



# AUSTRALIAN MILITARY MEDICINE

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# **Australian Military Medicine Association**

## **Statement of Objectives**

The Australian Military Medicine Association is an independent, professional scientific organisation of health professionals with the objectives of:

- promoting the study of military medicine
- bringing together those with an interest in military medicine
- disseminating knowledge of military medicine
- publishing and distributing a journal in military medicine
- promoting research in military medicine

Membership of the Association is open to doctors, dentists, nurses, pharmacists, paramedics and anyone with a professional interest in any of the disciplines of military medicine.

The Association is totally independent of the Australian Defence Force.

## Editorial

Russ Schedlich

As 1998 draws to a close, it is time to reflect on the past year. It has been a year full of challenge and change, triumph and tragedy.

As a result of the Navy's worst peacetime disaster since the loss of HMAS *Voyager* in 1964, your erstwhile Editor spent a considerable part of the year on the Board of Inquiry into the fire in HMAS *Westralia*. The results of that inquiry have yet to be announced. But alongside the heroes of the firefighting effort stood the toil of the medical teams rendering appropriate treatment to the injured, and preparing for the possible resuscitation needs of the missing, who sadly had perished before they could be reached.

The provision of medical support to Operation *Bel Isi* in Bougainville continued, with health personnel from all three Services contributing throughout the year. Sterling work, both to the Peace Monitoring Group and, on occasions, locals, was performed by the team, staffed largely with Permanent Forces personnel but with Reserve specialists providing those skills not otherwise available.

The response of the Defence Health Service to the tsunami disaster in Papua New Guinea was superb, showing yet again our willingness to respond in very short order with very effective health support. Graphic media reporting showed the trials and tribulations of medical teams working in extremely demanding circumstances to almost overwhelming number of casualties.

Last summer, during Southern Ocean patrols, Navy mounted major operations to recover severely ill and injured personnel from ships many thousands of miles from port. In one case, this required the short notice deployment of a frigate with a medical team embarked (including a RAAF anaesthetist), and a long, overwater, helicopter medevac between the two ships in mid ocean.

Only a few months ago, the RAAF despatched, at only hours' notice, a P3 Orion

with intensive care team embarked to Manila to retrieve a critically ill Navy member to Sydney. And this came only a few days after a C130 had been flown to the same city to return one seriously ill and two other personnel from the Navy Task Group.

No doubt there have been many other medical operations of similar dimensions through the year. What do they all tell us?

We are going through, as the Chinese say, interesting times. We have a dramatically re-cast Defence Health Service, joint and, at the strategic and management level, integrated. It is much flatter and smaller at the top than it was. We have a senior management Board consisting largely of Reservists. – These changes have not been without pain and disruption, some of which is likely to continue, although hopefully lessen as we all adapt to the new arrangements.

At the end of the day, however, the examples of medical operations cited above demonstrate, firstly, what we are all about, and, secondly, how well we are able to respond and perform in difficult circumstances. It is these efforts by which we will be judged, both by our patients and, more importantly, by our leaders. It is these tasks at which we must not fail, because failure will bring well-deserved opprobrium, and lead inevitably to questions of our worth to the ADF.

So our overriding task is to ensure we are well trained and well prepared for the provision of operational health care in all the environments in which we work. We must all work towards achieving these continuing aims in the new Defence Health Service. It is a challenge that faces us all, Permanent, Reserve and civilian. We must not fail.

The Editor and his Team wish all our readers a safe and happy Christmas and New Year.

## *President's Message*

Nader Abou-Seif

As I write this, another year is approaching its end. Looking back at 1998, I see the association undergoing a period of consolidation. The results and recommendations of last year's membership survey have been digested, and the issues raised have been addressed, or are in the process of being acted upon. Our membership numbers are stable and our financial position is healthy.

AMMA has continued to be a focus for the exchange of ideas and fellowship within the Military Medicine community. As this year's conference has shown, the quality, skills and experiences of our members remain extremely high. This year's meeting has again been of the highest standard and has provided a great opportunity to share with our colleagues. I hope that next year's meeting in Adelaide will provide more of our membership the opportunity to be a part of this important gathering.

What does 1999 have in store for the association? Council is aiming to increase our membership and to continue to encourage active involvement in a broad range of activities such as regional meetings, a growing journal and a more developed presence on the Internet. AMMA will continue to support research through our annual grant and to encourage access to all our resources. Our library is currently under-utilised, but is available to provide a resource to all our members.

In the last seven years, AMMA has grown from humble roots to a major part of the wider Australian Military Medicine Community. I hope that in the next few years, we may be involved in continued growth and participation in the development of post-graduate training in Military Medicine. I think that the time is right for a progression into this area, and that AMMA is well placed to be involved in the achievement of this goal.

As we look back at a year that has seen our members involved in the planning, deployment and provision of health services of the highest standard, both in Australian and Overseas, we can once again see the capabilities of our community. We can look forward to the last two years of this century, knowing that a committed and capable group will face the next century. This year's changes, which have been the object of uncertainty by many, have not affected the enthusiasm of our membership for their interests in the practice, history and future of military medicine.

Here is to a New Year that, with your help, will be our best yet. I hope the coming season will be a joyful and safe one for you and that next year will be a happy and productive one for all of us.

Note: 1999 Conference dates have changed and are now 8-10 October, in Adelaide.



## 'Weary' Dunlop Paper

# The biodynamic and physiological implications of supermanoeuvrable flight<sup>1</sup>

D.G. Newman<sup>2</sup>

### Abstract

Fighter aircraft are by design highly agile and manoeuvrable weapon platforms. A high degree of agility is essential in the three-dimensional environment of air combat manoeuvring (ACM). Supermanoeuvrability (SM) is the term used to describe the ability of a fighter aircraft to exploit more of its flight envelope through advanced aerodynamic features, including thrust vectoring and advanced flight control systems. SM allows the aircraft to operate effectively at much lower airspeeds, well into the post-stall region of the flight envelope, and to manoeuvre at high angles of attack with full control authority. After examining SM aerodynamics, flight test results and the performance characteristics of current SM aircraft, the paper will then centre on the biodynamic and physiological implications of human exposure to the SM flight environment. SM aircraft will operate in a much more complex acceleration environment than ever before. Exposure of the human occupant of such an aircraft to this environment raises serious questions in terms of the potential for spatial disorientation, the performance requirements of assisted escape systems and tolerance of the cardiovascular system and cervical spine to complex G loads.

*"A big aerial barge is too clumsy for fighting. Agility is needed."*

- Baron Manfred von Richthofen<sup>1</sup>

Fighter aircraft are designed to be agile and manoeuvrable weapons platforms. A high degree of manoeuvrability is essential in the three-dimensional, highly fluid environment of air combat manoeuvring (ACM), in order to achieve and maintain an offensive position relative to the target aircraft. In general terms, the generation of an optimal firing solution requires that the nose of the aircraft be pointed at the target. In the one-versus-one situation, the more agile fighter will be able to achieve such a position first, thus being able to take the initiative, control the development of the engagement and effect a valid shot at the opponent first. With the development of advanced all-aspect air-to-air missiles, the need to obtain a first-shot firing position has become even more critical. Manoeuvrability

thus holds the key to success in modern air combat.

