force is Canadian culture itself.⁹ Traditionally, the nature of work women gravitate towards is different from that of men, as people are shaped by both nature and nurture. In society, women often assume the role of primary caregiver by maintaining the homestead as well as looking after their children and families. In the Canadian labour market, there are two general sectors: the goods-producing sector and the service-producing sector. Historically, women worked in the service-producing sector in occupations such as wholesale, education and health services, while a large number of men worked in the goods-producing sector in categories such as construction, manufacturing and the exploitation of natural resources.¹⁰ It is suggested that, although society has come a long way from the idea of gendered occupations, some bias still exists. Major (Maj) Jenn Burford examines this bias:

History and cultural norms have reinforced the idea that soldiers are male and therefore the CAF needs to overcome this idea if it is to recruit more women. It may be that women are not aware of the variety of occupations available within the CAF and therefore have not even entertained the idea of a career in the military.¹¹

To achieve a balanced force that truly represents Canada, one must conquer this bias. A change in Canadian culture must occur to foster a more inclusive environment for everyone, thereby diminishing the idea of a “bros club” and changing the population’s perspective on military employment.



A search and rescue technician participates in the final exercise of the National Search and Rescue Exercise 2015 (SAREX15) held at Comox, British Columbia, on September 18, 2015.

A change in societal views and the removal of gender bias will benefit the CAF, but until this happens, the military will have to examine options to eliminate this perception.

Many who have looked at the issue of a balanced force and female integration have suggested that there are two key aspects the CAF must consider to achieve the goal set forth by 2027: recruitment and retention. Since the release of *SSE*, the CAF has conducted research focusing on the recruitment process and trialing new recruiting initiatives targeting the barriers women identified. The intention is to create change by modifying the CAF's marketing strategy, implementing recruitment initiatives as well as reviewing and amending policies.¹² A study conducted by the Privy Council Office's Innovation Hub recognized areas for improvement in the CAF, concluding that five areas needed to be considered. It suggested the review of CAF policy and guidelines for: deployments and relocation; leave without pay; childcare support; contract length; and Canadian culture/diversity.¹³ Based on these recommendations and the goal of achieving a balanced force, the CAF implemented a number of initiatives targeting women. Programmes such as Operation GENERATION and Women in Force were incorporated, showing marginal increases in the number of women recruited or considering the military as a career path. The Women in Force Programme was conducted from August – November 2017,¹⁴ providing an opportunity for civilian women to integrate with female soldiers and understand the many aspects of military employment through hands-on experiences, including tactical skills, training and fitness.¹⁵

Despite these efforts, only 860 women enrolled in the military in the 2017–2018 fiscal year. This was an increase of 8% over the previous year,¹⁶ but when one considers the increase of 3,500 Regular Force and 1,500 Reserve Force members also mandated in *SSE*, this number falls short. In October 2018, Maj Stéphane Thivierge assessed all the factors relating to integration,

including the goal of having 25% female representation by 2027, the mandated increase in Regular and Reserve members as well as the baseline attrition of women. Thivierge concluded that, to achieve a balanced force and integration, we must recruit 1,666 women per fiscal year,¹⁷ which means that these recruiting initiatives will not be enough.

Recruitment and retention go hand in hand when trying to maintain a balance between men and women in the military. Miriam Mathews argues that a diverse force makes the best team when its members are incorporated purposefully: “Recruiting and retaining diverse [aviators] cultivates innovation.”¹⁸ Early attrition of members is costly, and the CAF has a vested interest in retaining its personnel and their expertise. The CAF is unique in that, “unlike most civilian industries, mid-level and senior leaders cannot be simply hired into CAF; it takes years of indoctrination and institutional experience to be a strong and seasoned member of the profession of arms.”¹⁹ Training members is expensive and resource-intensive. Despite the forces opening all their occupations to women in 2001, a number of issues still drive women to leave the military. Research and surveys identify these issues as a lack of work-life balance, parental responsibilities and meaningful employment while pregnant. Employment-equity statistics from 2013 showed declining numbers of female representation in higher ranks, with women comprising only 18.4% of junior officers, 15.4% of majors, 9.6% of lieutenant colonels, 4.8% of colonels and 3.8% of generals.²⁰ While not all women are interested in a military career—or balancing work, a marriage and children—the CAF must have flexible policies that will facilitate women who are interested in reaching their full potential.²¹

“Without a diverse membership, the CAF is at risk of falling out of relatability with the Canadian public.”

The integration and retention of women within the operating environment provides the CAF with additional force capabilities. The modern operating environment is significantly different than the historically observed state-on-state warfare. As Maj Dennis Mann highlights, “the cultural factors present in many of the current operating environments can limit male access to parts of the population, specifically women and children.”²² Without integrating women into all aspects of the CAF, there would be capability gaps that hinder information gathering, community outreach as well as engagement in female-only societies and groups.²³ A higher number of women in the force will not only increase our operational effectiveness, but it will also provide a higher probability of selecting and developing the right women for senior leadership positions. If the CAF desires diversity for the purposes of enhancing military capability, increasing the number of women will create long-term effects and ultimately a more balanced force. Mann suggests that “without a diverse membership, the CAF is at risk of falling out of relatability with the Canadian public.”²⁴

Although the public’s support is important, our operational effectiveness and abilities should be chief considerations when selecting and employing personnel. In 2000, United Nations Security Council Resolution (UNSCR) 1325 recognized the requirement for “increased representation of women at all decision-making levels in national, regional and international institutions.”²⁵ It further emphasized female participation in the preservation and development of peace and security. With the adoption of UNSCR 1325, the CAF noticed a lack of women in senior leadership positions. However, in an organization that is heavily weighted on merit, is rapid

diversification—without a proportionate amount of time—possible without implementing programmes and policies that hinder equality? In the CAF’s merit- and leadership-based environment, handouts just do not cut it. Are these programmes and changes to policy accomplishing the objective? If the only measurements of success are a certain number of women being in the CAF and leadership positions, then perhaps the CAF is meeting the objective.²⁶ While using the Employment Equity Act and *SSE* to provide a foundation for integrating women, the CAF is also discriminating against others. The recruiting centres now have a specific number of positions within occupations that are saved just for women. When I joined, there was a push for females in both combat-arms and pilot occupations. I was urged to consider this career path because there were 38 pilot positions saved for women and, if I met the prerequisites, I was guaranteed selection.

Despite abolishing any gendered occupational requirements in 2001, the majority of women are still employed in what society considers traditionally female areas, including healthcare, education and administration.²⁷ Since women often prioritize family over work, does placing women in key leadership and employment positions weaken the organization’s structure? One of the CAF’s key operational principles is the idea of service before self. Lieutenant-Commander (LCdr) A. N. Comisso relayed research stating that “74 percent of working mothers had stayed home from work to care for a sick child compared to 40 percent of working fathers.”²⁸ Comisso also suggested that, to assist with work-life balance, members should be given flexible work hours. If members were to work a longer day in order to work from home every other week, “this flexibility could allow

Candidates of the Infantry Officer Development Period 1.1 course (Dismounted Infantry Platoon Commander) conduct hasty attacks, ambushes, raids and patrols—while being assessed as dismounted platoon commanders in offensive operations—as part of an intense 12-day exercise at the Infantry School Combat Training Centre, 5th Canadian Division Support Base Gagetown, New Brunswick, July 12, 2019.



women to better manage responsibilities at home while still contributing to the organization.”²⁹ At what point does an organization look at these suggested solutions and realize that the change required to retain certain people is beyond comprehension for this line of work and ultimately places a burden on other members within the same units/squadrons?

The CAF is striving for statistical representation, but at what cost?

relevant now as it was in 1970. The CAF is striving for statistical representation, but at what cost? Current female CAF members were surveyed about recruitment, and they related that it was “more important to fulfill quotas than steer women towards their career choice or other occupations that may be of interest and many indicated they were pushed into occupations that did not match their strengths and skills.”³¹ One would think that the CAF should employ the most capable person for the job, regardless of their gender.

The CAF uses a “bottom-up” career-progression model³² which leaves no options for entry directly into higher ranks; this model means that it will take several years for there to be sufficient female representation within senior positions. One might assume that this statement is accurate; however, the CAF implemented programmes that some argue moved women through the ranks much quicker and without the experience and knowledge of some of their male counterparts. The Special Selection Programme for Female Selection to Canadian Forces Joint Command and Staff Programme (JCSP) is one of the affirmative-action policies that the CAF implemented to achieve its goal of overall female-officer integration into senior positions.³³ In a military emphasizing leadership as well as valuing honesty and integrity, it is ludicrous to think that officers could be chosen to attend the Canadian Forces College (CFC) through JCSP based on their gender rather than solely on their professional achievements and leadership abilities. An organization that is pushing for integration to reflect the values and beliefs of Canadian society allows women to be placed in senior positions based on gender, not merit.

In 1997, Canada’s most senior military officer directed the programme’s launch to give females easier access to CFC beyond those that would be selected based on their achievements and merit. Around one hundred officers attend this programme each year, usually based on their ranking and annual evaluation reports.³⁴ The order stated that “past gender-based employment policies which restricted women from serving in all [Canadian Forces] roles have reduced their competitiveness for selection to CFC.”³⁵ Sixty percent of the spots are reserved for operational occupations—including combat arms, pilots, etc.—with the remainder going to non-operational occupations. With women not entering these occupations until 1987,³⁶ it is no surprise that they had not progressed to a level affording them merit for JCSP/CFC selection. This programme did not support equal opportunity, and it was cancelled by Canadian Forces General message (CANFORGEN) 147/18 on August 27, 2018. It was an affirmative-action effort designed primarily to rectify a wrong of the past, while hoping to achieve a statistical goal of integration.

