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**THINGS MAY PLAY OUT DIFFERENTLY:
THE INFO-SPHERE DEFENCE FORCE**

By

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About the Author

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INTRODUCTION

> Of course it is not meant to be implied...that the limit of an infinite sequence or of a function always exists. In particular cases it may happen that there is no limit of an infinite sequence...[1]
>
> Alonzo Church

> Unless soldiers and statesmen, diplomats and arms-control negotiators, peace activists and politicians understand what lies ahead, we may find ourselves fighting - or preventing - the wars of the past, rather than those of tomorrow.[2]
>
> Alvin and Heidi Toffler

Let us test the limits of our thinking about the future of air power with a *koan*: if manned airplanes created air power and air forces, will manned airplanes destroy both? My distinguished colleagues have shared a variety of visions, paying particular attention to the role that technology might play in the future of air power. While there is much meritorious in what they have said, since many of them ought to be - in one way or another - in a position to help chart a course for air power, we need to consider another possibility: *Things may play out differently*. The course I wish for you to consider is that in the information rich Third Wave[3] states and groups of the future that seems to be emerging, manned atmospheric attack platforms may have very dim prospects. In fact, their prospects may be as dim as the ability of today's atmospheric air forces to contribute to combat and conflict resolution in the far future. It may be romanticism, not realism, that binds air forces to the atmosphere.[4]

The highest and best use of military power has always been to help political leadership and military surface forces meet their objectives. Attack operations in the atmosphere probably will be necessary in the future, but these operations need not use manned aircraft, need not use aircraft, and may not even require 'air forces' as separate services. The next evolution of air power may not be the further exploitation of manned flight through the atmosphere or space. Rather, what follows today's air power may not be built on the linear extension of the species 'airplane', no matter how fancily or expensively evolved the breed, but on information. Thus, things may, and perhaps ought to, turn out much differently than we envision today.

How can I say this? I can say it because it should be as obvious to the air power theorist as it is to the gambler that 'the future' is as unknowable as it is beyond our ability to control. This is disappointing for those steeped in the old science who would clarify, simplify, and bound the genuine complexity of the real world with the cold and artificial theory derived from the science of times past.[5] One's linear projections,

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[1] Alonzo Church in Runes, Dagobert D., (ed) *Dictionary of Philosophy*, Littlefield, Adams and Company Totowa NJ, p 169.

[2] Toffler, Alvin and Heidi, *War and Anti-War: Survival at the Dawn of the 21st Century* Warner Books, New York 1993, p 268.

[3] Toffler, Alvin, *The Third Wave*, William Morrow and Company Inc, New York, 1980.

[4] I am grateful to Dr Libicki for allowing me to adapt our co-authored work. These remarks were derived, in part, from Szafranski, Richard and Libicki, Martin C., '...Or Go Down in Flame?', *Air Power Journal*, 10:3, Fall 1996.

[5] See Stacey, Ralph D., *Managing the Unknowable: Strategic Boundaries Between Order and Chaos in Organizations*, Jossey-Bass Publishers, San Francisco, 1992; Gleick, James, *Chaos: Making A New*

another's trend extrapolations, and someone else's immodest imaginings ultimately may have the same validity, the same predictive power. That is, accuracy residing somewhere in a sequence that runs from none, or zed, all the way to zip. It is a delusion, no matter how comforting, to believe that one can forecast where air power will go 20 or more years hence. It is self-deception, and in large and generously funded organisations, self-deception on the grandest scale, to believe that since air power's platforms reify air power, the future of air power can be 'planned' and 'managed' year by year far into the future merely by managing the acquisition of platforms.[6] Rather, we must consider the possibility that there are a number of plausible futures wherein complexity creates all kinds of disequilibrium, and disequilibrium drives us off the comfortably chartered linear path.

AIR POWER IS ABOUT WARFARE, AND WARFARE IS EXTREMELY COMPLEX

We airmen should begin to listen more closely to our critics. Armies and navies and naval infantry fault air power's advocates for forgetting what air power ought to be about. It ought to be, these critics assert, about helping resolve conflict on the surface, at the seat of purpose on our planet. Air power began because of problems on the surface, and air power atrophies, they chide us, when it becomes so detached from the mud, blood, and complexity of operations on the surface that it promises the ability to resolve multi-layered and multi-attribute conflict by simple, bloodless, technological, and remote control. Douhet begot Mitchell and Mitchell begot Harris and Harris begot another, who begot yet another, in a long line of fragile theorists whose air power promises never seem to quite be fulfilled.[7]

Air power theories, distilled to their essence - and we have heard them repeated here - assert that methodically breaking things and killing people from the air, whether deep in the enemy rear or at the point of invasive intrusion, can reduce surface combat. This is so obvious as to be as unarguable as it is unremarkable. But do they do this by fracturing the mechanical integrity of the enemy warfighting machine or 'system'? Can they even end the war? There are 'pre-hostility' and 'deterrence' variants of the theory, of course, but they many children have the same lineage. The true test of theory is not merely explaining what happened, but the ability to accurately suggest or even predict what might happen. Air power reduces surface combat, but more

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Science, Penguin Books, New York, 1998; and Gary Zukav, *The Dancing Wu Li Masters: An Overview of the New Physics*, William Morrow and Company Inc, New York, 1979.

[6] Air power's platforms do not, of course, reify air power. This fallacy and its implications are thoroughly examined in Builder, Carl H., *The Icarus Syndrome: The Role of Air Power Theory in the Evolution and Fate of the U.S. Air Force*, Transaction Publishers, New Brunswick, NJ, 1994.

[7] Warden III, John A., *The Air Campaign: Planning for Combat,* National Defense University Press, Washington DC, 1988. See also Warden III, John A., 'Air Theory for the Twenty-first Century', in Karl P. Magyar (ed), *Challenge and Response: Anticipating US Military Security Concerns*, Air University Press, Maxwell AFB AL, 1994, pp 311-318; and Warden, 'Employing Air Power in the Twenty-first Century', in Schultz, Jr, Richard H.. and Pfaltzgraff, Jr., Robert L., (eds.), *The Future of Air Power in the Aftermath of the Gulf War*, Air University Press, Maxwell AFB AL, 1992, pp 64-69. See also Ware, Lewis, 'Some Observations of the Enemy as a System', *Air Power Journal* 9:4, Winter 1995, pp 87-93.

elaborate theories understandably seem to have trouble both explaining and predicting.