Modern fighter aircraft are much more manoeuvrable than their predecessors. Improvements to materials technology and flight control systems have produced new fighter aircraft that demonstrate what have become known as "supermanoeuvrable" capabilities. Supermanoeuvrability (SM) is the term used to describe the ability of a fighter aircraft to exploit more of its flight envelope through advanced aerodynamic features.<sup>2,3,4</sup> It represents a quantum leap in fighter aircraft technology, and is destined for incorporation into the next generation of combat fighter aircraft. As an aerodynamic concept, SM allows the aircraft to operate effectively at much lower airspeeds, well into the post-stall region of the flight envelope, and to manoeuvre at high an-

<sup>1</sup> Newman DG. The biodynamic and physiological implications of supermanoeuvrable flight. *Aust Mil Med* 1998. 7(3):3-10  
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gles of attack (AOA) with full control authority. SM thus significantly expands the useful portion of the fighter aircraft's operating envelope, making it a far more formidable air-

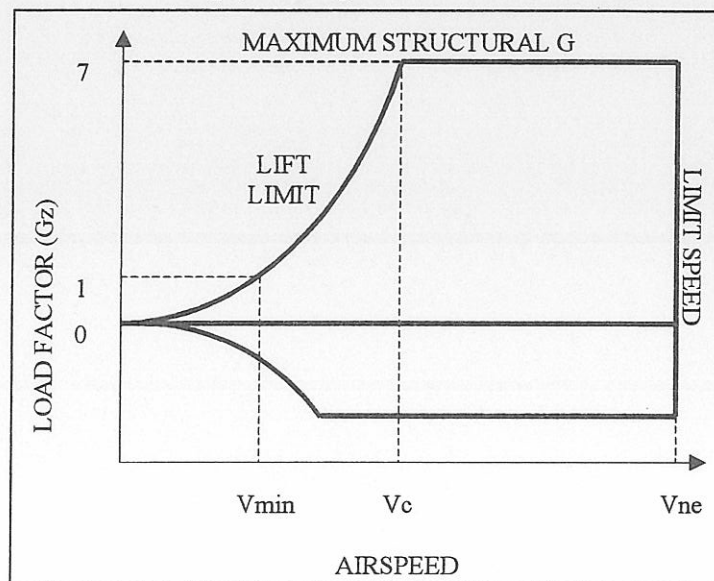


Figure 1. V-n diagram of generic fighter aircraft.  $V_{min}$  = stall speed,  $V_c$  = corner speed,  $V_{ne}$  = limit or never-exceed speed (Adapted from Shaw RL. *Fighter combat: tactics and manoeuvring*. Annapolis: Naval Institute Press; 1985)

borne weapons platform than ever before.

As a result of their extreme degree of agility, these aircraft operate in a particularly complex acceleration environment. This environment is now not limited to the Gz axis, as is largely the case with current fighter aircraft. Previously unheard of accelerations in the Gx (front-to-back) and Gy (lateral) axes can be generated by SM fighter aircraft, which reflects their unorthodox manoeuvring abilities. Exposure of the human occupant of such an aircraft to this environment raises serious questions in terms of the potential for spatial disorientation, the performance requirements of assisted escape systems and tolerance of the cardiovascular system and cervical spine to complex G loads.

This paper will examine the aerodynamic concept of SM before addressing the significant biodynamic and physiological implications of human exposure to the SM flight environment.

### The Concept of Supermanoeuvrability

Early fighter aircraft were limited in their effectiveness by engine performance, structural strength and the weapons that they carried. These aircraft had relatively poor performance envelopes, particularly in terms of turning ability. Their main armaments were

guns, and in order to shoot their opponent they were forced to manoeuvre their aircraft into the rear quarter of the target aircraft. A circular chase would then develop, with both aircraft attempting to achieve this rear position first and maintain it long enough to fire effectively on their opponent. Traditional ACM tactics have consistently been based on this need to get behind the enemy aircraft in order to shoot.<sup>1,5</sup>

The advent of the jet fighter and the introduction of the air-to-air missile changed the nature of air combat. The jet-powered fighter of today is a very capable aircraft. It is immensely strong, incredibly powerful and agile. It exploits modern materials technology and is designed in accordance with relaxed stability criteria. It can carry a multitude of weapons, and in the case of the multi-role F/A-18 can be loaded with both air-to-air and air-to-ground weapons.

Air-to-air missiles have a Weapon Employment Zone (WEZ) much larger than that of the gun. WEZ refers to the area around a target aircraft that will result in a high probability of success for a missile fired within that zone. A missile fired outside its WEZ has a low probability of achieving a kill solution. The size of the WEZ varies between different types of air-to-air missiles, depending on the missile's on-board avionics, propulsion and guidance systems, fuel load and turning ability. The larger the WEZ, the greater the area and number of options that are available to the offensive aircraft for a missile shot. In order to win an air-to-air engagement, the offensive aircraft has only to manoeuvre in such a way that the target aircraft falls into the WEZ for the particular missile that is being carried at the time. This position may not necessarily be directly behind the target. Indeed, with the development of advanced all-aspect air-to-air missiles combining high turning performance with high off-boresight capability, the requirement to position one's aircraft to the rear of the opponent in order to fire a shot has diminished to a significant extent. Successful shots can now be taken with the opponent aircraft approaching head-on or at off-boresight angles of up to 90°.

The dominant principle in modern air combat is that of "first look, first shoot, first kill." This principle has driven the development of increasingly powerful and capable airborne radar systems and air-to-air missiles. An aircraft with SM characteristics is in a better position to achieve first look, first shoot, and first kill than a less agile opponent. In order to get the first shot off, SM allows the fighter aircraft to bring the opponent



aircraft more quickly into the WEZ of the desired weapon. In addition, SM may arguably be of use in a defensive scenario, by allowing the aircraft to evade an incoming all-aspect missile (ie by driving the missile to gimbal lock). The increasing potency of modern air-to-air missiles and the increasing complexity of the modern aerial battlefield makes SM an important addition to the manoeuvring inventory of the fighter pilot.