The Royal Commission on the Status of Women in Canada was tabled in 1970, and Commissioner John Humphrey expressed his disapproval for any imposed quota system, viewing them as discriminatory.³⁰ If an imposed quota produces policies that provide an advantage to one gender while denying access to another, then I would suggest that his theory is just as

The Canadian population expects the CAF to reflect Canadian society by employing women in all facets of the military organization. As a result, *SSE* has directed the CAF to increase the proportion of women enrolled to 25% by the year 2027. Initiatives, programmes and policies have been enacted to increase female enrolment, retention and promotion for many years, yet we still cannot meet the goals set forth. The CAF has several key tenets and beliefs that do not allow for flexibility and accommodations. The idea of service before self does not support the traditional role of women as primary caregivers, nor their likelihood to take time off to care for their children. Still, the military has taken several steps in the right direction to remove known barriers that affected integration in the past. Since 2001, women have been able to seek employment in all trades within the military, and many policies have been amended to remove any potential obstacles. It is undeniable that women are often drawn to service-producing occupations and, as a result, there is not equal representation throughout all trades. There needs to be a limit where, when the CAF regards its integrity and appearance, it can decide that the push to achieve a balanced force may be a step too far. We must not accept and implement affirmative-action policies such as JCSP; while they produce the desired outcome and advance women in the ranks, they undermine the integrity of said women and discriminate against men in the process. It is important for the CAF to ensure that equal opportunities are available for all Canadians who want to serve their country. However, the CAF's job is to protect Canada at home as well as abroad and, as such, it should have the most capable individuals in every position, regardless of gender.

Captain Kelly Heath is an aerospace control officer. She has worked at 8 Wing Trenton as the chief controller of tower operations, specializing in visual flight rules. Captain Heath currently works at 427 Special Operations Aviation Squadron in Petawawa, Ontario, coordinating air power effects for Canadian Special Operations Forces Command as the squadron air traffic control officer and deputy chief of operations.

ABBREVIATIONS

CAF	Canadian Armed Forces
CFC	Canadian Forces College
DND	Department of National Defence
JCSP	Joint Command and Staff Programme
<i>SSE</i>	<i>Strong, Secure, Engaged: Canada's Defence Policy</i>

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Is the
Visible Minority
Representation Target
Set by *SSE* Realistic

By Chief Warrant Officer Gino Collard



As part of the 2019 Royal Canadian Air Force Fellowship Programme, I was embedded into the Toronto corporate office of a Canadian mining company for 5 months. I visited remote mining sites in Quebec and British Columbia, met employees from the company as well as several business partners and affiliate companies in the Toronto area, and took part in many constructive discussions. I was exposed to most aspects of the mining industry at large, including its sustainability, finances, legal considerations, exploration and mining itself. However, as a senior non-commissioned member, I was naturally drawn towards personnel—specifically, the employment of visible minorities (VMs). I noted several differences between the Canadian Armed Forces (CAF) and the public sector, specifically with regards to their overall representation in the Toronto workforce. Please note that, for the purpose of this article, references made to diversity only refer to VMs.

The companies I observed during the fellowship will hire the best person for the job, regardless of their ethnicity or gender; they do not have publicized quotas or goals when it comes to hiring VMs. Toronto has been one of the multi-ethnic epicentres of Canada for years and, as a result, ethnic differentiation is practically nonexistent in the workplace. No specific programmes are in place for recruiting VMs and, based on discussions with senior managers, inclusion programmes within the Greater Toronto Area (GTA) are not as necessary as they are in regions containing mining sites. In fact, when visiting the mining operations in Northern Quebec and Northern British Columbia, I quickly noticed that a much smaller number of VMs were present.

One of the priorities laid out by the government is to have a military that "looks like Canada."

A Statistics Canada census prepared in 2016 showed that VMs represented approximately 52% of the GTA's overall population¹ and, based on my observations, VMs surprisingly account for about 50% of the workforce in the downtown Toronto area. So, it would seem that GTA businesses have successfully achieved a state of equal representation for VMs in the workplace without specific employment equity or integration programmes. On the other hand, the CAF's VM representation is still falling short of its goal of 11.8%,² hovering at approximately 5%—and yet, in the 2017 publication *Strong, Secure, Engaged: Canada's Defence Policy (SSE)*, one of the priorities laid out by the government is to have a military that "looks like Canada."³ This feat is almost impossible to achieve in the current military employment concept knowing that, in 2016, the overall percentage of Canadian VMs was already around 22%.⁴ The current employment concept assumes that, at a minimum, every new recruit will want to commit for a 25-year career and will be willing to move every 3–4 years in support of Canada. These assumptions do not fit within the career path of most VMs I met in downtown Toronto. In the GTA, the industry thrives on a large pool of keen VM applicants looking for a chance to prove themselves. Almost every VM employee I spoke to had no intention of ever leaving Toronto; their main reasons were reluctance to leave their family / ethnic groups and the comfort of Toronto. Notably, employees would admit openly that they were not generally committed to their employer. It was explained to me that their commitment was intrinsically linked to instant gratification⁵; they hoped to get as much experience as possible within two to three years before, hopefully, moving on to a bigger company for higher pay in the GTA. As such, expecting a 25-year commitment from the observed demographic is hard to conceive, considering their relatively short-term goals. In Toronto, however, this symbiosis is evidently effective for both parties, especially considering industry has little to no responsibility for training employees and does not seek a return on investment or long-term commitment.

AIM

The aim of this article is to demonstrate that, within its current employment and recruitment concepts as well as the targeted demographic groups, the CAF will not be able to meet its VM employment goals. First, I will review the benefits of hiring VMs and some of the efforts put forth by the CAF to create a more inclusive environment. Next, I will explore some barriers to VM employment as well as some necessary institutional changes to realign the CAF closer to SSE's objectives.

INTRODUCTION

Over the last century, Canada has become one of the most demographically diverse countries in the western world. Its society can easily be described as a cultural mosaic, wherein every culture fits side by side without any threat of assimilation, allowing newcomers to flourish in their adopted country and further develop Canadian culture. In his Canadian Forces College (CFC) paper on multiculturalism in the CAF, Lieutenant-Commander W. B. Brown describes Canadian society as integrative rather than assimilative.⁶ He points out that, by being integrative, there is a better chance for immigrants to demonstrate loyalty towards the adopted country.

As a result, Canada has developed a wide-ranging culture, initially put in motion by the 1971 Canadian Multiculturalism Act and followed by the recognition of multiculturalism in the Canadian Charter of Rights and Freedoms in 1982. At that point, multiculturalism was a reality, but until 1995, there was no clear guidance on its application to the workplace and employment in general. This prompted the government to establish the Employment Equity Act in 1995, steered by the following purpose:

This Act is to achieve equality in the workplace so that no person shall be denied employment opportunities or benefits for reasons unrelated to ability and, in the fulfilment of that goal, to correct the conditions of disadvantage in employment experienced by women, Aboriginal peoples, persons with disabilities and members of visible minorities by giving effect to the principle that employment equity means more than treating persons in the same way but also requires special measures and the accommodation of differences.⁷

Pursuant to this act, the Government of Canada set out the ground rules for equal employment opportunity in Canada with the creation of the Employment Equity Regulations;⁸ among other strategies and policies, it served as the basis for the *Canadian Armed Forces Diversity Strategy*.⁹ Through an elaborate and targeted internal action plan, the strategy led to policy modernizations and continues taking huge strides for an all-inclusive operational CAF model. But is this enough?

Embracing diversity is, without a doubt,
a recognized force multiplier for the CAF.

IS DIVERSITY GOOD FOR THE CAF?

In his CFC research paper, Major (Maj) J. N. Mahoney provides an in-depth analysis of some of the reasons why diversity is good for the CAF.¹⁰ He first elaborates on the simple fact that the traditional recruiting pool of Caucasian male applicants is shrinking, and tapping into the growing Canadian VM population will assure the organization's survival. Historically, "the Canadian Forces has attracted young rural white males who have had previous exposure through [a] serving relative or friend, with a high school education or less and with little future educational aspirations."¹¹ This situation will become even more critical, as the CAF is increasingly trying to recruit candidates with higher education. Mahoney then addresses the need for the CAF to be proportionally



Sergeant Gurpreet Dipak speaks with Specialist Brown about the medical trade during Exercise HIGHLAND THRASHER at Fort Stewart Army Base, Georgia, on April 2, 2016.

representative of the population it supports for political and legal legitimacy.¹² People are more inclined to approve decisions and actions when the latter are made by representatives they associate with (i.e., share the same ethnic background).¹³ Finally, he explores the need for cultural intelligence as an advantage for every level of leadership in support of unconventional conflict and humanitarian scenarios. This statement is reinforced by Maj Christopher Ryan's service paper on multiculturalism, where he states that "if current operations are not an aberration but represent the complexities of the future, multiple perspectives, particularly those that are culturally based, will prove invaluable. Also, a collective, native based, cultural intelligence may be an operational resource that cannot be reproduced through training."¹⁴ Lieutenant-Colonel Jean-François Bidal also brings an interesting parallel to cultural intelligence; he highlights the value of linguistic diversity through the recent Canadian deployments to African countries where French is the only official language.¹⁵ Embracing diversity is, without a doubt, a recognized force multiplier for the CAF.

THE CAF'S STRATEGY

The *Canadian Armed Forces Diversity Strategy* was implemented, envisioning "a CAF that is comprised of members who reflect the rich diversity of Canada and who are recognized and encouraged to maintain and contribute through their unique experiences, abilities, and perspectives within a respectful and inclusive environment."¹⁶ The strategy strives for the CAF to reflect the society it represents while taking a more holistic approach than the Employment Equity Act, as well as to apply strategic goals and institutional effects that can be sustained over time.¹⁷ The *Canadian Armed Forces Diversity Strategy* action plan, developed in 2016, contains the strategic roadmap and the metrics for the CAF to become a more inclusive employer. In the action plan, the framework directing VM inclusiveness is established primarily on the acquisition of individual and institutional cultural competence through academia, research and an examination of other countries'

experiences in the matter. Cultural competence is the ability to understand, communicate with and effectively interact with people across all cultures.¹⁸ Cultural competence encompasses

1. being aware of one's own world view;
2. developing positive attitudes towards cultural differences;
3. gaining knowledge of different cultural practices and world views; and
4. developing skills for cross-cultural communication and interaction.