When challenged, air power's advocates have historically responded that the fault lies in other's failure to perfectly understand or perfectly apply the air power theory of the day. We failed to bomb the power grid and went after submarine pens, so production did not decline. We went after the coastal and inland transportation network, so production of war material increased. We failed to centralise control of air power, so the enemy exploited us. We filed to bomb the capital or the sanctuary, so the war raged on in the jungles and on the trails. We failed to complete the elements remaining in the master attack plan, so a big bad actor endured. And so on. As an aside, it seemed to me that the confusion, especially in Washington, regarding the utility of bombing this miscreant or that has never been higher. The confusion always seems to pivot on the question: 'After the bombing, what?' Neither teleological nor mechanical air power theories provide answers. Vindication of one air power theory after another eludes us because events in the real world of warfare always seem to inhibit us from following this or that piece of theoretical advice. And so we move from theories of pressure, and control, and coercion into the mumbo-jumbo of paralysis, and aerial occupation, and halt, to whatever comes next. All the while, the sailor and the soldier find this pre-occupation with theory as self-serving as it is silly.

They find it silly because conflict and warfare seem to be rather complex, messy and permanent features of the human condition. They find it silly because many airmen do not seem to comprehend that humans live and work and fight on the planet, and that they usually fight about something relating to the planet. They find it silly because people have no evidence that people will not always fight on the surface of the planet in the future. Fighting, Keegan tells us, is viewed s being full of 'moral consolations,' including 'the thrill of comradeship, the excitements of the chase, the exhilarations of surprise, deception and the *ruse de guerre*, the exaltations of success, the sheer fun of prankish irresponsibility',[8] Sad as it may be, people seem to like to fight.[9] And these people need not be organised into states. They can be brigands or terrorists. There seem to be a nearly infinite number of ways in which humans can organise to hurt one another.[10] Theory is fine if it enables us to explain and predict better, but the evolutions and revolutions in warfare are not easily predictable. Warfare is about humans. Humans are wonderfully creative and innovative. Their fighting has never depended on the tools they choose to employ. Thus, specific and formulaic defeat mechanisms are hard to envision. It seems to take a combination of things, and the application of air power's *Mors ab alto* is only one thing in the formula.

If this is so, then we must accept that air power may be unable to stop people on the surface from fighting, and that air power alone cannot deter, resolve or terminate the fights that will occur. To promise that air power can prevent surface forces from having to be engaged or to shed their blood is an intriguing promise, but I think, an empty one. Adhering to it carries three embedded penalties. First, it may consume

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[8] Keegan, John, *The Illustrated Face of Battle: A Study of Agincourt, Waterloo and the Somme,* Viking Penguin Inc, New York, 1989, p 285.

[9] O'Connell, Robert L., *Ride of the Second Horseman: The Birth and Death of War*, Oxford University Press, New York, 1995, pp 82-83, takes a different view. See also his *Of Arms and Men: A History of War, Weapons, and Aggression*, Oxford University Press, New York, 1989.

[10] We should ask the air power theorists whether or not the Hutu and Tutsi were engaged in warfare.

much more treasure in promising that less blood will have to be consumed. Air power's tools have never been inexpensive. Said another way, because the markets for B-2s and F-22s are somewhat limited, production runs necessarily will be smaller and cost higher. Investment in these kinds of tools, if they are not demonstrated to be necessary, may prevent us from making some necessary investments in the modernisation of surface forces and the tools they employ directly or indirectly. Second, if warfare is becoming transformed, to use van Creveld's words, then the same transformation that erodes the geographical distinctions between front and rear and the operational differences between regular and irregular, may also deny attack air power its focus and purpose.[11] The third penalty, and the one to which we must now attend, is that 'the air' is no longer the operational high ground of our forebears.

Air forces were founded on the belief that mastery of the technology of manned flight would allow a nation to leap over World War I's bloody stalemate and strike a crippling strategic blow deep into the vital cogs and gears of the enemy's war-fighting machine. Air - the atmosphere - became the high ground. Command of the air, the nascent theorists promised, made victory everywhere else only a matter of dogged will and time. In the first interwar period, and we are in another, this technology was reified in manned aircraft. Manned, because only the human body had the physical strength, sensors and computing power to manhandle flying machines and accomplish air power's chores. Technology has evolved in 70 years. The slightest fingertip pressure can now move flight control surfaces. Moreover, sensors, computers, energetic materials and the means to transport them no longer require that a human body be present in the air over the fray. The technology of operating in the air was the old problem. The air no longer requires the presence of humans to attempt to assert control. The need for humans on the surface, however, remains.

If we look more closely at air power theory, we find that implicit in it is the belief that it is better to strike some things on the surface than others, and that striking the right things can achieve more profound effects than striking the wrong ones. Information has always been at the heart of the problem. Information also is the new and future problem. In the baldest terms, if you have more and more unimpeachable information about the enemy than the enemy has about you, then only modest applications of precisely aimed, correctly timed force suffice to affect the surface battlespace. To the degree that air forces were or are about operating in, or attempting to control the high ground, then the new high ground is not the air or space or even aerospace, it is cyberspace. Understood in its broadest sense, cyberspace is the confluence of all the various bits and information streams which, taken together, generate the strategic topsight prerequisite for the effective operations that lead to success on the surface. By history, predilection, and structure, topsight is the natural - but not automatic - domain of air forces. For an air force to stake its claim to operations affecting tomorrow's high ground, that air force would need to redefine itself as an infospheric institution rather than an atmospheric one.[12] This redefinition, of course, is problematic and, to today's airmen, paradoxical.[13]

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[11] Van Creveld, Martin, *The Transformation of War,* The Free Press, New York, 1991, pp 196-205.