A certain level of manoeuvring is, of course, still required in the air combat environment, particularly during a close-quarters within visual range engagement. With conventional fighter aircraft, heavy manoeuvring at high G loads bleeds off air speed, and the aircraft subsequently approaches minimum flying speed,  $V_{min}$ . One way to offset this is to provide more engine thrust, but there is still only a finite amount of thrust available from a given powerplant. Below  $V_{min}$ , the aircraft stalls due to lack of effective lift and aerodynamic control.  $V_{min}$  thus becomes an important limiting factor in manoeuvring flight. Figure 1 is a typical V-n diagram for a generic fighter aircraft, which plots load factor versus airspeed. The stall speed (or  $V_{min}$ ) is clearly shown. Conventional fighters cannot operate in the region to the left of this limit.<sup>1</sup>

Nose-pointing ability, particularly during tracking of the opponent for a guns-kill, requires the ability to rapidly pitch the nose up at the target. Such a manoeuvre will generate a high AOA relative to the aircraft's velocity vector. AOA is the angle formed between the chord line of the wing and the velocity vector of the aircraft, and is expressed as units or degrees of alpha or AOA.<sup>1,4</sup> At high AOA, the aircraft's energy state rapidly decays as airspeed is bled off. The limiting lift speed is approached, and if the manoeuvre is maintained, the aircraft will stall and lose aerodynamic control in all three primary axes. The control surfaces (elevators, ailerons, and rudders) become ineffective due to the presence of low-energy airflow and wake shed from the wings and forward fuselage. Aircraft such as the F/A-18 can generate relatively large AOAs (in the order of 35°) but at the expense of some controllability and agility.

SM can be defined as full control authority at high AOA in the post-stall region of the manoeuvring envelope (see Fig 1). As such, the SM fighter can operate safely with full control at airspeeds and AOAs that are denied to a conventional aircraft. At low airspeeds and high AOA, the SM aircraft can point its nose at the target and rapidly achieve a satisfactory firing solution. The SM aircraft has the ability to effectively roll

around its velocity vector at high AOA, and point the nose in the desired direction. Additionally, this high pitch rate capability and nose authority allow the aircraft to continuously track the opponent aircraft despite any defensive manoeuvring the latter may employ. In tactical terms, constantly threatening the target aircraft (by exploiting the SM aircraft's nose-pointing ability) will be inherently intimidating. Furthermore, conventional clues as to an opponent's energy state will be denied to the target aircraft, as aspect, AOA and nose position will no longer have the same meaning.<sup>1,4</sup>

SM is achieved by designing an aircraft according to extremely relaxed stability criteria.<sup>4</sup> The inherently unstable airframe is able to fly in a controlled fashion only through the use of sophisticated digital flight control systems (FCS) with high-speed processing capability. The flight control systems provide a digital interface between the pilot and the aircraft's control surfaces, and are heavily dependent on the quality and sensitivity of the control laws written and incorporated into the flight control computers. The performance of the aircraft can be significantly altered or enhanced by modifications to these control laws. Indeed, flaws in the software can result in the loss of the aircraft, as occurred with one of the prototype SAAB JAS39 *Gripen* aircraft, which departed controlled flight at an airshow forcing the pilot to eject. Thrust vectoring control (TVC) systems and advanced aerodynamic features (such as powered canard foreplanes) provide the appropriate control authority in all regions of the flight envelope.

TVC allows flight at very low  $V_{min}$  values. In the case of the British Aerospace/McDonnell Douglas Harrier jet, TVC allows a  $V_{min}$  of 0 knots of forward airspeed to be achieved in the hover mode of vertical flight. In addition, this V/STOL jet is capable of vectoring in forward flight by rotating the engine nozzles fully forward. This can produce rapid decelerations in the Gx axis, with a relatively rapid transition therefore between conventional forward flight and vertical flight. This has considerable potential for tactical advantage, particularly against a less agile aircraft, as it forces the other aircraft to overshoot and instantly become defensive rather than offensive.<sup>1,5</sup>

The Harrier's TVC system is mounted mid-fuselage, and as such does not allow it to achieve or sustain a particularly high AOA. Positioning the TVC aft of the engine nozzles allows the jet efflux to be deflected, which will produce a high pitch moment relative to the

aircraft's velocity vector. Given enough engine thrust, the aircraft can achieve and maintain a high AOA, effectively using the thrust as an aerodynamic control force.<sup>4</sup> In this way, the SM aircraft can operate beyond the stall barrier at previously unimaginable AOAs with no loss of control authority.

#### Current Supermanoeuvrable Aircraft

A number of experimental aircraft have been designed, built and test flown in order to investigate the supermanoeuvrability concept. Perhaps the best known of these is the Rockwell/MBB X-31 program. This aircraft first flew on October 11, 1990, and flew with thrust vectoring paddles on February 14, 1991.<sup>2,5,6</sup> The single-engined X-31 has a cranked delta wing with powered canard foreplanes and a fly-by-wire flight control system. The three thrust vectoring paddles can deflect the jet exhaust by up to 10°. <sup>2,5,6,7,8</sup> It has achieved an AOA of 70° during ACM, as well as demonstrating full post-stall controllability.<sup>2</sup> It became the first aircraft to execute a minimal-radius 180° turn.<sup>6</sup>

Several existing fighter aircraft have been modified as part of various SM technology flight test programs. These programs are the F-16 AFTI (Advanced Fighter Technology Integration),<sup>9,10</sup> the F-16 MATV (Multi-Axis Thrust Vectoring),<sup>3</sup> the F-15 STOL/MTD (Short Takeoff and Landing/Manoeuvre Technology Demonstrator),<sup>11</sup> the F-15B ACTIVE (Advanced Control Technology for Integrated Vehicles)<sup>11</sup> and NASA's F/A-18 HARV (High Alpha Research Vehicle). All of these programs are aimed at investigating the characteristics of advanced thrust vectoring and high AOA capabilities. AOAs of 70° and beyond have been achieved, with the aircraft remaining fully controllable.<sup>2</sup>

The Russian-designed Sukhoi Su-37 *Super Flanker* is an extremely manoeuvrable aircraft, which ably demonstrated its capabilities at the 1996 Farnborough airshow. It was first flown on April 2, 1996 under the code "Project 711." This formidable fighter aircraft has canard foreplanes, thrust vectoring via fully steerable engine nozzles (maximum deflection of  $\pm 15^\circ$  at 30°s<sup>-1</sup>) and a quadruplex digital fly-by-wire active flight control system.<sup>3,6,8,12,13,14</sup> Presently the nozzles are steerable in pitch only, but vectoring in yaw is being considered.