Since its implementation, the action plan has triggered a complete review of Department of National Defence (DND) and CAF policies and programmes as well as recruitment and training initiatives to ensure that they reflect the new Canadian multicultural reality. Under the Chief of the Defence Staff's guidance, the action plan goes even further in forcing a complete review of our Code of Values and Ethics in an effort to align it with the values of all the cultures the CAF represents. Changes are being implemented and, as such, the CAF has created groups and committees like the Defence Visible Minority Advisory Group,¹⁹ implemented several VM seminars as well as community outreach events, revamped recruiting processes and participated in cultural celebrations across the country. In the corridor between Windsor and the Niagara Region, Ontario, the CAF has partaken in over 1,000 multicultural events in the last year, which shows its strong presence in the community.²⁰ It is a necessary commitment, since several communities and minority groups are not aware that the CAF is recruiting. Some immigrants are also unaware of the qualifications for military positions, so face-to-face meetings are important. With an all-encompassing internal review, the CAF is clearly going in the right direction and has probably removed most of the deterrents to VM inclusion within its organization, but there is still no significant increase in the recruitment and retention of VMs.²¹

BARRIERS IN RECRUITING VMS

VMs want to work in the CAF—in fact, Maj Helen Theiner quotes several surveys showing a higher desire to join the military from VMs than the non-VMs.²² However, her research also highlights the existence of several recruitment barriers.

The first barrier is the mandatory security screening. Security screening is required during every new recruit's application to the CAF and can take up to a year to complete, depending on the complexity of the case.²³ It must be completed before any other processes, such as medical assessment, can be started. Since most VMs are, or descend from, recent immigrants, they often have strong and complex links to their country of origin; this is where most screenings fail.²⁴ Theiner believes that attracting more people, specifically until succeeding generations screen successfully, will help solve this problem. It is quite logical to think that future generations will have less problems with screenings, but, in my opinion, attracting more recruits will just extend the wait times and congest the system further. From 2017 to 2018, roughly 34,000 people applied for a Regular Force career in the CAF, while the annual strategic-intake plan limited recruitment to only 5,000 positions.²⁵

The second barrier Theiner identified was how deeply rooted the immigrants became after deciding where to establish themselves (generally in large centres like Toronto, Montreal and Vancouver):



Candidates of the Infantry Officer Development Period 1.1 course (Dismounted Infantry Platoon Commander) in offensive operations as part of an intense 12-day exercise at the Infantry School Combat Training Centre, 5th Canadian Division Support Base Gagetown, New Brunswick, July 12, 2019.

Many immigrants tend to settle in the same locations as others of the same ethnic origin within Canada. This occurs because immigrants arriving in a new country would want to settle in a region where they might expect a support base from other individuals of the same nationality providing at a minimum a sense of familiarity up to actual financial assistance. New immigrants would also expect to obtain initial employment through contacts provided in that support base and therefore would tend to be directed to similar occupations as already settled immigrants.²⁶

Once established, immigrants tend to not to want to move again, especially to remote areas away from family support.

The situation is compounded by a third barrier: citizenship. In Canada, military recruits—contrary to their United States (US) counterparts—must be Canadian citizens before they enrol. Therefore, new immigrants are required to first apply for citizenship before being recruited into the military. The application process for citizenship is quite extensive, as new immigrants need to be permanent Canadian residents for a minimum mandatory period of 1,095 days (three years) to apply.²⁷ Processing citizenship takes at least a year, meaning the entire process takes at least four years, which is likely enough to deter even the most determined applicant. Most new immigrants will then refuse to leave their ethnic communities and end up seeking employment in local organizations to meet their initial financial needs. They typically feel safe in their communities, and very few will develop an interest in joining the military.

One solution provided in Theiner's research was to utilize CAF Reserve units in large cities as an entry point to military life. A recent propensity and interest survey indicated a 72% interest in the Reserve vice 24% in the Regular Force.²⁸ This data certainly shows the value of a Reserve-focused approach as a great initiative for visibility and attraction, but that alone probably will not lead to VMs wanting to move to a northern Canadian military base to join the Regular Force.

Most of these small communities do not have the ethnic infrastructure and support groups to encourage VMs to move there, even if the CAF is internally ready to support them. Furthermore, specific rural populations near some of the bases and wings have not traditionally been very welcoming to VMs, making integration even harder.

Most of the people I spoke to did not know the military beyond what is portrayed in movies and the news, and those portrayals are often negative.

A trend I have noted while performing interviews in the GTA is the lack of positive visibility the CAF has in most of the communities, and it all starts with the educational curriculum. Most of the people I spoke to did not know the military beyond what is portrayed in movies and the news, and those portrayals are often negative. As explained by some of the geologists met during my fellowship, it is clear that their field of work was not treated as a promising career in school, thus reducing the number of potential applicants. Military presence in schools is often restricted to a speech during Remembrance Day; it becomes part of a history lesson, not a career opportunity. More importantly, as Clotaire Rappaille's extensive research found, "by the time we are seven ... most of our mental highways have been constructed."²⁹ Most of our cultural appreciation and/or bias is already built in by the time we enter the school system. So, by encouraging new immigrants to join ethnic communities upon arriving in Canada, we continuously ensure that most Canadian-born VMs are raised in societies that do not generally understand or support the CAF's mission. Suffice it to say, if no emphasis is put on the Canadian military reality throughout school life, it becomes very hard to imprint a desire to serve once VMs enter the job market.

REQUIRED INSTITUTIONAL CHANGES

The first institutional change to consider would be the implementation of a definite active presence from the CAF in the school system—possibly even a basic military awareness course highlighting the lifestyles, values, importance and benefits of the CAF for Canada. I do not mean mandatory military training or employment, nor am I suggesting that we should become a more assimilative society, although a certain degree of assimilation visibly works in the US.³⁰ I feel that there is an obvious need for military awareness in our school curriculum, and it must be initiated by a governmental authority to succeed, not by individual school boards. This is, in my opinion, the most important endeavour in ensuring our military's survival.

The second change to consider would be to provide new immigrants assistance with citizenship in return for years of mandatory service. The US, through its Department of Defense, has acted as an example to other militaries since the 1950s by recruiting non-citizens as part of their military.³¹ The US military has embraced diversity by integrating its entire population into the military system. To a certain extent, this inclusion strategy even led to an increased inclusion of every US citizen in the whole society. The United States Army also created a diversity roadmap in 2010, which was embraced by other armies from other countries.³² Yet, surprisingly enough, Canada has much more flexible foreign-worker employment rules than the US, but these do not



The events of the Royal Canadian Air Force ceremonial consecration of the flags parade held in front of Toronto's City Hall at Nathan Phillips Square located on 100 Queen Street West, Toronto, Ontario, on September 1, 2017.

currently apply to the CAF. According to the founder of a Toronto-based immigration law firm, “The government has expanded the number of categories of work permit categories that exempt employers from having to go through the cumbersome labour market approval process to obtain permission to hire a foreign worker.”³³ As I have observed, that process benefits most Toronto companies and could also explain some of the disparity in VM employment between the private sector and the CAF. Furthermore, the background check required by these companies is far less stringent than military screening.

A third institutional change would be for the CAF to concentrate its efforts in building infrastructure to use local resources in Toronto and other large Canadian cities, much like they have done with the Canadian Rangers programme for northern communities.³⁴ With full implementation of electronic signatures and online administration, cities like Toronto could easily become administrative and financial centres of excellence for the CAF. Furthermore, with a large number of prospective applicants, the need for more than a three-year contract would become unnecessary. Centralization has proved beneficial so far in information technology and other governmental departments; why not centralize 80% of the hard-to-fill administrative positions to a large city like Toronto? Furthermore, with instant access to information all over the world, there would be less of a need to deploy certain support trades, like financial services administration and human resources administration, allowing them to remain with their families longer. As stated earlier, immigrants and VMs feel safe within their adopted communities and will rarely entertain leaving them for a military job.

A fourth institutional change would be to create trades (e.g., linguists, cultural sociologists) based out of the GTA who could assist in translation, community research and recruitment, and who could remain visible all year in the Toronto area. These trades would definitely attract VMs.



Private Farah of 1 Princess Patricia's Canadian Light Infantry keeps watch as the rest of his platoon prepares to move out during Exercise ALLIED SPIRIT V in the Hohenfels Training Area in Germany on October 7, 2016, during Operation REASSURANCE.

Perhaps another change would be to revamp the Reserve units' mandate in the GTA to more directly support the CAF's activities versus their own exercises. This could help create the operational association required for an ultimate buy-in from VMs. Historically, the Reserve units have been working to the beat of their own drums, with a heightened focus on the local community they live in, and while providing periodic support to the Regular Force in times of crisis. Maybe it is time to create a stronger link between the Reserve and Regular Force, especially those units located away from Regular Force bases and wings. Why not introduce an internship programme to transfer Reserve members into Regular Force bases for periods up to six months to help with surges? This visibility may be just what the CAF needs to enhance the desire to join the Regular Force.

CONCLUSION

Embracing cultural diversity and VM inclusion is vital for the CAF's very survival; but trying to represent the Canadian population in the current Regular Force's employment concept and the existing realities of targeted demographic groups is too ambitious and unrealistic. Through its diversity strategy, the CAF is clearly making the required internal changes to create a thriving social environment for all VM groups, but that alone is not enough to overshadow other realities faced by VMs in Canadian society. The institutional changes I propose may appear simple, but they are merely a realization that some of the problems in recruiting and retaining minorities are often larger than what the CAF can reach. The CAF still has a part to play, but it will undoubtedly force a change in recruitment and employment. Who is to say how the representation of VMs in the CAF will be in a few generations? It sure looks promising, but we may have to do just that and wait a few generations to see any significant change.