[12] This is the soul of the air power 'manifesto' that Dr Martin Libicki and I wrote two years ago.

[13] It is neither problematic nor paradoxical to the cohort upon which the future of air power depends. See Tapscott, Don, *Growing Up Digital: The Rise of the Net Generation*, McGraw-Hill, New York, 1998, pp 231-234, 255-305.

Understanding the implications of this proposed transformation requires returning to first principles. The mission of air forces is not merely what they do - tending toward air and space operations - but what they contribute. What they contribute is what they originally and always contribute: vantage and topsight. It is vantage and topsight that allow air power to determine how to operate strategic effect. Knowing how to transport mass or energy to targets - plinking tanks, sinking ships, or flattening cities - has its time and place. Yet these operations are, *and always have been*, a subset of *knowing* how to get and efficaciously use knowledge to confound or terminate the production, distribution, and, increasingly, the enemy's ability to control its sources and methods of creating and applying its military strength. Technology permits ends - temporary strategic superiority - to be achieved using many tools: space-based, atmospheric, ground-based, and maritime systems, both manned and unmanned. If a separate air force exists for strategic purpose, then the knowledge or information derived from vantage, rather than any one attack method, becomes central. 'Central' to the degree that it is a rationale for an air force to drop its atmospheric orientation in favour of an infospheric one.

Just as air forces were born to exploit the technology of flight, they must now evolve to capitalise on the technologies of sensing and knowing. Our notions of the 'high ground' must change as air power theorists begin to accept the *coup d'oeil* as the peer to and enabling means for the long-cherished *coup de grâce*. I am not arguing here that air forces adopt the trendy profundity and modernity of 'information warfare' as their primary mission. The full gamut of information operations may work well against high-end foes, but enemies with no infrastructure to disrupt would leave an information warfare air force without the ability to contribute much. I am, however, arguing that vantage and topsight to harvest information are so much more important to air power than merely overleaping the trenches that all air forces will move in this direction. Denying an adversary vantage and topsight in cyberspace is a critical future mission, but not the sole mission, of the 'air forces after next.'

THE NEED FOR CLEAR THINKING

How does the vision of operating in, even seizing and controlling, the new high ground of cyberspace harmonise with the vision of the surface forces? There are at least two problems: vision and complexity.

VISION

Vision today is part of the problem. In the United States, *Joint Vision 2010* was designed to scan the strategic horizon, define ways for the smarter application of joint force, and thereby inform the still-separate 'visions' of the separate services. It aimed for a modernised understanding of unchangeable aspects of fighting. Yet, if one acquires an electronic copy of the document from the web and edits it to remove the adjectives and adverbs, *Joint Vision 2010's* lack of vision is astounding. Will there be precision strike in the future? Yes. Will one side strive to have greater awareness than the other? Of course. Would it be efficacious if joint forces could envision and engineer the dominating manoeuvre? Absolutely. Do focused logistics facilitate resupply in ways that unfocused or defocused logistics do not? Unremarkably so.

There is nothing really new here: Alexander, the Great Khan, and Napoleon would applaud these attributes, finding them familiar.

What is left unsaid, though, may matter more. Technology has increased the range of weapons and the precision with which they can be applied. Thus, *any* force, unless arbitrarily and unnaturally constrained, can strike deep. Any force can operate manned or unmanned aircraft.[14] Today, neither legislation nor downsizing makes jointness necessary as much as does the tendency of every service's or force element's target acquisition and prosecution systems to overlay and overlap. Since everyone can seize a piece of the action, everyone seizes a piece. Armies and navies purchase remotely piloted vehicles to be operated by sergeants and apprentice seamen. Smart cruise missiles, dumb and numb to the threats posed by air defenses or capture, go fearlessly into the fray. A consequence of technology is that the battlespace has become as indivisible as the cyberspace. It can no longer be divided into neat domains and parcelled out to each service to fight its own war - navies in the littoral, armies in the fields, and air forces high and deep. They just keep getting in each other's way. A future air force, if we conclude there are to be air forces in the future, is obligated to add its value by envisioning how operations can be conducted best in the totality of the battlespace. Anyone can strike things. Who will take responsibility for knowing which ones need to be struck, or modified, or ignored?

At the heart of a vision for the air forces of the future must be awareness of the need for a vast, interconnected, interoperable, and ultimately integrated information system, the arteries and capillaries of an 'organism of organisms.'[15] This would be an information system to which all forces contribute and from which they all draw. Air forces need not and indeed cannot populate the entire organic construction of various pieces being built, tested, used, refined, reused, swapped out, and retired in their turn. What air forces can and must do, however, is envision what this information organism must do and the organic architecture that enables it. Anybody can own a long range cruise missile or a remotely piloted vehicle, and many non-air force entities (including criminals and terrorists) will. But, stewardship of the brains of the organism of organisms is the aspect of controlling and exploiting the high ground the differentiates

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[14] *PR Newsletter*, 'First Student Military Operators Conduct Flight Demonstration of an Outrider TUAV', 3 March 1998. 'The first student military operators of Alliant Techsystems' (NYSE: ATK) Outrider (TM) Tactical Unmanned Aerial Vehicle (TUAV) conducted a flight demonstration of the Outrider air vehicle for approximately 200 Alliant team members, government officials, and representatives from the U.S. Army today in Hondo, Texas.'James Wilson, regional director for U.S. Senator Phil Gramm, R-Texas, reaffirmed the importance of the Outrider system to U.S. combat forces. 'In the battlefield of the 21st century, combat information systems will prove to be pivotal in determining the outcome of conflicts', said Wilson. 'The Outrider TUAV will provide our military forces the necessary tactical and strategic edge, without risking a single American life. Senator Gramm is very proud that operator training for the Outrider is being conducted in Texas, continuing this state's historic commitment to our national defense.' Speaking to the student military operators, B.J. Blanks, assistant district director for U.S. Representative Henry Bonilla, R-Texas, 23rd District, said the Outrider TUAV holds the promise of revolutionising the battlefield. 'It will give us the capability to see the enemy when the enemy cannot see us,' said Blanks. 'Each of you will play a vital role in making this a reality. Our congratulations for all you have accomplished, and our thanks for all you will do to make the Outrider a key part of tomorrow's military. America's military forces are number one because of dedicated soldiers and Marines such as you.'