#### Manoeuvres

The Su-37 has demonstrated a number of manoeuvres that characterise the performance of a SM fighter aircraft. The "Cobra" and "Super Cobra" manoeuvres involve rapid

pitch up to a high AOA while the aircraft continues on a horizontal forward flightpath. The high AOA is maintained (greater than 130° in the case of the Super Cobra – in this configuration the aircraft is effectively flying backwards) for several seconds as airspeed decays rapidly, before the TVC is used to pitch the nose forward to allow recovery. Very little altitude change occurs with these manoeuvres.<sup>3,13</sup>

The "Kulbit" manoeuvre is essentially a backward somersault through 360°, using thrust vectoring for rapid pitch rotation, again with very little change in altitude. During the manoeuvre the aircraft continues to fly along its forward flight path. Effectively a vertical loop has been completed in little more than the length of the aircraft.<sup>3</sup> A variation on this manoeuvre is the "bell turn," in which a Cobra-style rapid pitch up is used to generate a high AOA (approximately 90°) that is maintained until forward airspeed is effectively zero. Thrust vectoring is then used to rotate the aircraft backward about its tail, with a subsequent roll to normal flight from the recovery dive. This manoeuvre is effectively a minimal-radius 180° reversal. Another variant of this minimal-radius 180° reversal is the "J turn," in which the aircraft pitches up to approximately 50-55°, then rolls rapidly about 160° around the velocity vector to ultimately roll out heading in the opposite direction. This particular manoeuvre is also called the "Herbst Manoeuvre," after Dr Wolfgang B. Herbst, one of the initiators of the X-31 program.<sup>2,3,13</sup>

The "helicopter turn" involves the aircraft, in a low-speed, high-AOA state, descending rapidly while turning at a high rate around the horizon. The aircraft's velocity vector is essentially pointed down, with the aircraft rotating around it. Using this manoeuvre the aircraft can lose height quickly while still tracking the opponent aircraft.<sup>2,3</sup>

The F-16 AFTI technology demonstrator aircraft was unique in that it was capable of two additional manoeuvring parameters: direct side force and direct lift, by exploiting advanced integrated aerodynamic control technologies (including decoupled rudders). Direct side force allowed the AFTI pilot to laterally translate the aircraft at up to  $\pm 2$  Gy with no corresponding pitch or roll change. To an observer watching the manoeuvre, the aircraft would appear to suddenly move sideways while maintaining the original attitude. Similarly, the aircraft had the capacity for direct lift, allowing it to climb during forward flight with no change in aircraft attitude (much like the Harrier).<sup>9,15</sup>



The combat validity of these manoeuvres is still the subject of much controversy. "Speed is life" is an axiom of air combat. Exploiting SM characteristics tends to put the aircraft into a low-speed, low-energy state. If the target aircraft is not eliminated with the SM-generated shot, it then has a significant manoeuvring advantage over the lower-energy SM aircraft. The SM aircraft becomes in effect a ripe target, until it can regenerate its energy state. Thus, the pilot of a SM fighter must ensure he gets a kill when exploiting the manoeuvring characteristics of his aircraft.

Nonetheless, there appear to be a number of tactical advantages with SM technology, as mentioned above. These include consistent and continuous high-alpha nose-tracking ability, denial of conventional energy state clues to the opponent, and the ability to use the post-stall region of the envelope against a conventional opponent. In using the latter feature, the SM aircraft can convert a defensive situation to an offensive one by executing a minimal-radius 180° turn or by forcing the opponent to overshoot. This gives the SM aircraft the upperhand in a low-speed air combat engagement. Furthermore, the SM aircraft is likely to be able to achieve first look, first shoot, and first kill much earlier and more effectively than a conventional fighter aircraft.

In order to demonstrate this, the X-31 took part in a series of ACM evaluation trials against conventional fighter aircraft including the F/A-18 and F-14. The results were impressive: in close-in ACM, the X-31 was the victor in 104 out of 116 engagements. This represents an air superiority factor in favour of the X-31 of 8 to 1.<sup>2</sup>

### **The Implications of Human Exposure**

Supermanoeuvrable flight is therefore characterised by high +Gz onset rates, high angular accelerations in all three primary axes (X, Y and Z) and rapid changes in attitude and orientation.<sup>2,3,4,15,16,17,18</sup> Such a complex acceleration environment has significant biodynamic and physiological implications for the human occupant of such an aircraft. Specifically, these relate to problems of cardiovascular tolerance to high rates of applied +Gz, the tolerance of the cervical spine to the complex acceleration environment, the potential for spatial disorientation (SD) of the pilot during such unorthodox manoeuvring, and the additional requirements of assisted escape systems.

### Cardiovascular tolerance

Current fighter aircraft are capable of very high +Gz loads, in the region of +7.5 to +9 Gz. Future fighter aircraft such as the F-22 and the Eurofighter 2000 are projected to be capable of at least +10 Gz (peak) and +9 Gz (sustained). Furthermore, the +Gz onset rates of these aircraft are very high, in the order of 15 Gs<sup>-1</sup> in the case of the Eurofighter 2000.

SM aircraft will at the very least be capable of similar load factors and +Gz onset rates. The use of vectored thrust technology may allow high +Gz loads to be sustained for more protracted periods of time. Clearly the potential for G-LOC (G-induced loss of consciousness) to occur in the pilot of a SM aircraft is much greater.<sup>19</sup> While there is evidence that fighter pilots develop a degree of cardiovascular adaptation to their repetitive exposure to high +Gz this will not help the novice pilot.<sup>20,21,22</sup> Over time it is likely that a pilot will adapt to the +Gz envelope of the SM fighter, but until this occurs there is the not inconsiderable risk that the physiological capacity of the novice pilot will be exceeded by the extreme performance capability of the aircraft. G-LOC will thus remain an omnipresent threat to the fighter pilot.<sup>19,23,24,25,26</sup>

It will be imperative then to accurately map and profile the G environment of the SM fighter aircraft, as has been done with other fighter aircraft, including the F/A-18 *Hornet*.<sup>27,28</sup> Only by conducting this research will the aerospace medicine community be able to fully establish the extent of the biodynamic challenge facing the pilot of the SM fighter aircraft. Current anti-G countermeasures will not offer the required level of protection.<sup>16,18</sup> A greater understanding of the magnitude of the challenge may well lead to more effective countermeasures to protect the pilot from the environment he or she must operate in.

### Cervical spine

+Gz-induced neck injuries are a frequently reported phenomenon in pilots of high performance fighter aircraft.<sup>29,30,31</sup> A study among RAAF fighter pilots found a +Gz-induced neck injury prevalence rate of 85%.<sup>30</sup> Several causal factors have been identified, such as the level of +Gz experienced, movements of the head under high applied +Gz loads, and the weight of the head-helmet complex. The position of the centre of gravity of the head is also important. This tends to be forced forward when helmet-mounted equipment such as night vision goggles or helmet-mounted sights and display systems are used.<sup>30</sup>

With SM fighter aircraft, the G loads will be multi-axial.<sup>16,17</sup> G-induced neck injuries in pilots of SM aircraft will therefore be the result of a complex vectorial sum of G loads. Of particular concern here in the pathogenesis of such injuries is the magnitude of the lateral or Gy component. These can be significant with SM fighters, and can clearly result in considerable potential for injury to the neck when the unsupported and unrestrained head is subjected to these high Gy loads. There is a clear compromise between protecting the neck by head restraint or support systems and the requirement for the pilot to have adequate all-round (especially rear-quarter) vision.

The problem is likely to be compounded even further by the incorporation of helmet-mounted sighting systems for use with the newer all-aspect air-to-air missiles. These systems are destined to be standard operating equipment for the pilot of a SM aircraft, in order to maximise the combat effectiveness of the aircraft as a weapons system. However, the price to be paid for increased utility of the aircraft is a greater incidence of +Gz-induced neck injuries. Indeed, this type of injury is likely to be reported far more frequently and/or to be of greater severity in the SM fighter pilot than it is in pilots of current fighter aircraft.