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ABBREVIATIONS

CAF	Canadian Armed Forces
CFC	Canadian Forces College
DND	Department of National Defence
GTA	Greater Toronto Area
SSE	<i>Strong, Secure, Engaged: Canada's Defence Policy</i>
VM	visible minorities

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Once There Was an Arrow

By Walter O. Gordon

Avro Canada completed and flew five prototypes of the CF-105 Arrow supersonic interceptor before the programme was terminated by Prime Minister John Diefenbaker on February 20, 1959. On that day, known ever since as “black Friday,” over 14,000 employees lost their jobs and the Canadian aerospace industry changed forever, never again to produce a state-of-the-art military aircraft. At the time, the Arrow was one of the most advanced fighter aircraft in the world; it was an almost inconceivable achievement by a company that only 13 years earlier was manufacturing Lancaster bombers under license during World War II. To this day, an aura of conspiracy surrounds the aircraft’s demise, fostered by the Canadian government’s subsequent order that all completed and partially completed Arrows be cut up and sold for scrap. Examined in the political and military context of the day, however, the Arrow’s cancellation was largely due to budgetary pressure, which was caused by the programme’s scope growing from developing a new airframe to developing a new airframe, engine, fire control system and missile.

Introduction

It has been almost sixty years since the abrupt cancellation of the Avro Canada CF-105 Arrow, yet the aircraft and the circumstances of its collapse—including the dismantling and selling for scrap of six completed aircraft—remain a fascination and tragedy for many Canadians to this day. From the initial development contract in the spring of 1954 to its first flight in 1958, the Mach 2 Arrow was a remarkable achievement for a company whose most advanced aeronautical achievement was building Lancaster bombers only 13 years earlier. The Arrow was, in many ways, the most advanced fighter aircraft in the world at the time; had it gone into full production with its designed Iroquois engine, its performance and capability would have fallen somewhere between the McDonnell F4 Phantom II and the Mach 3+ North American F108 Rapier. The former could be considered a peer of the Arrow, with its first flight also in 1958. However, the latter only existed as a mock-up and was years from its first flight when cancelled by the Eisenhower administration in 1959.¹

Avro Canada, the Jetliner and the CF-100

Avro Canada's origins trace back to the aircraft division of National Steel Car located in the town of Malton, adjacent to the Toronto airport. In its four-year existence from 1938 to 1942, this newly founded division of a company that manufactured railway cars built over 1,000 single-engine Westland Lysanders, twin-engine Avro Ansons and several other small aircraft types under license to firms in the United Kingdom. As World War II progressed and aircraft orders mounted, operational inefficiencies increased, prompting C. D. Howe, wartime Canada's "Minister of Everything," to nationalize the aircraft division. Renamed Victory Aircraft, the factory grew to over one million square feet and had almost 10,000 employees by the war's end, and it had produced 430 four-engine Lancaster bombers, one of the largest, most complex aircraft in production at that time.² Demand evaporated overnight at the end of the war, however, and the staff were reduced to 400 employees.

**The Arrow
was, in many
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world at the time.**

Not wanting to stay in the airplane business, the Canadian government sold Victory Aircraft to the Hawker Siddeley Group of the United Kingdom, and it became a wholly owned subsidiary named A. V. Roe Canada, or Avro Canada.³ Avro Canada's first aircraft were both unprecedented at any company: a commercial jet transport, the C102 Jetliner, and a radar-equipped, twin-engine jet fighter, the CF-100 Canuck.

The airliner was created in response to a request from Trans-Canada Air Lines (now Air Canada) for a short- to medium-range jet transport with stall speeds and runway requirements comparable to existing propeller aircraft. It was initially designed to be a twin-engine aircraft using Rolls-Royce Avon engines with nearly 3,000 kilograms of thrust, but they were not available in time, so it



An Avro Canada C102 Jetliner
(Photo: Canada Aviation and
Space Museum)

was redesigned to use four Rolls-Royce Derwents, each with about 1,360 kilograms of thrust. The C102 Jetliner, as it was named, first flew on August 10, 1949. It was the first flight of a jet transport in North America and nearly the first jet flight anywhere, missing out to the De Havilland Comet in England by only two weeks. Trans-Canada Air Lines eventually wavered in its desire for a jet, however, and demanded unachievable performance parameters that allowed it to back out of purchasing the aircraft. Howard Hughes expressed strong interest in the Jetliner, flying it himself many times and offering to finance the building of 30 aircraft for Trans World Airlines. However, the Korean War and C. D. Howe intervened, with Howe personally pulling the plug on Jetliner production to devote all available Avro Canada resources to production of the CF-100. Foreshadowing the fate of the Arrow three years later, this world-beating aircraft was cut up for scrap in 1956.⁴

Howard Hughes expressed strong interest in the Jetliner.

The requirement for the twin-engine, radar-equipped jet fighter that became the CF-100 Canuck is best expressed by Air Marshal Wilf Curtis, who was Chief of the Air Staff during its development and production:⁵

First we had to look up the specification for the best bombers in the world, how high they would fly, and how fast. Then we asked for a fighter which would fly higher, and fly faster. It became obvious that if our air force was to have the kind of aircraft our planners said it needed, then we would have to design it ourselves. That is precisely how the CF-100 was born.⁶

The RCAF (Royal Canadian Air Force) specification to achieve this, Specification AIR71 Issue 2, called for an aircraft with a climb of 40,000 feet at a rate of 10,000 feet per minute, a combat radius of 650 nautical miles and a combat speed of 490 knots. These requirements were quite challenging in 1946, but Avro Canada signed a contract for two CF-100 prototypes and a static test article in October of that year. A successful and long-serving aircraft, the CF-100 first flew on January 19, 1950, and remained in Canadian service until September 1981. A total of 692 were manufactured for the Canadian and Belgian Air Forces.⁷



The Avro Canada CF-100
Canuck (Photo: Canada
Aviation and Space Museum)

CF-105 Requirement and Development

Considering the evolving nature of the threat and the length of time required to develop a new aircraft, in March 1952, the RCAF released the results of a study for an aircraft to replace the CF-100. Avro responded with concepts for two notional aircraft, one single- and one twin-engine; neither completely met the requirement, but the twin-engine aircraft came closest. A year later, an official specification for the new aircraft was released: Specification AIR73, “Design Studies of Prototype Supersonic All-Weather Interceptor Aircraft.” This document specified a two-seat, long-range, Mach 2+ aircraft with a weapons bay larger than a World War II B29 and the ability to sustain a 2G turn at 1.5 Mach and 50,000 feet. One senior Avro official at the time had this to say about the requirement’s difficulty: “The RCAF laid down such a complex and difficult specification that any engineering team in the world would have been hard pressed to meet that spec. At the time there were many American engineering teams who said they wouldn’t even try to meet the spec and that we were off our rocker to even try it.”⁸

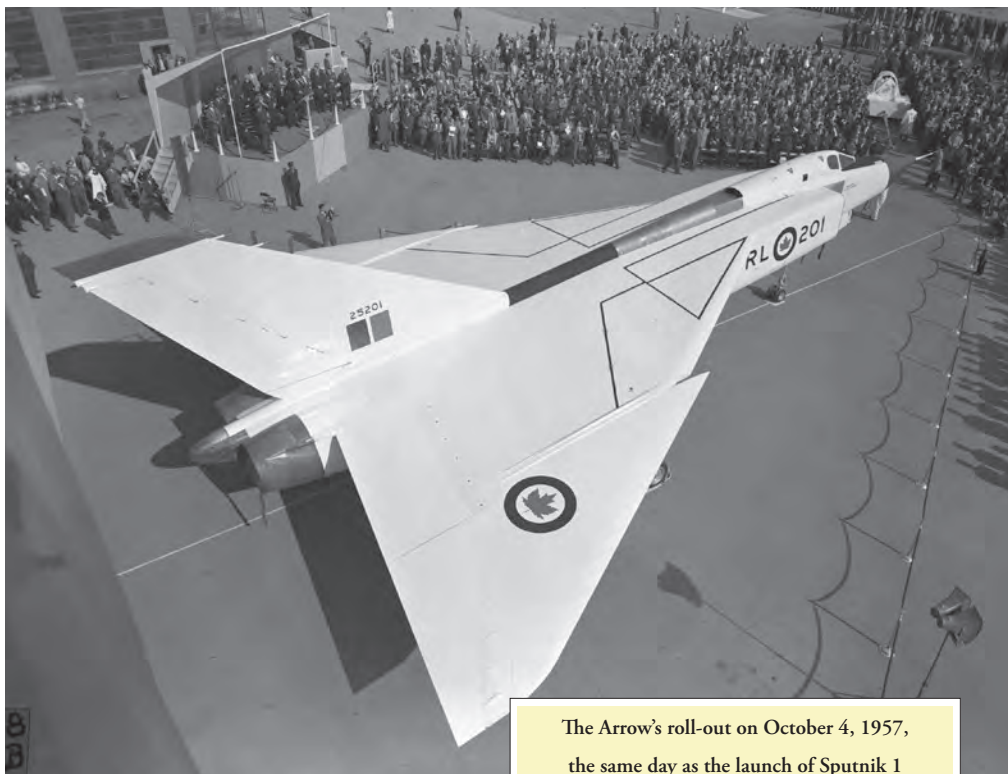
Avro submitted several concepts in response. One submission, the C105/1200, was deemed most responsive by the RCAF, which then released a new specification around that design, AIR74. In 1953, the Liberal Government approved the design and Avro’s production of two prototypes based on this specification for \$30 million⁹—although this figure did not include the development of an engine, fire control system or missile, which would assumedly come from the United States (US) or United Kingdom. The eventual selection of these items would ultimately play a significant role in the aircraft’s fate.¹⁰

Developing the CF-105 weapon system now consisted of a new airframe, engine, fire control system and radar, each as advanced as the world had ever seen.