[15] This organism-of-organisms description is meant to underscore the differences between this notion and the somewhat more mechanical one of 'system-of-systems'. It is the fact of organism that renders this construction so complex and so dependent on trying to capitalise on its emergent properties.

next-generation infospheric air forces from today's air forces. Today's air forces, I fear, may be slowly yet inexorably petrifying themselves in the amber of much more expensive, slightly faster, slightly stealthier atmospheric operations. An infospheric air force possesses capabilities which lock out most would-be competitors to the degree that it makes their air and surface forces much less competitive with ours.[16]

Weapons for this infospheric variant of today's air forces do not disappear. An 'armed' force with information but no means to convert it into striking power is pointless. An infospheric air force must have faster means of energy delivery. The weapons of an infospheric air force will be real-time engagement weapons ranging from lasers to neutral particle beams and high-powered, focused microwaves. Today's sensor-to-shooter paradigm is hopelessly outmoded for an infospheric air force. Such an infospheric force will need a sensor-to-warhead model and speed of light command and coordination for speed of light weapons.[17] A vision that sees next year's fighter as a line extension of last decade's one, and consumes nearly every penny of its dole to get it, may be a poor vision indeed. But clear thinking illuminates complicated challenges and clear opportunities.

COMPLEXITY

The new sciences illuminate how incredibly complex the real world is, in spite of our best efforts to bound the complexity. Single things seem to be part of one or more systems, and systems are vast and interconnected organisms that defy mechanical analogs. They have emergent properties that can neither be predicted nor controlled. Thus, it is impossible to change only one thing.[18] To change the orientation of an air force or an army requires changing many, many things. Thus, we should not be surprised that the United States 'Army After Next' is beginning to look like the United States Marine Air Ground Task Force of today, albeit more technologically marvellous. Nor should we be surprised that an air force oriented on operations in the cyberspace requires different organisation, training, and equipment.

Airmen and sailors put on terrible parades. Why? Because in air forces and navies the ability to march hither and yon in ranks and files merely is an artifice for instilling teamwork and discipline. Marching has nothing to do with what airmen or seamen

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[16] An earlier version of this paper read 'makes their air and surface forces noncompetitive with ours'. Lieutenant Colonel Leonard A. Blasoil, USMC, wrote 'Whenever I hear absolute terms applied to warfare ('lock out *all* competitors') I start to twitch. We'll never lock them ALL out. The pesky old enemy, who is a thinking human (whether he's wearing a steel helmet, a fez, a straw cone hat, or a wood fedora) has a way of surprising us and challenging our dominance in ANY sphere. My favorite historical example is Dien Bien Phy, where an army which represented a nation without a state, which possessed not a single aircraft or pilot, managed to gain and maintain air supremacy over the one strategically critical portion of the battlefield, for the duration of the strategically critical period. Their feat of arms changed the world'.

[17] To really test the limits of thinking, technology, and concepts of operations, envision what it would take for a self-serving target system. That is, a system so vast and fast that to misbehave was to have a weapon or engagement system automatically allocated and applied.

[18] Robert Jervis does a superb job exploring the implications for scholars and political scientists. See Jervis, Robert, 'Complexity and the Analysis of Political and Social Life', *Political Science Quarterly*, 112:4; Winter 1997-1998, pp 569-593.

contribute to warfare or security or national power. Young airmen and sailors realise this, but the hierarchies that control them do not. These hierarchies, adopted from the army, have their roots in autocracy, mass, and the phalanx, with 'modern' embellishments provided by Frederick, Napoleon, and the pre-World War I German general staff. All these guys are dead, but we keep them alive in air forces still timidly struggling for the acceptance and legitimacy that we believe only the ground forces can grant. We seem to be unable to envision and generate the alternative forms of training and education in the particular kinds of teamwork needed for the airman's art. Why can we airmen not have all-officer air forces? The Norwegians do.[19] Why can't enlisted airmen 'fly' satellites or airplanes or stand alert with ballistic missiles? Why can we not envision organisational structures that look more like Information Age networks than Industrial Age armies? Yet, it may be that even the United States Army accepts that its vision of 'Force XXI,' the Next Army, will require soldiers and a human resources system that:

> ... emphasises risk-taking and participative decision-making behaviours in order to engender adaptability. Similarly, it relies more on self-managed soldiers, requiring them to assume greater responsibility.[20]

Likewise, the United States Marine Corps understands that the Marine of the future must be more empowered than the Marine of today. The Marines assert that networks, implicit communications, and intuitive or naturalistic decision-making will change today's notions of command 'and control' and differentiate tomorrow's Marines from today's.[21]

There are opportunities embedded in testing the limits of our own thinking by squaring up to these challenges. One of the opportunities is that we could greatly expand the recruiting base for air forces. Carl Builder suggests that in democratic states the ability to serve the state in the armed forces is, at its heart, a social issue.[22] Thus, in the United States, for example, more and more minority groups are integrated: first black, then women, then homosexuals. The armed forces always seem ill-ready for these natural expansions of democratic inclusion. Builder envisions that the next group to press for integration will be the physically challenged. It is not the mission of air forces to run at or away from the enemy. Thus, the physical standards for airmen need not be the same as those for soldiers. Tomorrow's air forces could capitalise on the wealth of human talent that casting a broader recruiting net would allow. If organisation and training do not change in tandem with vision or equipage, then transforming the valuable contributions air forces can make is unlikely or impossible.

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[19] Alan Stephens pointed this out in a recent discussion.

[20] US Government, 'Rewarding, Organizing, and Managing People in the 21st Century: Time for a Strategic Approach', *Executive Report of 8th Quadrennial Review of Military Compensation,* Office of the Assistant Secretary of Defense for Force Management Policy, Government Printing Office, Washington DC, 30 June 1997, p 71.