#### Spatial disorientation

The very nature of SM flight creates an extremely dynamic motion environment that could lead to spatial disorientation of the pilot, with the concomitant flight safety implications.<sup>16,17</sup> At high AOAs, the pilot will lose the horizon as a major visual reference and orientation cue. This, combined with rapid attitude changes and high angular accelerations in several axes, theoretically increases the potential for SD. This can readily be appreciated when one considers the type of manoeuvres that SM fighter aircraft are capable of, as discussed above. Most of these manoeuvres involve significant reduction in forward speed (Gx deceleration), rapid pitch-up, and in most cases a high rate of roll around the velocity vector and/or rotation around the aircraft's centre of gravity (ie the helicopter turn). The neurovestibular integration product of the resultant sensory inputs is likely to be unfamiliar to the pilot, tending to disorient him as a result. At the very least, maintaining situational awareness will be much more of a challenge.<sup>16,17</sup> There have been reports from the various SM flight test programs of disorientation and loss of situational awareness occurring in some of the test pilots.<sup>16</sup>

SM flight will subject the semicircular canals (SCCs) to multi-directional stimulation at suprathreshold levels. The 3 matched pairs of SCCs transduce angular accelerations, and with SM flight each pair of canals is likely to be detecting such angular excursions. The threshold limit for detection of angular acceleration by the SCCs is described by Mulder's constant, which has a value of  $2^\circ\text{s}^{-1}$ . This constant is an angular acceleration-time product, and any stimulation greater than  $2^\circ\text{s}^{-1}$  will be detected by the SCCs and communicated to higher cortical centres.<sup>32,33</sup> The rapid attitude changes and high roll rates inherent in SM flight are likely to far exceed Mulder's constant, and as such be of supra-threshold intensity.

The complicating factor is the requirement to move the head around whilst manoeuvring in order to maintain situational awareness and visual contact with other aircraft, particularly the target. Such head movement could well precipitate a cross-coupled or Coriolis illusion that could conceivably be quite severe.<sup>32,33</sup> Furthermore, the G-excess illusion could also be more prevalent and potentially more severe for the same reasons. Some individuals could also suffer from motion sickness due to the highly unusual nature of SM flight.

It is likely that the pilot will adapt to the potentially disorientating nature of SM flight, but certainly during initial conversion training or after a layoff period the potential for SD is much higher. It seems logical to argue that a not insignificant number of these aircraft will be lost as a consequence of SD during the first several years of their service life, due to the aircrew's inherent unfamiliarity with the dynamic nature of the SM flight environment.

#### Assisted escape systems

The modern ejection seat is an extremely capable escape system. SM fighter aircraft, however, create a new set of performance requirements for ejection seats. The performance envelope of the seat must have a greater volume than is currently available in order to reflect the enhanced manoeuvring capability of the airframe, and to ensure the safe escape of the pilot.

The ejection seat fitted to a SM fighter must be able to operate at low forward airspeeds, at high angular accelerations and at particularly unusual attitudes. Furthermore, it must be able to generate a safe escape trajectory despite the rapid gyrations that the aircraft might be undergoing as it manoeuvres. As has been seen already, SM flight is



characterised by its highly dynamic nature, and the generation of a complex acceleration environment. The ejection seat must be able to cope with these forces, such as high lateral G loading, high AOA, high rates of rotation, or high sink rates, alone or in combination, at the moment that the ejection sequence is initiated. The seat must be capable of clearing the aircraft despite such adverse conditions, and of ensuring adequate altitude gain and time of flight for full parachute deployment. Unless the ejection seat is capable of meeting these objectives, the pilot has less chance of surviving an ejection during a SM phase of flight. At the very least, his chances of sustaining the well-known forms of ejection injury rise considerably. To prevent this, the SM fighter must have an ejection seat fitted that has been designed to meet SM specifications.

## Conclusion

Life for the fighter pilot in the next millennium is likely to be far more complex than it is now with the introduction of SM aircraft into service. As has been discussed, there are significant biodynamic and physiological implications for the human occupant of the SM fighter. While the engineering development of these aircraft proceeds, a full appreciation of these implications remains pending.

There is little doubt that the spectacular increases in performance and capability afforded by SM fighter aircraft have a very real human cost. The aerospace medicine community must address the implications of human exposure to the SM flight environment, in order to protect the fighter pilot from the adverse consequences discussed in this paper. After all, it is these individuals who will be regularly exposed to what is essentially a complex, dangerous and poorly understood biodynamic environment.

## Acknowledgments

The author would like to thank the aircrew of 20 (R) Squadron, Royal Air Force, (especially Wing Commander Andrew Golledge and Flight Lieutenant Pat Voight) for introducing the author to the Harrier jet and vectored-thrust flight operations.

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## Review Articles

# The Pathology Advisory Working Party (PAWP). A ten year review<sup>1</sup>

K.A. Rickard<sup>2</sup>

### Formation

The Pathology Advisory Working Party (PAWP) held its first meeting at Victoria Barracks in Sydney on 24 September 1987. It had evolved from the Pathology Advisory Sub-Committee (PASC) of the Services Health Policy Committee (SHPC) which comprised the three Directors General of Health when each held two-star rank and the chairmanship of SHPC was rotated among them. It could be said that the evolution to the concept of an Office of the Surgeon General ADF was a natural progression from the concept of a chairman of the SHPC.

The working party concept was introduced soon after the establishment of the office of the SGADF in February 1987. There were considerable practical, technical, scientific and administrative advantages in the working party concept. The Chairman of PAWP was the Surgeon General's Consultant in Pathology, and the other two members were the respective Service Consultants in Pathology.

### Terms of Reference

PAWP's Terms of Reference were set out in a draft Policy Directive in 1990 and included the provision of advice to the Surgeon General on:

- pathology equipment
- clinical policy
- the selection of pathology equipment
- statutory standards relating to protection of personnel
- laboratory performance and pathology policies
- joint Service standardisation and interoperability and training.

### PAWP Activities

In the ten years since its inception, PAWP has had on its agenda a wide range of matters relating directly, and some indirectly, to pathology. Retrospective perusal of the minutes of PAWP meetings indicate that the major items of its consideration could be classified in the following areas:

- blood transfusion, blood banking and blood supply to the ADF;
- advice on pathology equipment, purchasing and standardisation;
- ADF laboratories participation in quality assurance programmes;
- NATA accreditation of ADF laboratories;
- introduction of data management systems;
- advice on ADF policy for infectious disease screening and management;
- maintenance of communication networks and meetings with laboratory scientific officers;
- personal PAWP review of particular ADF laboratories;
- continuous communications with the office of SGADF for the purpose of offering advice on a wide range of matters relating to the practice of pathology in the ADF.