The Arrow's planned engine changed in short order from the Rolls-Royce RB.106 to the Curtiss-Wright J67 and then to the Pratt & Whitney J75 after the first two were cancelled by the British and American governments, respectively. Anticipated performance with the J75 was deemed insufficient, however, and while the plan remained for the initial aircraft to fly with the Pratt & Whitney engine, the government funded the separate development of the all new PS13 Iroquois. It was designed by Orenda Engines, the gas turbine-engine division of Avro Canada that built the highly successful engine that powered the CF-100, and the Iroquois was to be both lighter and more powerful than the J75. The RCAF also decided to change the initial order from 2 prototypes to first 11 and then 29 pre-production aircraft developed according to the Cook-Cragie plan created in the US. Under Cook-Cragie, even the first aircraft were made with production tooling rather than as essentially handmade prototypes, which would be followed by development of the production tooling. While ultimately intended to accelerate the delivery of production aircraft, Cook-Cragie also accelerated the cost, as much more comprehensive design and testing had to be performed to get the tooling and aircraft

right the first time, instead of evolving after the building and testing of one or more prototypes. By 1955, these changes, combined with the Iroquois' development, raised the projected development cost of the programme to \$410 million.¹¹

When the Arrow's development began, a fire control system and compatible missile had yet to be chosen, but Avro assumed it would be the Hughes MX1179 and Falcon missile under development in the US for their aircraft. As with the J75 engine, this combination was also deemed inadequate. By 1956, the RCAF contracted with RCA in the US to develop Astra, a new fire control system, to give the Arrow greater capability operating independently over northern Canada than could be achieved with the MX1179, which was designed to operate over the Continental US with assistance from ground radar. Instead of the Falcon, Astra would operate with the advanced Sparrow II missile being developed by the United States Navy. When the Navy dropped support of the missile in late 1956, it was picked up by the RCAF as well. Developing the CF-105 weapon system now consisted of a new airframe, engine, fire control system and radar, each as advanced as the world had ever seen.¹²



The Arrow's roll-out on October 4, 1957,
the same day as the launch of Sputnik 1
(Photo: Canada Aviation and Space Museum)

The Aircraft

The first Arrow rolled out amid great fanfare and numerous very important persons, including the Minister of National Defence, George Pearkes, and 71-year-old J. A. D. McCurdy, who piloted the first flight of an aircraft in Canada almost fifty years earlier on the frozen surface of Baddeck Bay, Nova Scotia. Unfortunately, while the following day's front page of Toronto's *Globe and Mail* featured a photograph of the CF-105 and the ceremony, the headline was "Russia Launches First Satellite," pushing the Arrow's actual story to page five. The surprise launch of Sputnik 1 had taken place the same day. In a portent of challenges to come, this concrete demonstration of the same booster technology required of an intercontinental ballistic missile caused the perception of that threat to grow significantly, especially when forecast several years in the future when the Arrow was scheduled to go into service.¹³

Arrow RL-201 took to the air at 9:51 AM on March 25, 1958, with Avro Canada's chief test pilot, Jan Zurakowski, at the controls. The aircraft handled flawlessly at speeds up to 250 knots as he exercised various aircraft

**The aircraft
exceeded the
speed of sound
on its third flight.**

systems, including the standard and emergency modes of the fly-by-wire control system. When the aircraft touched down 35 minutes later, the only anomaly was a nose-gear warning light caused by a faulty microswitch. The aircraft exceeded the speed of sound on its third flight, achieving Mach 1.1 and 50,000 feet on April 3. Two weeks later, on April 18, “Zura” took RL201 to Mach 1.52. It was on this flight that the voice of an RCAF radar controller tracking the aircraft was overheard on the hotline to flight operations in Malton: “Look at that son of a bitch go! WILL...YOU...LOOK... AT THAT SON OF A BITCH GO!!”¹⁴

Over the next eleven months, the five J75 powered Arrow Mark 1 aircraft made 66 successful test flights, which were largely uneventful except for two landing accidents in which both aircraft were repaired. The highest speed achieved was Mach 1.98 by RL202 on November 11.¹⁵ Jack Woodman, the lone RCAF pilot to fly the Arrow, had this to say about the aircraft’s performance:

On my 6th and last flight I reported longitudinal control to be positive with good response, and breakout force and stick gradients to be very good. Lateral control was good, forces and gradients very good and the erratic control in the rolling plane, encountered on the last flight was no longer there ... Excellent progress was being made in the development ... From where I sat the Arrow was performing as predicted and meeting all guarantees.¹⁶



Arrow 201 in flight, with a CF-100 in the foreground
(Photo: Canada Aviation and Space Museum)

By February 1959, the first Arrow Mark 2 powered by the Iroquois instead of the J75, tail number RL206, was complete and within weeks to months of its first flight, depending on the outcome of final testing of its two engines. Since the Mark 1 had never been pushed to its limits, the consensus at the time was that the Mark 2, with its lighter and more powerful engines, would easily break the world speed record for jet-powered aircraft. It would never get the opportunity.¹⁷

Storm Clouds

That same year, Canada and the US jointly created the North American Aerospace Defence Command (NORAD). Commanded by a US Air Force four-star general with an RCAF three-star general as deputy, NORAD put operational control of US and Canadian air defence forces under a single command in Colorado Springs. The first men to occupy these posts, General Earle Partridge and Air Marshal Roy Slemon, came out firmly in support of the Arrow. But participation in NORAD also put pressure on Canada to support the semi-automatic ground environment (SAGE) radar/computer network designed to coordinate North America's air defence as well as the Bomarc surface-to-air missile that was designed to work with SAGE and strongly advocated by the US. Implementing SAGE potentially undercut the requirement for the Arrow, as it was designed to have a two-man crew and a radar, fire control system and missile, which did not require the level of control offered by SAGE, unlike less capable and less costly American interceptors, such as the F106. Bomarc itself was also portrayed as a more affordable alternative to manned interceptors.¹⁸

The last and greatest threat to the Arrow was budgetary.

The last and greatest threat to the Arrow was budgetary. As with so many aircraft development programmes since, rising costs caused reduced numbers, which drove unit costs higher, especially compared to US alternatives in which a Canadian buy would simply be tacked on to existing production and not incur development cost at all. The greatest increase in cost, however, was the RCAF's decision in 1956 to fund the development of a radar, fire control system and missile unique to the Arrow. The resulting programmes to develop the Astra and Sparrow II were probably the greatest mistake and largest liability of the Arrow programme.¹⁹

Cabinet deliberations on the air defence of Canada and the Arrow, specifically through the summer of 1958, culminated in what should have been a warning shot to Avro by the Prime Minister on September 23, 1958. In a speech to parliament, John Diefenbaker made the following points, in order:²⁰

1. In light of the "rapid development that has taken place during the last year in missiles for both defence and attack ... missiles should be introduced into the Canadian air defence system and [the] number of supersonic interceptors required for the RCAF Air Defence Command will be substantially less than could have been foreseen few years ago, if in fact such aircraft will be required at all in the 1960s."
2. Two Bomarc bases would be established in northern Ontario and Quebec.
3. SAGE would be integrated into the Canadian air defence system.
4. "The government has decided it would not be advisable at this time to put the CF-105 into production ... however ... the developmental program for the Arrow aircraft and the Iroquois engine should be continued until next March, when the situation will be reviewed again in light of all the existing circumstances at that time."

5. Contracts to develop Astra and Sparrow would be terminated and replaced on the Arrow with American systems.

Interpretation of this speech varied widely. The headline of one *New York Times* article read, “Canada Switches Defense Policy: Scraps Plans for Jet Fighter and Turns to U.S. Missile as Weapon of the Future.” It went on to say that “the blow to the A.V. Roe Company was somewhat tempered by the announcement that production and research on Arrow prototypes will continue until March 1.”²¹ One wonders if the article’s author knew more of the Cabinet and Prime Minister’s intentions than were stated in the speech. At the opposite end of the spectrum, Crawford Gordon, the CEO of Avro Canada, said the following during a televised address: “I want to stress most emphatically that the Arrow programme has not been cancelled, nor has it been decided not to put it into production. On the contrary, the Prime Minister’s statement says the programme is to continue ... We are convinced that, when the review takes place next March, the Arrow will be ordered into production.”²² The Prime Minister’s deliberately ambiguous statement permitted this interpretation as well, as if the decision was already made not to put the aircraft into production; it begged the question of what would be decided at the review in March. An article in the *Globe and Mail* was less sanguine, pointing out one reason the decision was deferred was to “avoid serious winter unemployment,” which would result from outright cancellation at that time.²³

In fact, the prospect of terminating the Arrow had been considered for some time, although that information was classified. The Canadian Cabinet—which included the Prime Minister, Minister of National Defence, Minister of Finance and others—began discussing the programme’s potential cancellation almost as soon as RL201 rolled out. Cabinet minutes from October 29, 1957, which were classified as secret for several decades after, show marked concern over the aircraft’s rising cost and advised that work on the “CF-105 and Sparrow II proceed for a further twelve months and that a decision be then made as to whether the government embark on procurement. ... The situation could be closely watched and the programme stopped if necessary.”²⁴

In the months following the Prime Minister’s speech on September 23, 1958, the classified minutes of subsequent Cabinet discussions showed the Arrow’s fate was almost certainly signed that September and would be sealed by the New Year:

1. September 22, 1958: “The Minister of National Defence expressed the view that [it] seemed likely the development of the Arrow would be terminated by the end of March.”²⁵

In fact, the prospect of terminating the Arrow had been considered for some time, although that information was classified.