[21] Working USMC DRAFT tentatively titled 'Beyond C2: A Concept for Comprehensive Command and Coordination of the Marine Air-Ground Task Force', 3 March 1998.

[22] Conversation with Carl Builder.

THE CONTRIBUTIONS THAT AN INFOSPHERIC AIR FORCE MAKES

What contributions? Martin Libicki and I suggested that technology and today's need to deter and defer major power rivalry would cause three new missions to emerge over the next quarter century: extended information dominance, global transparency, and strategic defence. While I think that information dominance and global transparency must be goals, they will remain goals, BHAGs, that cannot be attained assuredly.[23] Nonetheless, to pursue some lesser goals would deny us the chance of meeting greater ones. Technology both enables and requires that the information dominance sought by the United States be extended to its friends. Apart from rare, expensive, and always incomplete 'stealth,' tomorrow's battlespace will be far more transparent to both sides than today's. Everything creates a signature of some kind - be it sound, odour, contrail, pressure, movement, or twitches in the geometric environment. Every new bit illuminates the battlespace - whether discovering the tank in the weeds or the aircraft in the clouds - and, thanks to Moore's Law, the number of bits per buck has been doubling and will continue to double every 18 months. The more bits, the more illumination. Given a sufficiently dense covering of bits and the odds that enough of them will land on everything worth identifying increase. This is not purely a military phenomenon: indeed the most powerful forces for generating and disseminating information include the World Wide Web, the Internet, cheap and plentiful video cameras, commercial satellites, and the nearly do-it-yourself unmanned aerial vehicles (UAV). Exactly which capabilities appear when can always be debated, but the pattern is clear and may even be accelerated by fortuitous discoveries in the United States, in Europe, in China, or here.

We have only, for example, exploited a portion of the knowledge that we can exploit for sensing. Carl Sagan and Ann Druyan write:

> Bumblebees detect the polarisation of sunlight, invisible to uninstrumented humans; pit vipers sense infrared radiation and detect temperature differences of 0.01°C at a distance of half a metre; many insects can see ultraviolet light; some African freshwater fish generate a static electric field around themselves and sense intruders by slight perturbations induced in the field; dogs, sharks, and cicadas detect sounds wholly inaudible to humans; ordinary scorpions have microseismometers on their legs so they can detect in pitch darkness the footsteps of a small insect a metre away; water scorpions sense their depth by measuring the hydrostatic pressure; a nubile female silkworm moth releases ten billionths of a gram of sex attractant per second, and draws to her every male for miles

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[23] Collins, James C. and Porras, Jerry I., 'Building Your Company's Vision', *Harvard Business Review,* September-October 1996, pp 65-77. A 'BHAG' is a 'big, hairy, audacious goal.' The term is used in business to describe 10- to 30-year compelling visions for the firm. On page 73, Collins and Porras write:

> A true BHAG is clear and compelling, serves as a unifying focal point of effort and acts as a catalyst for team spirit. It has a clear finish line, so the organization can know when it has achieved the goal; people like to shoot for finish lines. A BHAG engages people - it reaches out and grabs them. It is tangible, energizing, highly focused. People get it right away, it takes little or no explanation.

around; dolphins; whales, and bats use a kind of sonar for precision echo-location.[24]

Our technology already captures some of the capabilities and survival-enhancing sensors of other species. Why would we not wish to learn more about the micro-anatomy that makes these capabilities possible? Submarine sonar is big and bulky and already whale-like, but might we not reduce its size and weight along the bat's or the dolphin's model? Are we not good enough scientists and chemists and engineers to steal and incorporate this knowledge? Asked another way, why clone a whole sheep? Perhaps we need only clone the sensory apparatus of other species? Consider this: In eighty years, there has been a *trillionfold* decline in the cost of calculation. If this rate of improvement were to continue into the next century, the 10 teraops [trillion operations per second] required for a humanlike computer would be available in a $10 million supercomputer before 2010 and in a $3,000 personal computer by 2030.

But can this mad dash be sustained for another 40 years? Easily! The curve... is not levelling off, and the technological pipeline contains laboratory developments that are already close to my requirements.[25]

Consider the environment that would or will exist if the world were populated with 'humanlike' computers. Why stop with humans? Should we not apply better and better instruments and information technology to suck from nature all knowledge and discover all the ways that all the species sense and know? Knowledge *is* power in the Third Wave, and our *hubris* suggests that we can unlock all the important secrets of nature. The computer, long the paradigm for understanding the organic process of the brain, probably will lose its favoured place as a model in the next 20 years and the organic processes of living sensors and processors will fuel the next level of advances in intelligent tools.

Thus, there is no great risk in asserting that in the future to be present is to risk being sensed by one phenomenology or another. The attendant revolution in precision guidance means, likelier than not, that to be sensed is to be engaged or even killed. Thus, to linger transparently is to court death. All this seems to favour defence over offence, since movement creates more and more easily discerned signatures than hiding creates Whether the infospheric air force is defensively inclined until it seizes the offence or not, the future most definitely favours those who can integrate the various information flows into a coherent picture of the battlespace rather than an opportunistic series of isolated appearances. Why shouldn't this be the infospheric air force that follows the atmospheric one?

In this environment, today's platforms simply cannot pass unnoticed en route to or when engaged in tomorrow's major fights. This fact, plus the current and apparently growing aversion to casualties in democratic and even in democratising states,[26] suggest that sending large numbers of young men and women to war against

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[24] Sagan, Carl and Druyan, Ann, 'What Thin Partitions...', in Solso, Robert L., *Mind and Brain Sciences in the 21st Century*', The MIT Press, Cambridge MA, 1997, p 31.

[25] Moraec, Hans, *Mind Children: The Future of Robot and Human Intelligence*, Harvard University Press, Cambridge MA, 1988.