### Blood Transfusion and Blood Supply

#### Blood Banking Methods

Although blood transfusion is infrequently performed in the current ADF environment, PAWP has, over the years, spent considerable time on the various safety and technical aspects of transfusion medicine and the supply of blood to the ADF.

<sup>1</sup> Rickard KA. The Pathology Advisory Working Party (PAWP). A ten year review. *Aust Mil Med* 1998; 7(3):11-17  
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Blood transfusion in the ADF is a matter which, in times of conflict, would rapidly become a very important practical matter for ADF laboratories and units, both mobile and static. Accordingly, the decision was taken to make use of the Army Blood Transfusion Manual as a valuable starting point of reference for general methodologies. This manual was expanded, modified and developed with considerable help from Colonel Robert Beal AM, the Army consultant in blood transfusion. Eventually, using the Manual as a gold standard, PAWP developed the concept of an ADF Blood Transfusion Manual and a Blood Banking Methods Manual. After several years of arduous staff work by a wide range of people, PAWP was instrumental in the development of both these documents as Joint Service Publications (now Australian Defence Force Publications - ADFP), and they became, respectively:

- ADFP 711. Blood Transfusion Manual
- ADFP 710. Blood Banking Methods Manual

These Manuals were published in the period 1990 to 1991. It is of note that the Australasian Society of Blood Transfusion and the previous Commonwealth Serum Laboratories gave permission to incorporate guidelines on pre-transfusion testing and blood grouping techniques.

PAWP has always been keen, for the primary purpose of patient safety and uniformity of standards, to adhere to the classical methods of blood banking techniques throughout the ADF. The last two to three years has seen the development of modified techniques for grouping and cross matching. PAWP has recently sanctioned the possible introduction of the Diamed Micro typing system that allows blood grouping and cross matching techniques to be performed in a gel agglutination system.

#### Blood Supply to the ADF

A corollary to PAWP's continuing interest in blood transfusion medicine has been considerable input to the SGADF on various aspects of blood supply to the ADF. Because of inherent difficulties with blood supply and blood transport in times of conflict, the concept of ADF personnel as mobile blood donors has been espoused by PAWP.

This approach automatically introduces the issue of screening for infectious diseases for all Defence Force personnel as potential blood donors in an emergency or conflict situation, or prior to deployment. Hence, much attention has been paid to HIV, HCV

and HBV screening, and more latterly screening for HTLV-1. Mobile blood fridges for transport of blood have been on the PAWP agenda and these were put to the test for the Rwanda deployment in 1994.

The other concept for a fundamental source of blood supply to the ADF in times of deployment and emergency is the Red Cross National Blood Transfusion Service. This is based on the major Blood Banks' pool of voluntary donors in all capital and provincial cities in Australia. These concepts, which have emanated from the deliberations of PAWP, are contained in HPD 703, Blood Supply to the ADF.

Proposed structural changes in management of Australian Blood Banks may warrant modification of procurement methods for blood for the ADF from the new Australian blood transfusion network.

Representatives of PAWP have presented their ideas on blood transfusion in the ADF at meetings of the Australian Society of Blood Transfusion in Canberra in July 1992, and at the Australian Counter Disaster college at Mount Macedon in late 1992.

#### Frozen Blood

Although not immediately applicable to the ADF, Australian personnel deployed in *USS Comfort* during the Gulf conflict had experience with this technology. PAWP has been in communication with the Ministry of Defence in London, and has received updates on progress with hydroxy ethyl starch methodology from their Director of Medical Information Systems. Much of this research is first rate and was being conducted by the Royal Army Medical Corps in Aldershot.

#### **ADF-Wide Commonality of Pathology Equipment**

ADF-wide commonality of pathology equipment is an issue that PAWP has considered extremely important and has been a critical agenda item since its inception.

Despite the apparent logic of commonality of equipment, particularly in regard to biochemical analysers, cell counters and antibody screening equipment, PAWP has met considerable difficulty over the years in endeavouring to ensure that this concept is accepted by the ADF. Scientific officers, who meet in close proximity to PAWP, have in general endorsed the philosophy of commonality of equipment.

Some of the difficulties we have met in regard to ADF laboratories embracing the logical proposal for ADF-wide standardisation of pathology equipment relate to the preferred



contract tender method used by the ADF. There has been interesting correspondence between the Health Materiel Working Group (HMWG) and PAWP in regard to particular desirable items. HMWG have been at pains to point out that specifications cannot incorporate "lock-out" or restrictive clauses.

Review of PAWP minutes reveals some interesting situations in regard to equipment. One such incident involved the Ektachem analyser. At one stage these were extensively used by ADF laboratories and on RAN ships. In RAN ships, the level of diagnostic support offered far exceeded that required for care offered by ACC-trained sailors. There were also problems with calibration and control of this equipment and a considerable degree of operational skill was required. The RAN eventually removed the Ektachem from ships.

The replacement item was the Reflotron which was in many ways far more suitable for a ship board platform. No sooner was this item, ideal for near patient testing, embraced by the ADF as a result of PAWP recommendations, that criticism was received from one or two medical practitioners that the Reflotron did not offer a wide enough range of biochemical parameters.

For the last two to three years, there has been much more valuable liaison between PAWP and Health Materiel Logistics staff in the Office of the Surgeon General. With this liaison, the Combined Medical Capital Equipment Programme has been much more effective in regard to the activities of PAWP and considerable effective and efficient rationalisation has recently occurred.

### Quality Assurance Programme

All the major ADF laboratories participate in the Quality Assurance Programmes of the Royal College of Pathologists of Australasia (RCPA). This ensures that ADF laboratories all pursue strict quality control procedures and that our laboratory units are comparable to peer group laboratories across the country. Participation in quality assurance programmes is not only essential for maintenance of laboratory standards and the service they provide to ADF personnel, but is a *sine qua non* of NATA registration.

Participation in QAP for ADF laboratories was an initiative of both PAWP and its predecessor the PASC.

PASC noted in March 1983 that after visits to various Defence laboratory establishments over the previous three years a need was identified for participation in quality control programmes. Involvement of various laboratories proceeded soon after but then

the question of collation of ADF results arose. A little over two years later interchange of results was not occurring, but with the passage of time and close collaboration between PAWP and the respective scientific officers there is now good correlation of results and feedback from the RCPA QA group.

ADF laboratories are participating in Haematology, Blood Bank Serology, clinical Chemistry and Microbiology Quality Assurance. It is interesting to look at the degree of sophistication now in existence in ADF laboratories and their excellent QAP record, and relate this to the comments from ADF laboratory managers in 1982-83 that ADF laboratories could not achieve the necessary standard to participate in RCPA QA. This participation now happens regularly.

In March 1995, it was noted by PAWP that the ADF was spending some \$60 000 per annum in QAP. Following an initiative from 1 Field Hospital, PAWP accepted the view that the ADF should review its QAP participation to perhaps better reflect our environment and technical function and facilities. QAP is an ongoing commitment activity and important agenda item.