2. December 22: “The Minister of National Defence pointed out that it was still his understanding that [Arrow and Iroquois] development would be terminated by March 31st.”²⁶
3. December 31: “The Prime Minister asked whether any member of the Cabinet wished to change the decision *which had been made* on the Arrow programme.”²⁷ [emphasis added]
4. January 28: “The Minister of Finance said that almost as soon as he tabled the main estimates for 1959–60 it would become known that there was no provision for expenditures on the Arrow beyond April 1st, except cancellation costs.”²⁸

These determinations took place before March, when, according to the Prime Minister’s speech, “...the situation [would] be reviewed again in light of all the existing circumstances at that time.”²⁹

Black Friday

At 9:30 AM on Friday, February 20, 1959, Prime Minister John Diefenbaker began a speech to the House of Commons: “Mr. Speaker, with the leave of the House, I should like to make a somewhat lengthy statement on the subject of one facet of the national defence of Canada.”³⁰ Hours later, the headlines in that afternoon’s *Toronto Daily Star* read, “Diefenbaker Decides: SCRAP ARROW. ‘No Other Work for Makers of Arrow or Engines’ – Ottawa.”³¹ By the end of that day, over 14,000 Avro employees and, shortly thereafter, a comparable number at 650 subcontractors were out of work.³² The Prime Minister continued:

I wish to announce the decision relating to air defence which was foreshadowed in the statement given to the press on Sept. 23. The Government has carefully examined and re-examined the probable need for the Arrow aircraft and Iroquois engine—known as the CF-105—the development of which has been continued pending a final decision. It has made a thorough examination in the light of all the information available concerning the probable nature of the threats to North America in the future years, the alternative means of defence against such threats, and the estimated costs thereof. The conclusion arrived at is that the development of the Arrow aircraft and Iroquois engine be terminated now. Formal notice of termination is being given now to the contractors.³³

Formal notice was received at Avro and Orenda by teletype just before noon: “Take notice that your [Arrow and Iroquois] contracts are hereby terminated. ... You shall cease all work immediately, terminate subcontracts and orders, place no further subcontracts or orders and instruct all your subcontractors and suppliers to take similar action.”³⁴

Around four o’clock that afternoon, Crawford Gordon made the following announcement to Avro Aircraft and Orenda Engines employees through the public address system at Malton:

Following the Prime Minister’s statement, we have received news from the government instructing us to immediately cease all work on the Arrow and Iroquois programmes at Malton ... Notice of termination of employment is being given to all employees of Avro Aircraft and Orenda Engines pending a full assessment of the Prime Minister’s statement on our operation. We profoundly regret this action but have no alternative since the company received no prior notice of the decision and therefore we were unable to plan any orderly adjustments.³⁵

Since, as the Cabinet minutes indicated, the decision to cancel the Arrow was made the previous autumn, it begs the question of why Avro was not notified at the time, which would have given them several months to shut down the programme in a less disruptive fashion. Initially, it appeared the Diefenbaker government tried to break the news slowly through the announcement in September 1958 but, by the following February, was determined to end the programme quickly and irrevocably. In a statement regarding the immediate layoff of 14,000 Avro employees made the following Monday, the Prime Minister placed the blame squarely on the company:

The particularly disastrous conditions under which various employees find themselves [is] a result, not of our action—for that action we gave notice last September—but the precipitate, unwarranted, and unjustifiable decision on Friday of discharging these employees who had been faithful over the years, without regard to any considerations. ... [Avro management] knew it was coming. I will not say they knew the exact date but they knew what the decision was and that it was unchangeable.³⁶

Unless there was undocumented communication between the government and Avro, this statement is simply untrue.³⁷

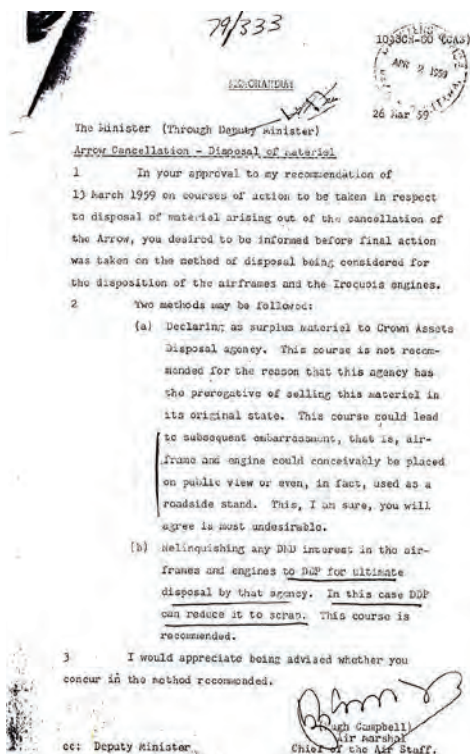
In *Canada's Changing Defense Policy, 1957–1963: The Problems of a Middle Power in an Alliance*, Jon McLin provides a very succinct explanation for the government's actions:

All of this could have been avoided, and a considerable saving achieved of mental gymnastics needed to defend contradictory arguments, by a frank admission of the fact that the Arrow was cancelled because it was too expensive for Canada to buy. Such an admission, however, required the recognition, psychologically and politically difficult, that Canada could no longer pay the price which advancing technology exacted to remain a producer of the more sophisticated military equipment. Unwilling to recognize the loss of power and prestige involved, the politically-sensitive Diefenbaker government obscured the issue. This made the future adjustment more difficult and lengthy without rendering it less painful.³⁸

The statement is all the more remarkable because it was published in 1967, long before many relevant records were declassified.

Aftermath

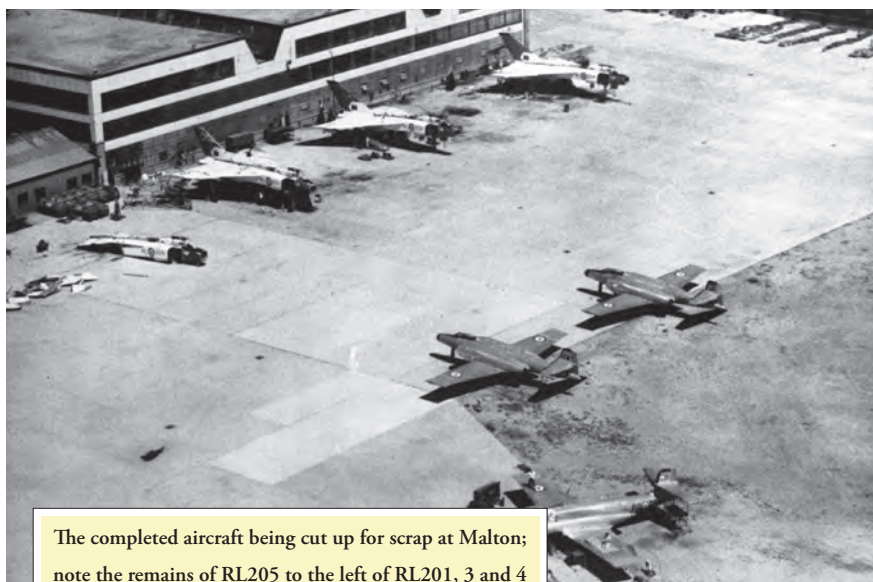
After black Friday, a remaining issue was what to do with the five completed and flown Arrow Mark 1 aircraft and the single Mark 2, RL206, as well as other aircraft and engines in various stages of completion and production tooling for the Arrow and Iroquois. This decision went all the way to the Chief of the Air Staff, Air Marshal Hugh Campbell, who recommended this course of action to Prime Minister Diefenbaker: “[Relinquish] any DND [Department of National Defence] interest in the airframe and engines to DDP [Department of Defence Production] for ultimate disposal by that agency. In this case DDP can reduce it to scrap.” Upon receiving the order, Fred Smye, the president of Avro Aircraft, initially refused; however, he was told that, if he did not act, the Army would be brought in to cut them up. Smye states, “With that threat I capitulated. This was a terrible mistake, one which I will regret for the rest of my life.”³⁹



A memo from Air Marshal Hugh Campbell recommending the Arrows be scrapped⁴⁰

By the end of the year, the entire programme was reduced to 2,785 tons of scrap and sold to Sam Lax of Lax Iron and Steel for \$304,370, or twelve cents per kilogram. At that price, the remains of a completed CF-105 were sold for \$2,185. The ultimate indignity may have gone to Zurakowski, the Avro test pilot who made the first flight and prompted the comment of "Look at that son of a bitch go!" when taking RL-201 to Mach 1.52. While driving home from work one day, Zurakowski had the misfortune of pulling up next to the remains of that same aircraft on a flatbed truck en route to Lax Iron and Steel.⁴¹

All that remains of the six completed aircraft today is a cockpit and nose section in the Canadian Aviation and Space Museum in Ottawa. They belonged to RL206, the completed Arrow Mark 2 that, by black Friday, was within months of demonstrating the aircraft's full capability with Iroquois engines. The handwritten annotation "cut here" is still visible sixty years later, marking the location where the saw cut it from the fuselage.



The completed aircraft being cut up for scrap at Malton; note the remains of RL205 to the left of RL201, 3 and 4 (Photo: Canada Aviation and Space Museum)



The nose section of Arrow 206, all that remains of the six completed aircraft, in the Canada Aviation and Space Museum, Ottawa (Photo: Walter O. Gordon)



“CUT HERE” is still clearly visible on Arrow 206 fifty-nine years later (Photo: Walter O. Gordon)

The loss of so many jobs literally overnight devastated the region. The “employment wanted” section from the *Brampton Conservator*, a small local newspaper in a small local town, is representative: “Former A.V. Roe employee ... any class of work ... Former Avro general machine shop and fitting experience, willing to try anything ... Former Avro worker, eight years, would like work of any kind.”⁴²

Ex-Avro-Orenda Employment Wanted

AVRO MEN

PLANNER, tool designer or machinist requires employment. Phone GL.1-3095.

TOOL and gauge maker, seeks position in vicinity of Toronto, employed last seven years as tool inspector at Orenda Engines. Will consider any job allied to above qualifications. Phone GL.1-1469.

WORK wanted, sheet metal layout, ten years experience; also sales experience, ½-ton panel truck available. Former A.V. Roe employee, 10 years. Apply W. Brown, Box 213, Brampton.

SECURITY Guard with four years experience, would prefer job in same line. Please. Phone Butler 6-4190.