[26] Larsen, Eric V., *Casualties and Consensus: The Historical Role of Casualties in Domestic Support for U.S. Military Operations*, RAND, Santa Monica, 1996.

secondary enemies need no longer be the expected behaviour of the armed forces or the states that control them. Secondary enemies are those who the citizens rightly or wrongly believe cannot possibly directly threaten the country. More and more frequently, greater leverage may come from empowering allies to do 'it' themselves, particularly when aided by the knowledge of an infospheric air force armed with the capability of over-the-horizon applications of energy. Empowering is a key concept; telling friends the location of enemy targets to within the blast radius of their ordinance permits them to defend themselves against larger foes tied to Second Wave parameters of force. The means by which friends are so empowered are the same bitstreams that feed the organism of information, whether information be packaged for delivery or ingested organically. Hence, the first mission: extend to friends the information advantage enjoyed by possessing an infospheric air force. Should they cease being friends, they can no longer drink from this font of information. Without information, they must fight without the advantage of topsight.

The pursuit of a global transparency mission naturally follows. The surest deterrence to any nation aspiring to hostile great power status may be the certain knowledge that it is under continual watch. Let a miscreant so much as contract for biological research, buy a fermenter, open a small factory in the desert, and somewhere, somehow, some part of the information organism knows. Anyone can then instantly train their boresights on the offender. This knowledge need not always be converted into engagement; its demonstration alone may dissuade. Police, for example, find that mere illuminating an armed robber with an aiming laser encourages instant, albeit episodic, disarmament. Thus, the second new mission of the armed forces: to instrument the world to transparency so that no country can misbehave in the dark.

The evil that lurks in the hearts of humans may hide still a few more decades, but not the means to convert evil thoughts into evil deeds.[27] Add the instant or extremely rapid wherewithal to denude will of means, and ill will becomes an aggravation instead of a threat.

The third mission, strategic defence, flows from the second. Over 90 per cent of trying to stop a ballistic or cruise missile is finding it. The same organic system that can arm an ally with information and make large parts of the plant transparent also can sweep the skies for air and space threats and dispatch their coordinates to whatever means are chosen for their engagement. If attack becomes pointless because it is doomed to

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[27] Connor, Steve, 'Science finds key to beating fear,' *The Times Newspapers Limited*, February 22 1998. If one can treat fear chemically, other opportunities present. As biochemistry and neuroscience develop, it may become possible to deter by inducing fear in an adversary. Connor notes:

Scientists found that the emotion of fear is biochemically manufactured in tiny pathways between nerve cells in a small, almond-shaped structure within the brain called the amygdala, which is thought to be central to the processing of other primal emotions.

A key finding is that certain connections between the nerve cells within the amygdala become strengthened when someone learns to fear something. This raises the rate at which nervous signals can flow through the brain's fear centre, and so increases the intensity of the emotion. In this way the scientists have shown that, emotionally, the brain can learn form experience.

Patricia Shinnick-Gallagher, professor of pharmacology and toxicology at the University of Texas, who led one of the two research teams, says it is the first time anybody has shown that the experience of fear has a physical impact on the wiring of the brain.

'I guess you could say we have described the set of fear in the brain.

'We can now determine the actual mechanisms underlying fear and can specifically design drugs to treat patients who cannot exert control over their fears,' she said.

be detected and defeated, then the defence apparently remains stronger than the offence.

THE SUMMONS TO INFOSPHERIC AIR FORCES

Those who would hold the new high ground need to attend to three activities that must become the *raison d'être* of tomorrow's air and space forces: (1) operating militarily in a transparent world, (2) understanding space, and (3) defending homelands from aerospace threats. Taken together, we may consider these needs as the inescapable facts of any plausible future. They are facts, not problems. A fact is something that cannot be changed. Problems arise from ignoring or trying to alter facts. Air and space forces must focus on the facts of the future and use them advantageously.

In a transparent battlespace, big things make ore kinds of signatures than smaller ones. Encasing a human in the life support system necessary to operate in the high atmosphere or in space requires plenty of weight and cube and even then may be frustrated by the high-G loads necessary for maximum agility. Remove the human body from the flight deck and combat air vehicles can surge ahead. The bandwidth to put 'space-derived data into the cockpit' can be redirected to contribute more effectively to other parts of the system. Data need to go to warheads, not task-saturated humans who also have to worry about staying straight and level, breathing, temperature control, urination, and, perhaps more importantly, capture and exploration Once the human is removed, small vehicles can quickly become very, very small and very, very fast and pose new problems to defenders. Once pilots are understood as information-processing components - and an infospheric air force would accept that naturally - the rational allocation of these functions between carbon and silicon can proceed more intelligently.

Central to a redefinition of air forces is what it means to be an 'airman'.[28] In World War II, a high percentage if airmen were subject to risk as air crewmen. Today's aircraft are far fewer and more efficiently manned. No more than a very small percentage of any nation's air force can be in the air at any one time. Upon how thin a base of pilots at risk can an air force rest? Yet, what would substitute as self-definition in an infospheric air force? How have other Services coped with similar requirements for change?

Armies, heavy and difficult to move, have no choice but to stay with the 'getting ready to get ready' template for combat consistent with the traditional cycle of initial response, built-up, counterattack, and consolidation. Perhaps a digitised army converts tanks to interactive simulators for 'virtual mission rehearsal' during the long, slow ride to 'build-up' or perhaps the short work transparency makes of tanks may be too frightening to contemplate. Either way, armour constitutes the skin rather than soul of armies. At its heart it is self-definition as the will of its citizens made manifest in force.[29] This force, in turn, is expressed by being on scene-today in a real context, but over time also in a virtual one. In the United States, the Marines have gone further than the Army in shedding weight: tanks are a burden that light, lethal agile forces may aim to shun. United States Marines plan to ride into the future on a self-definition that draws on the chaotic and complex context in which they ply their trade. A Marine is a human transformed into the transcendent rifleman. A Marine strives to be nothing more than a Marine. Similarly, navies are wedded to the sea before they are wedded to any instrumentality of mastering it. To command the seas and engage adversaries 'from the sea' is not necessarily to exert power with mass but to exert discrimination with energy - the medium remains the message for navies.