### NATA Registration

NATA registration of ADF laboratories is a matter that has continually been before PAWP and on the agenda since 1986.

In November 1986 the Commonwealth Chief Medical Officer of Health advised the Department of Defence that the Prime Minister agreed that all Commonwealth laboratories should seek registration with the National Association of Testing Authorities (NATA). This related to recommendations of the Ross inquiry into the Health Insurance Act pertaining to procedures to accredit all Pathology Laboratories in Australia whose services attract Medicare benefits. Although ADF laboratories would not be attracting Medicare benefits, the Commonwealth Chief Medical Officer of Health requested Department of Defence support in ensuring that all pathology laboratories under the Department's control seek accreditation.

A little later, requisite funding was obtained for NATA registration of ADF laboratories.

It is fair to say that the resultant efforts necessary for NATA registration have been a continuing saga within the remit of PAWP. We have been most fortunate to have had Colonel E.D. Rothfield ED RAAMC (Ret List), former Director of Biochemistry at St Vincent's Hospital in Sydney and with vast Army experience and considerable clinical chemistry and

clinical pathology expertise, as a member of PAWP. He has been of great assistance to PAWP and the ADF in helping to organise the NATA registration of certain laboratories.

Registration involves a major documentation and coordination of the laboratories' procedures and procedure manuals and standards, preliminary inspection by independent NATA inspectors, and a final NATA inspection which must be satisfactory at all levels prior to NATA registration.

The following ADF laboratories have received, or are applicants for, NATA/RCPA accreditation/registration:

- 1 Field Hospital
- 3 RAAF Hospital
- 6 RAAF Hospital
- 2 Field Hospital
- Balmoral Naval Hospital
- 1 Recruit Training Battalion
- Malaria Research Institute
- HMAS Cerberus
- HMAS Albatross
- RAAF Tindal
- RAAF Williamtown

#### **Scientific Officers**

Since its inception, PAWP has considered it vital to have a close working relationship with the Scientific Officers staffing ADF laboratories. In its earliest days PAWP strongly encouraged the formation of a tri-Service Scientific Officers' group that would meet regularly to review the wide range of technical, methodological and equipment matters affecting their laboratories.

Within two years of PAWP's first meeting in September 1987, the Scientific Officers were meeting regularly and a few weeks prior to the next scheduled PAWP meeting, so their discussions could be considered by PAWP.

Once the Scientific Officers meeting became a regular fixture it was suggested by PAWP and approved by the Scientific Officers that one of their number be appointed annually to represent the Scientific Officers as an invited attendee at PAWP meetings. This has now been happening for some six years. This Scientific officer has been most valuable to PAWP for the first hand feedback that is then available to PAWP. It is hoped that feedback in the opposite direction from PAWP to the Scientific Officers is of similar value. Over the past two years, Ms Cathy Cavanagh, Scientific Officer from Balmoral naval Hospital, and Captain Carolyn Jones from 1 Military Hos-

pital, have been attending the PAWP meetings.

Ms Cavanagh undertook some scientific projects for PAWP and provided most comprehensive reports. She has been extremely valuable in the coordination of the introduction of laboratory management systems to ADF laboratories. Her laboratory has conducted valuable Defence laboratory testing programmes for antibodies to HTLV-1 and has put forward a proposal for centralised screening for infectious diseases in the ADF.

Captain Jones has given reports on technicalities of G6PD screening and other pertinent matters for PAWP.

It is obvious that the symbiosis of PAWP and the Scientific Officers is beneficial to the smooth functioning of ADF laboratories.

In the latter days of PASC and the earlier days of PAWP, valuable analytical papers were written by Wing Commander P. White RAAF on the issue of advisory committees and the management of Defence Pathology Services. Here a strong case was made for a tri-Service laboratory manager. A later paper by Wing Commander White challenged the role of the PAWP Service consultants who he regarded as clinical pathologists and as such may not have a role in the management of ADF laboratories. In this latter paper, he proposed a Laboratory Management Advisory Sub-Committee and a redefined Pathology Advisory Group.

Suffice to say that, despite all these issues, the PAWP agenda and activities have expanded considerably and together with the regular meetings of Scientific Officers fulfil an eminently suitable laboratory management group.

#### **Clinical Matters**

The foundations of modern pathology certainly overlap much of clinical medicine and accordingly PAWP has been tasked with providing opinions on a variety of primarily clinical matters affecting the ADF. These tasks have mostly related to clinico-pathological aspects of infectious conditions such as hepatitis B, HIV-I infection and hepatitis C infection. Arising very much out of the deliberations has been ADF policy on screening for infectious diseases in all recruit entries and ADF members on deployment and posting to RAN ships.

The resultant workload of screening has had major impacts on ADF laboratories, providing considerable stimulus to staff. It has also provided a stimulus to the Combined Medical Capital Equipment Programme be-



cause of the necessity to have available the latest techniques and technology.

A research paper produced by Ms Cavanagh at BNH, ADF laboratories in their screening profile for infectious diseases were shown to be testing some 37 000 people per year. ADF laboratories currently performing infectious disease screening tests are:

- 1 Field Hospital, Ingleburn NSW
- 2 Field Hospital, Ennoger, QLD
- 3 RAAF Hospital, Richmond, NSW
- Balmoral Naval Hospital, NSW

Tests undertaken by these laboratories are shown in Table 2.

**Table 2.** ADF screening tests and target populations

Test	Target Population
HIV-1/HIV-2 antibodies	*
Hepatitis C antibody	*
Hepatitis B surface antigen	*
RPR	*
Glucose 6-phosphate-dehydrogenase enzyme	*
Blood Grouping	*
Pregnancy test	Female recruits
Rubella antibodies	Army female recruits
HTLV-1 antibody	RAN

\* - All Services

Malaria is such an important infectious disease on a world basis and change in malarial incidence is so critical that PAWP has long had a watching brief on this matter. We have had the opportunity to review some of these matters on at least two separate occasions with MRI (formerly AMRU) and have had the Director of MRI, Professor Karl Reickmann, attend a PAWP meeting.

Malaria abuts on PAWP directly in relation to G6PD screening of recruits and personnel since malaria therapy and prophylaxis may trigger haemolytic anaemia in those who are G6PD deficient. Although screening has taken place, haemolytic events have already occurred within the ADF, which we recognise now has a flavour of a multi-cultural and multi-ethnic background.

#### DNA Storage and Profiling

PAWP has been in active contact with the Surgeon General United States Army, and also the laboratories of the Armed Forces Institute of Pathology (AFIP) Washington, in regard to the possibility of storage of DNA of all serving Defence Force personnel. This is to allow for possible future forensic identification and not for any research purposes or law enforcement. AFIP uses PCR techniques and

a DQ-alphadot/biot for amplotyping and DNA testing.