AVRO worker wants work in shoe factory on clicker or dryer machine, 17 years experience. Phone GL.1-4619

FORMER A.V. Roe employee, Experienced as punch press operator and truck driving, or any class of work. Phone GL.1-1922.

DESIGN draftsman, ex-Orenda employee experienced in sheet metal layout and losting, requires position. GL.1-6651.

FORMER Avro general machine shop and fitting experience, willing to try anything; own automobile. Phone GL.1-9189.

FORMER Avro worker, eight years, unskilled, would like work of any kind, chauffeur's license. Phone GL.1-5449.

FORMER Avro employee, 7 ½ years tool and die making, started trade as apprentice to nautical and scientific instrument making in England, age 63 years young. GL.1-3363.

“Employment wanted” classified advertisement
in the *Brampton Conservator*⁴³

Conclusion

Perhaps the most remarkable mystery of the Arrow is not why it was cancelled, but how it happened at all—how Victory Aircraft went from building Lancasters under license in 1945 to rolling out one of the most advanced aircraft in the world 12 years later. James Floyd, then 94, provided a glimpse into the mindset during that era at Avro Canada when he received the Pioneer Award from the Canadian Air and Space Museum on July 20, 2009. While offering advice to engineers of the current generation, he recalled a plaque behind his desk at Malton during the development of the Arrow: “If something seems worthwhile, but is obviously impossible, do it anyway.”⁴⁵

The last word on Avro Canada and the Arrow will go to Hodge, one of the 25 Arrow engineers recruited by NASA after black Friday. When asked how Avro Canada accomplished so much and created such an advanced aircraft in such a short period of time, he simply said, “We didn’t know we couldn’t.”⁴⁶

Those whose skills were in high enough demand were recruited elsewhere, many to aircraft manufacturers in the US. Twenty-five ex-Avro engineers were hired by the National Aeronautics and Space Administration (NASA) into the space programme. Jim Chamberlin, chief of technical design on the Arrow, was the first programme manager for Project Gemini. John Hodge, who led the team responsible for evaluating aerodynamic loads on the Arrow, became the first NASA flight director after Chris Kraft. Hodge had very significant roles in Gemini, Apollo and the design of Space Station Freedom, which eventually evolved into the International Space Station.⁴⁴

Acknowledgments

The author wishes to express his sincere appreciation and gratitude to John Hodge, his wife Audrey and his daughter Janice Schrager for their support in an interview with Mr. Hodge on August 26, 2018.

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While working as an engineer in western New York since 1981, Gordon had a concurrent 30-year career in the United States Air Force (USAF) and Air Force Reserve, retiring as the commander of the 914th Air Refueling Wing, Niagara Falls, New York, in 2014. He is a veteran of Operation DESERT STORM and was the deployed commander of the 914th Wing during the invasion of Iraq in 2003. Walter has a bachelor of science and master of science degree in aerospace engineering from the University at Buffalo and master of science in strategic studies from the USAF Air War College.

ABBREVIATIONS

LAC	Library and Archives Canada
RCAF	Royal Canadian Air Force

NOTES

1. This paragraph references “Avro Canada CF105 Arrow 2,” Ingenium, accessed December 8, 2018, <https://ingeniumcanada.org/artifact/avro-canada-cf-105-arrow-2>; National Naval Aviation Museum, “F4N Phantom II,” accessed December 8, 2018, https://www.navalaviationmuseum.org/attractions/aircraft-exhibits/item/?item=f-4n_phantomII; and Erik Simonsen, “F108 Rapier: The Air Force’s Mach 3 Interceptor That Almost Was,” *Air Force Magazine* 97, no. 9 (September 2014): 114–19.
2. Greig Stewart, *Shutting Down the National Dream: A. V. Roe and the Tragedy of the Avro Arrow* (Toronto: McGraw-Hill Ryerson Limited, 1988), 18; and Robert Bothwell and William Kilbourn, *C. D. Howe: A Biography* (Toronto: McLelland and Stewart Limited, 1979), 161.
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5. Norman Hillmer, “Wilfred Curtis,” *The Canadian Encyclopedia*, updated December 16, 2013, <https://www.thecanadianencyclopedia.ca/en/article/wilfred-curtis>.
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7. This paragraph references Randall Whitcomb, *Cold War Tech War: The Politics of America’s Air Defense* (Burlington, ON: Apogee Books, 2008), 88; and Ron D. Page, *Canuck: CF 100 All Weather Fighter* (Erin, ON: The Boston Mills Press, 1981), 17–19, 192.
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9. Murray Peden puts the figure at \$30 million and Stewart puts it at \$25 million. Murray Peden, *Fall of an Arrow* (Toronto: Stoddart Publishing Co. Limited, 1992), 25; and Stewart, *Shutting Down the National Dream*, 180.
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12. Smye, *Canadian Aviation and the Avro Arrow*, 53–54.
13. This paragraph references Richard Organ et al., *Avro Arrow: The Story of the Avro Arrow From Its Evolution to Its Extinction* (Erin, ON: Boston Mills Free Press, 2004), 35; “Russia Launches First Satellite,” *Globe and Mail*, October 5, 1957, 1, 5; and Jon McLin, *Canada’s Changing Defense Policy, 1957–1963: The Problems of a Middle Power in an Alliance* (Baltimore: The Johns Hopkins Press, 1967), 69.
14. This paragraph references Organ et al., *Avro Arrow*, 49–51, 115; Greig Stewart, *Arrow Through the Heart: The Life and Times of Crawford Gordon and the Avro Arrow* (Whitby, ON: McGraw-Hill Ryerson Limited, 1998), 136; and Peden, *Fall of an Arrow*, 74–75.
15. Organ et al., *Avro Arrow*, 115–16; and Campagna, *Storms of Controversy*, 80–81.
16. Campagna, *Storms of Controversy*, 81.

17. Peden, *Fall of an Arrow*, 94–95.
18. This paragraph references “Avro Arrow Next to Indispensable to NORAD, Air Marshal Indicates,” *Globe and Mail*, November 25, 1958, 1; McLin, *Canada’s Changing Defense Policy*, 62–63; and Canada, Library and Archives Canada (LAC), RG2, “Air Defence Requirements; Recommendations of Cabinet Defence Committee” series, volume 1,899, August 28, 1958, reproduction copy number 17,438, 8, <http://www.bac-lac.gc.ca/eng/discover/politics-government/cabinet-conclusions/Pages/item.aspx?IdNumber=17438>.
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38. McLin, *Canada's Changing Defense Policy*, 84.
39. Smye, *Canadian Aviation and the Avro Arrow*, 80.
40. Air Marshal Hugh Campbell and Major-General George Pearkes to Prime Minister John Diefenbaker, April 2, 1959, Saskatchewan Council for Archives and Archivists, http://scaa.usask.ca/gallery/arrow/view_image.php?image=75.
41. This paragraph references Peter Zuuring, *The Arrow Scrapbook: Rebuilding a Dream and a Nation* (Dalkeith, ON: The Arrow Alliance, 1999), 127; and Stewart, *Shutting Down the National Dream*, 276.
42. Jeff Rollings, "The Day the Avro Arrow Died," *In the Hills*, March 21, 2009, <https://www.inthehills.ca/2009/03/the-day-the-avro-arrow-died/>.
43. Rollings, "The Day the Avro Arrow Died."
44. This paragraph references Barton C. Hackett and James M. Grimwood, *On the Shoulders of Titans: A History of Project Gemini* (Washington, DC: NASA Scientific and Technical Information Office, 1977), 30; and John D. Hodge, "John D. Hodge Oral History," interviewed by Rebecca Wright, Johnson Space Centre, accessed August 13, 2018, https://www.jsc.nasa.gov/history/oral_histories/HodgeJD/HodgeJD_4-18-99.htm.
45. Scott Maple, "Jim Floyd Chief Engineer of the Canadian Avro Arrow Receives Canadian Air & Space Award," YouTube, accessed June 24, 2018, 13:45, <https://www.youtube.com/watch?v=-gPjOTxajVM>.
46. John Hodge, interview with author, August 26, 2018.

BOOK REVIEWS



A HISTORY OF THE MEDITERRANEAN AIR WAR 1940 – 1945 VOLUME FOUR: SICILY AND ITALY TO THE FALL OF ROME, 14 MAY, 1943 – 5 JUNE, 1944

By Christopher Shores and Giovanni Massimello

London: Grub Street Publishing, 2018

696 pages

ISBN 978-1-91162-110-2

Review by **Chris Buckham**

This book is the fourth instalment in a comprehensive review of the air war in the Mediterranean theatre of operations. The previous books provided a phenomenal foundation for anyone interested in this period of the war. Building upon that base, volume four advances the narrative outside of the North African theatre and into the invasion of Sicily and the Italian mainland. Christopher Shores and Giovanni Massimello maintain the depth of detail and vast scope of research that they, alongside their colleagues, have brought to their previous works.

The narrative structure appeals to both the serious historian and the casual reader. The period covered by the book is broken into daily instalments. A synopsis of the each day's events, from both the Allied and Axis perspectives, is followed by a meticulous breakdown of Allied claims and losses (with as much detail relating to the event as possible) and a similar synopsis of Axis claims and losses. The claims section is subdivided by nationality to provide additional details. A fascinating element to this side-by-side presentation of information is that the reader can compare claims and casualties by each side and appreciate the deltas between the claimed kills and the actual losses. It indicates the gradual but inexorable tipping of the balance away from the Axis air forces that Germans claim to have lost to flak—as opposed to aircraft combat.

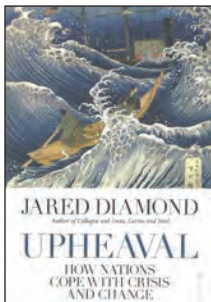
What sets this book—and the series as a whole—apart is the depth of research and detail captured by the authors. It is truly remarkable that, even with the loss of veterans over time, so many details and personal elements are still captured. One begins to better recognize the resilience of the Axis powers, even as they are forced out of mainland Africa, to resist the ever-increasing power of the Allied air forces. Furthermore, the authors include numerous examples of individual operations that provide a great deal of insight into the tactics and challenges unique to the Mediterranean theatre of operations.