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[28] Although problematic to many reviewers of an earlier draft, "airman' is a good word. It anchors air forces after next to their roots, does not - like 'info-man' - sound goofy, and is superior to 'operator', a word that connotes 'snake oil vendor' to many. 'Operator' is a problem. Colonel Charles J. Dunlap Jr., USAF, 'Organizational Change and the New Technologies of War,' unpublished manuscript, raises an important question about 'operators'. Dunlap writes:

> Likewise the Air Force, probably unaware of the implications of its statement, has openly announced its intention to use civilians operationally. In *Global Engagement: A Vision for the 21st Century Air Force* the service states that 'combat operations in the 21st Century' will broaden 'the definition of the future operator'. It goes on to state that: 'In the future, any military *or civilian* member who is experienced in the employment and doctrine of air and space power will be considered an *operator*'.
> Once civilian technicians or contractors become involved in operations in a way that exceeds what was traditionally understood as mere support and fighting forces, they risk being characterized as 'unlawful combatants' under international law. Among other things, if captured unlawful combatants can be tried and punished for their hostile actions, even for the same things for which a uniformed combatant would be immune. It is very doubtful that many of these 'surrogate warriors' are cognizant of their new status or comprehend the ramifications of it.

Dunlap cites: Wilson, George C., 'Special Ops: Bosnia's best hope', *Army Times*, January 8, 1996, at 31 and Dennis Steel, 'The Human Touch: Civil Affairs in Bosnia', *Army*, April 1997. He notes that at 21, U.S. Special Operations Command has specific statutory authority to conduct training in foreign areas. *See* 10 U.S.C. § 2011. Some of these missions are 'medical capability' exercises that essentially provide basic medical services in less-developed nations. *See also* 10 U.S.C. § 401 *et seq*. (humanitarian and civic assistance funding authority), and Susan L. Marquis, *Unconventional Warfare*, 1997, p 239.

[29] In the United States, our Army sponsors, among other popular television shows, 'The Simpsons.' In its advertisements the U.S. Army defines itself not only as the world's best army, but the 'smartest' one. Would not the world's smartest army re-think the contributions that tanks and artillery could make in the future?

What then of air forces? Air forces everywhere are habituated to being the wilful, rebellious little siblings of their nation's army. They just cannot be unshackled from the ground or escape the fact that the surface is important. In the United States, the Air Force found it difficult to change without clinging to the instrument that won it independence. Then came ballistic missiles and what some viewed as the shotgun wedding of aero and space. Will the even greater evolution to cyberspace - it is really nothing more than that - create a fuss, even though it is absolutely faithful to the vision of air power's founders? Of course it will create a fuss! The combat airman is the last and emotional vestige of knighthood, the product of the warriors' quest for one-on-one combat. Air forces breed cranky individualism because their best and brightest believe, when all is said and one, that warfare really is about LeMay being superior to Khrushchev, or Horner being superior to Saddam. An atmospheric air force that seeks a personalised 'right stuff', but limits the attainment of right stuff to aviators, risks an exploitable schism among its various communities. An infospheric air force must and would be based on the teamwork inherent in the construction of the networked information organism that defined it.

The air force apex always will be defined as the masters of the medium, but in an infospheric air force, the medium of air can yield a bit to the various space media. And if it is risk that defines the apex, consider that as processing power grows and the spectrum remains fixed, the ability to illuminate, command, and control the battlespace inevitably will reintroduce the essentiality of physical presence. Air forces likely will leave the air for space and cyberspace, only to find the nakedness of space as vulnerable as the air. Fortunate for them that they also moved to cyberspace.

So, how should air forces proceed? If air forces understood themselves to be organised around not the aging technology of flight but the nascent and growing technologies of topsight, they might be able to play continuous roles and missions debates in a far more constructive manner. Like any shrewd firm, an infospheric air force would cast of low-information missions in favour of high-information ones, strengthen its competence to capture, handle, and move information, and position itself for vigorous institutional life well into the next century, all the while contributing to fostering jointness without risking its own identity. The current division of services by media is problematic for air forces. Take any given mission. Step one in the democratic roles and missions dance is to assign each service responsibility for weapons emerging from their particular medium: ground, sea, or air. Step two, which breeds the grossest hairballs, is to argue that systems emerging from one medium are, of course, superior (better, faster, cheaper, etc.) to systems emerging from another. Service prestige is put on the line in defence of technical characteristics that play more or less randomly across the face of combat. This is a way to build litigious bureaucracies, not institutions. Air force, by virtue of their need for theory rather than sentiment as their organising principle, wind up defending not what they contribute, but how they do it, as a means of preserving their end-strength. Inevitably this tactic puts their coherence on the line every time such issues arise. Sadly, their end-strength and coherence may both suffer.[30]

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[30] A review of appropriations indicates that congressional cuts levied on DoD and the services between 1991 and 1995 resulted in average percentage reductions of 2.4 per cent for DoD, 2.9 per cent for the Navy, 0.2 per cent for the Army, and 5.5 per cent for the Air Force. Thus, during the interval of post-

What should theory say about an air force's strategy for allocating missions? Consider the tedious recurring debate over the 'three' or 'four' air forces in general and close air support in particular. Declaring in the United States or elsewhere that there is but one Air Force and three other services also possessing air arms is to deny the facts and fuel continuing disputation whenever the embers of fact are fanned. Even so, 'one' atmospheric air force may disdain every other service's use of aircraft in general, and when it feels like it, jealously guards the close-air-support mission in particular. So the one institutional air force may do close air support, even without making it a special competence. Done with great personal skills and courage, but still with little institutional enthusiasm. Meanwhile, the army struggles along with antiquated coordination mechanisms and puts all the organic close air support capabilities it needs in the helicopter, since The One Air Force allows it no other choice. The answer for an infospheric air force is obvious: let this mission and its associated equipment go. And why not? In the United States, the Marines prove a ground force can supply its own jet-powered air power organically. Close air support is a necessary but low-yield and low-information component of warfare, one which contributes little to topsight, and rarely, if ever, provides the satisfaction of achieving strategic effect. As long as armies fight armies, close air support will be necessary. But it is nowhere written in stone that an air force must fulfil this responsibility.

A similar debate entails long-range missiles, both those for air defence and those for ground attack. Air defence is an Army bailiwick in the United States, sometimes contested by the United States air Force, as an unwarranted intrusion into the deep battle. Here, the Air Force strategy should be obvious: acquire the radars, the fire-control internetting, and the communications that glue the system together. Offer the missiles to whoever wants to drag them around the countryside. This keeps the role of preserving topsight over the increasingly nonlinear battlespace and yields both the bullets and the trigger. What about deep attack ground- or sea-launched missiles? The same solution. Any force element ought to be allowed and able to pinpoint and hit static targets. Since static targets present lower information challenges and missiles are just more mass, an infospheric air force would relinquish these to surface force. An infospheric air force armed with speed-of-light engagement systems and corresponding concepts of operations, economises mass to optimise energy. Thus, an atmospheric tasking order of the future would neither become an 'air and space' order nor an air force responsibility to produce. An infospheric air force would provide the information systems by which it is produced and the bandwidth by which targeting is accomplished. Today's divisions are notional because fire control and guidance are intimately connected to specific missiles or engagement systems. Such union is precisely the wrong way to establish missile guidance in the future. Ultimately, it is the infospheric command which informs the firing control mechanism, and an air force, if it is smart, will put first claims on these operations in the cyberspace to become the core of the military's information machine. An infospheric air force is, among other things, the battle- or engagement-management organism.

Today's roles and missions debates seem to hearken back to solving the surface and air targeting and coordination problems brought to a boil the last few days of February

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Desert Storm air power euphoria, Air Force cuts were 27 times greater than cuts taken from the Army and exceeded cuts to surface manoeuvre forces by a wide margin.

1991. Instead, today's air forces ought to look ahead and make claims base don what 2015 or 2025 portends: a global battlespace reapportioned by the micro-second. It is a short hop to extend an air force's acknowledged claim to tactical mission defence battle management to overall cognisance of the entire complex information flow required to shoot down another missile. Moreover, the airborne laser is a fine speed-of-light weapon, albeit on a less than equally modern platform, and an infospheric force needs weapons. While an atmospheric air force jealously guards its claim to the right firing platform; infospheric air forces go for the jewels: engagement speeds as fast as information speeds.

If an atmospheric air force wishes to contend with other services over platforms, the way to do it is not to waste time arguing over one or another medium, but to lay claim to the information-rich components. An infospheric air force also can take the lead in maturing our understanding of information operations. An infospheric air force realises that A-2 (intelligence) and A-6 (computers and communications) no longer can reside in their own little stovepipes separated from A-3 (operations). The transition from an atmospheric to an infospheric air force also will give long-term planners in A-5 at least five years to work, examining every aspect of the force and seeing where it fits into the new structure.

A related issue entails what an air force posturing for the future should keep organic and what it should moult to the private sector. An atmospheric air force retains its air base orientation, and a result is the retention of ancillary functionality and the footprint that goes with it. Consider ancillary functionality: in the United States Air Force there are far more nurses than aviators, with nearly 20 per cent of the total Air Force in health professions. This is ludicrous. The military's ability to command large forces in single-minded pursuit of worthy aims must be retained. Yet, an infospheric air force would ask which elements need to be 'military' to ensure continuity of information and command operations under stress.[31] If would carefully review the current practice of outsourcing its technical magic or buying it off the shelf.[32] An infospheric air force is a BHAG, and BHAGs require more focus and single-minded leadership than doing the same old things better, faster, and cheaper, or more stealthily.

CONCLUSIONS

The leap from an atmospheric to infospheric 'air' force is the next logical step, as paradoxical as it may seem. Air forces have capitalised on the speed, range, freedom, or manoeuvre, and vantage their medium provides. Yet, nothing travels faster than information. Nothing impedes the distance knowledge can travel. Nothing makes movement more intelligent, economical, and fruitful than information. And nothing less than an infospheric entity would provide the vantage that engagement of systems of all kinds will require. Atmospheric solutions sufficed until technology permitted

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[31] See Dunlap Jr., Colonel Charles J., USAF, 'Organizational Change and the New Technologies of War'.

[32] The problem grows. See, for example, Wolk, Martin, 'Hacker Crashes Thousands of Windows Computers', 5 March 1998, Reuters Ltd., and 'Five-Sided Cyber-Attack: Hackers breach the Pentagon', *TIME Daily,* 25 February 1998.

multiple solutions from any medium. We are not almost there, we are there. We must fully expect that change and divestment will be tortuous and torturous, but we also know that without vision, the people perish. Air forces stand in a transitional zone, pulled by the lure of the future even while still shackled by the comfortable past. To affix their affections, theory, and force structures exclusively to aircraft transporting mass to targets is to remain behind. Only by boldly moving forward can the air forces of the planet's democracies revitalise and rediscover themselves and their value. The lure of the romantic past provides a Siren-like seductiveness to those hardy handfuls of aviators in modern nations everywhere who are struggling to retain control of their forces. But other services broke their bonds to horse and sail.

Will air forces go forward, or will they stop or tarry? With so much to gain, to tarry or stop seems folly. If folly is chosen, however, count on it being proclaimed wisdom. Yet, it seems to me that the inexorable march of contingency only can lead to one of two outcomes. In the better outcome splinter groups arise, chipping off air force missions piece by piece and leaving the institution a withering core. The worse outcome is for the ideology of the atmosphere to withstand all challenges, alienating those within and outside an air force who see elements of the future with clarity. Then, someday within the next one or two decades, the old air forces will awaken to find the revolution grasped firmly by those with few tears left for the old atmospheric air force. Either way, if the air forces of democratic states fail to do their states and their allies the favour of succeeding, we will have twisted Churchill's description of real tenacity and valour in a perverse way. It would be most unfortunate if historians of the next century looked every one of us here in the eye and recorded that 'Never have so few done so little for so many.' We can only hope and strive to make things play out differently.