The pictures and narrative also provide a sense of the adversaries' spirit despite the pressures of combat and loss. One gets a real understanding of the coping abilities and mental strength of the individuals involved in this war. Further, the African theatre of operations has been described as one of the few "wars without hate" in the Second World War. The implication is that, with the absence of significant collateral-damage targets, there was less of a negative emotional component to the fighting and a great deal more respect for one's adversaries, leading to an ability to appreciate their company once the fighting was over. However, one is also left with a sense of hostility in the environment within which these forces clashed. A crash caused by combat, mechanical failure or becoming lost over water or over the desert frequently led to a slow and lonely demise. Very rarely were searches performed.

Some of the more fascinating aspects of the book include the photo montage and narrative surrounding the sinking of the Italian battleship Roma by Kampfgeschwader 100's Dornier Do 217s using the PX1400X "Fritz X" radio-guided weapon systems. The book includes a detailed account from crew of the two aircraft that undertook the strike. It makes for absorbing reading and speaks to the advances in air-to-ground/sea weapon systems. The PX1400X is a little-known system that was guided remotely via an onboard camera from its launch aircraft to the target. Launched from seven kilometres away, the "mothership" was impervious to anti-aircraft fire. In the case of the Roma, the attackers escaped without a scratch.

Grub Street Publishing has once again produced a book of the very highest quality. The print is a bit small, but the layout is clean and clear. The photos have been reproduced with astonishing clarity, many of which are very rare or have never been published before. The variety of aircraft types presented in the book really emphasize the challenges to the support elements of the different nations involved. Overall, this work provides an outstanding and overarching perspective of the air war in the Mediterranean. It is very strongly recommended for those looking to gain a deeper appreciation of the Mediterranean theatre.

Chris Buckham served in the RCAF as a logistics transport officer for 33 years. Highlights of his career include serving almost 11 years abroad and 5 years with Canadian Special Operations Forces Command, as well as assuming the roles of equerry to the Queen and exchange officer with United States European Command. He now works as a project manager contractor with the RCAF.



UPHEAVAL: HOW NATIONS COPE WITH CRISIS AND CHANGE

By Jared Diamond

Boston: Little, Brown and Company, 2011

500 pages

ISBN 978-0-241-00343-5

Review by **Lieutenant-Colonel James Pierotti**

Some books take you on strange journeys through fact and history, leaving you with lots to think about after putting them down. *Upheaval: How Nations Cope with Crisis and Change* by Jared Diamond is one of these books. Its premise is that the trajectories of dealing with a personal

crisis can be used as a way to measure success or failure for national crises. The author uses twelve factors related to the outcomes of personal crises to look at six global crises. He then applies this lens to the world to see what might need to be done to resolve ongoing crises. The Royal Canadian Air Force can learn from a journey such as this one to increase its understanding of the world around us.

Jared Diamond is the Pulitzer Prize-winning author of *Guns, Germs, and Steel: The Fates of Human Societies* and *Collapse: How Societies Choose to Fail or Succeed*. These multidisciplinary works were both bestsellers that mixed history with many other fields of study, and his newest work is similar. Diamond has extensive knowledge in diverse fields and conducts research in countries all around the world. In addition, he has a very engaging writing style that vividly draws the reader into his world.

The strange part of the journey is Diamond's use of personal experiences with all the countries involved to paint a colourful narrative of the crises and their resolutions. In the prologue, he states, "The earliest memory that I can date is of Boston's Cocoanut Grove fire, which happened just after my fifth birthday. Although (fortunately) I was not at the fire myself, I experienced it second-hand through the frightening accounts of my physician father."¹ These personal anecdotes worked far better than I expected, as they conveyed deep emotions from one individual's experience on the sidelines of nation-shaking events.

The aim of this book is to take a well-known framework of factors related to personal crises and rework it to fit a national framework. Some of the factors used include a national consensus that one's nation is in crisis, honest self-assessment, dealing with national failure and situation-specific national flexibility. These, along with eight other factors, form the framework used at the end of each chapter to gain insight into six nations during times of crises. The cases examined are Finland during and after the Second World War, Japan in the 1850s, Chile after 1970, Indonesia's creation, Germany's rebuilding after 1945 and Australia's journey of self-discovery. The second half of the book is devoted to crises underway in Japan, the United States and the world at large.

All chapters end with a return to the analytical framework, but it does not always feel natural or applicable to the nation's narrative. I struggled to see the personal-crisis framework's relevance to some nations as well as its utility in understanding ongoing national crises. At the end of the book, Diamond acknowledges the limitations of his work with this: "My sample of nations is not only small, but also selected non-randomly. I selected those countries not because they offer a random subset of the world's 216 nations, but because they are drawn from the countries that I know best."² This means that the analysis presented is limited in scope and needs considerable empirical data to make the framework more useful, and the author readily agrees. He intended this work as an entryway into more research to further explore the linkages described.

A pleasant surprise came in his insider's look at the problems currently plaguing the United States and how they came about. For those of us watching the heated and polarized activities of our southern neighbours, the end of this book provides much to learn about where the world is headed and what problems need to be solved. This insight is supported by facts and figures that put an interesting spin on our current world. Another aspect I enjoyed was an analysis on the role of leaders at the national level and how they did or did not differ from the perspectives and ambitions of the people they led.

Overall, while there is little new material here, Diamond covers crises in the world that I was unfamiliar with; I learned a great deal about Australia, Indonesia and particularly Chile. I do not believe that the use of the personal-crisis matrix provides a framework that is more than passingly useful to understanding a nation's trials and tribulations. However, this intriguingly strange journey through the eyes of someone who has witnessed much of what he discusses makes this a very worthwhile read. If you wish to learn more about national crises over the last 150 years—and about the crises affecting the world right now—upheave your day and enjoy this highly relevant and recent book.

Lieutenant-Colonel James Pierotti is an air combat system officer with 4,500 tactical-airlift and search-and-rescue hours on the CC130 Hercules. He is an author of Canadian search-and-rescue history and currently teaches joint targeting at the NATO School Oberammergau in Germany.

NOTES

1. Jared Diamond, *Upheaval: Turning Points for Nations in Crisis* (Boston: Little, Brown and Company, 2011), 3.
2. Diamond, *Upheaval*, 456.



SUBMISSIONS BEING SOUGHT FOR THE J. A. WILSON AIR POWER AND HISTORY ESSAY CONTEST

The Royal Canadian Air Force Journal is pleased to assist the RCAF Heritage Fund (RCAF HF) in announcing the first annual J. A. Wilson Air Power and History Essay Contest. The top prize in the contest is \$1,750, with the runner-up garnering \$750.

ESSAY TOPICS

The essay contest is open to individuals who produce a well-researched, scholarly paper relating to one of the following subject areas:

- a. Canadian military aviation—history / historical operations;
- b. the RCAF and national security;
- c. RCAF policy and doctrine;
- d. RCAF organizational and development issues;
- e. RCAF operations;
- f. the RCAF and equipment acquisition;
- g. Canadian space policy and issues;
- h. Canadian air defence and sovereignty-policy and issues; and
- i. Global air and space power issues (e.g., coalition operations, air policing, future aviation technology, space).

Questions concerning the suitability of a topic should be referred to the RCAF Chief Historian, Dr. Richard Mayne, at Richard.Mayne@forces.gc.ca.

SUBMISSIONS GUIDELINES

The following guidelines shall be followed for all submissions to the J. A. Wilson Air Power and History Essay Contest:

- a. Submissions may be made in either of Canada's two official languages.
- b. Submissions are to be between 3,000 and 5,000 words in length, not including endnotes/footnotes.

- c. Submissions are to be written in accordance with the conventions of *The Chicago Manual of Style*.
- d. Authors should follow *Concise Oxford English Dictionary* or *Le Petit Robert* spelling conventions.
- e. Essays should be submitted digitally in Microsoft Word or rich-text format.
- f. All supporting tables, images and figures that accompany the text should be sent in separate files (i.e., not embedded in the text). Original vector files are preferred; high-resolution (not less than 300 dpi) .psd or .jpg files may be submitted.
- g. Copyright permissions are required for all material that is not Department of National Defence (DND) or author originated.
- h. The author must include a brief biographical sketch (not more than 250 words) that includes their current position/occupation and contact information (telephone number, email address).

SUBMISSION DEADLINE AND DETAILS

Submissions to the J. A. Wilson Air Power and History Essay Contest are to be sent to the RCAF Chief Historian at: Richard.Mayne@forces.gc.ca and should include the contest name in the subject line. Entries must be received no later than Friday, June 4, 2021. Late submissions will not be considered. Essays must be original. Those that have been published elsewhere will be rejected.

Submissions will be vetted by the RCAFHF. Selection criteria for essay prizes are subjective in nature and are solely based upon the RCAFHF committee's opinion as to the applicability and utility of the submissions in furthering Canadian air power and historical studies. Individuals whose submissions are not chosen will be notified via email.

Winning authors agree that the right of first refusal for the publication of their essay will rest with the editor of the *Royal Canadian Air Force Journal*.

BACKGROUND

John Armistead Wilson was born in Scotland in 1879, trained as an engineer, and moved to Canada in 1905. Although he was not an aviator himself, he was heavily involved in the formation of the Royal Canadian Naval Air Service. He was a key figure in the formulation of the Air Board Act of 1919 and most post-war aviation policy for Canada. While he was dubbed “the Father of Canadian Civil Aviation,” the policies he spearheaded ensured the mechanisms and political support essential for the successful creation and eventual growth of the RCAF. He was inducted as a member of Canada's Aviation Hall of Fame in 1974, twenty years after his death. He is generally regarded as one of Canada's first “air-minded” thinkers.

The RCAF HF is an independent organization designed to promote and preserve Canadian military aviation history and heritage projects that have difficulty finding support from other sources.