#### HIV and HCV

In regard to HIV screening and infection, considerable attention was paid to this matter in the latter days of the PASC and the earlier days of PAWP. PAWP's advice, particularly on methods and feasibility of testing for antibodies to HIV, gave considerable assistance to the genesis of Defence policy on screening and testing for HIV infection, and also on the processing and documentation of such testing and screening results.

Over the last few years the problems relating to HCV infection and screening for HCV antibodies, as well as the management of ADF personnel who are HCV antibody positive, has occupied a great deal of PAWP's time. PAWP is the first to realise that knowledge of HCV infection is continually evolving and HPD 217, which relates to management and screening of HCV infection, will require continual review. For example, the knowledge of HCV genotypes and their clinical variability and response to interferon therapy will require incorporation.

#### **PAWP Meetings**

The aim has been to hold PAWP meetings twice per year. By and large this has occurred. The limiting factor to the occurrence of meetings is availability of funds principally to cover members' travel expenses to the meeting location.

PAWP has held meetings as far west as RAAF Pearce and as far north as 1 Military Hospital at Yeronga. However, meetings have been held predominantly in NSW and Victorian Establishments to limit travel costs.

Approximately half of the PAWP meetings have been held in Establishments at which an ADF laboratory is situated. PAWP takes the opportunity to make a familiarisation visit to that particular laboratory. Such a visit serves a number of purposes:

- it enables PAWP members to view the laboratory facilities and equipment at first hand,
- it enables PAWP members to meet the Scientific Officer and laboratory staff personally and vice versa,
- it enables PAWP to gauge the functioning and work load activities of the laboratory and to discuss at first hand any particular problems or issues which may be present.

PAWP meetings held where laboratory facilities also exist have been most successful for all concerned.

#### **ADF Pathology in Rwanda**

Following the tragedies in Rwanda in 1994, the Australian government decided to provide a medical team to the United Nations mission in that country. A four-person pathology laboratory was prepared, packed and deployed to the war ravaged country as part of the ADF medical support force.

A report on this deployment written by the Scientific Officer, Captain Caroline Bathgate RAAMC, gave detail of the technical staff and equipment deployed to Rwanda. PAWP was delighted to receive this report and to compliment Captain Bathgate and her Army team on this very fine activity. PAWP was also proud to be able to learn that many of its deliberations and recommendations had been available to the team. It is reasonable to say that much of the foundation for this pathology activity arose from advice offered by PAWP over the preceding years. Equipment deployed was as follows:

- Biochemistry – a Reflotron and Gen Primer Gas analyser;
- Haematology – Symex F500; and
- Blood Bank – DIAMED gel agglutination system

All this equipment was most valuable in the environment of the Kigali Hospital. An average total of some 1,200 pathology tests per month were performed. It is interesting to note the value of the Reflotron system in this environment, again a product of PAWP deliberations after the incompatibility of the earlier biochemistry analysers. In total, some 60 per cent of the workload was represented by Haematology and Biochemical analyses.

The laboratory operated 24 hours a day and in emergency cases, such as land mine victims and vehicle accidents, was called upon to provide blood and stat parameters. The pathology laboratory operated a blood bank and held 30 units of blood – the DIASMED system being used for cross matching. It is interesting in relation to blood supply to the ADF, that although originally sourced from the Australian Red Cross Blood Transfusion Service, there were in-country delays to the supply system and an alternative source became the Netherlands Blood Bank.

Captain Bathgate concluded that for six months the ADF provided an efficient and reliable laboratory to the United Nations Aid Mission in Rwanda. The laboratory main-

tained the standards set by the category 3 Army laboratory derived from and affiliated with the 1 Field Hospital Pathology Laboratory. Certainly PAWP was a long way from the practical day to day action, but can take some joy in being able to observe the effectiveness and efficiency of one of their team of ADF laboratories under the most trying of conditions and circumstances.

#### **PAWP and the Future**

It would seem that whatever happens to the structure of the ADF health services there will be a continuing need for PAWP to offer guidance and advice to the ADF in matters relating to the practice and implementation of pathology in its broadest sense. PAWP members have always been keen and willing to serve the ADF within a format dictated by the demands and command structure of the ADF. PAWP members have been the various Navy, Army and Air force consultants in pathology acting under the chairmanship of the Surgeon General's Consultant in Pathology who so far has been the senior member of PAWP.

In the final analysis, bound by its terms of reference, PAWP is an advisory committee. It cannot set policy or make executive decisions but simply offer advice as it deems appropriate. Buried in the PAWP files is a comment that PAWP might be more effective if it had a higher profile in the Health Services of the ADF. It is somewhat of a vicious circle – if funds are not available to PAWP to meet, it becomes difficult to present a high profile. However, a higher profile enables PAWP advice to have somewhat more strength in future ADF discussions regarding pathology matters. Certainly, PAWP members are happy to meet the needs of the ADF, ADF personnel and ADF laboratories in the future.

#### **Summary**

The Pathology Advisory Working Party is a tri-Service group of senior officers who are all consultants in pathology and individual service consultants who work in close collaboration with senior staff officers from the Office of the Surgeon General. PAWP has been offering advice on the practical, technical, management and clinical aspects of pathology to the Surgeon General and his staff and hence the ADF over the past 10 years. With great pleasure and participation, PAWP has been involved with and seen the implementation of a number of very positive steps in the improvement of the practice of pathology in the ADF environment. PAWP has participated with the ADF laboratories in the implementation of Quality Assurance Pro-



grammes, NATA registration, a strong movement towards commonality of pathology equipment, active participation in the combined medical equipment programme, production of an ADF Blood Transfusion Manual and Blood Banking Techniques Manual, policy guidelines on infectious disease management and screening, coordination with Scientific Officers in laboratory management and to a limited extent some clinical research in regard to the medical status of Defence Force personnel. A gold standard for PAWP and a

forceful desire is that benchmark standards of pathology practice in the ADF laboratories should be the same as their peer group in civilian practice. PAWP has held strongly to the view that the standards and accuracy of diagnostic and screening pathology available to any member of the ADF should be exactly as good as that available to the general public, and the Australian citizens in the ADF are well served by ADF laboratories and pathology practices.

# Stress, workload, and fatigue. Keeping on top of it all<sup>1</sup>

N Westphalen<sup>2</sup>

It seems likely that the rate of change currently within the ADF may have important medical implications for some individuals, including aircrew. For the latter in particular, the interaction between high stress levels, workload and fatigue may have significant operational and flight safety implications.

Stress and work overload, fatigue and environmental effects are only some of many factors, all of which interrelate with each other in ways which have considerable potential to form an accident chain.

Despite the fact that I'm a medical officer and not a psychologist, the aim of this article is to explain these interactions and provide guidance for their alleviation.

## Stress and Workload

Stress can be considered a reaction to adverse conditions. It can be considered to have three components:

- **Life stress** is produced by adverse occurrences in everyday life, ranging from the trivial to the overwhelming (I'll leave it to you to decide where DRP lies!)

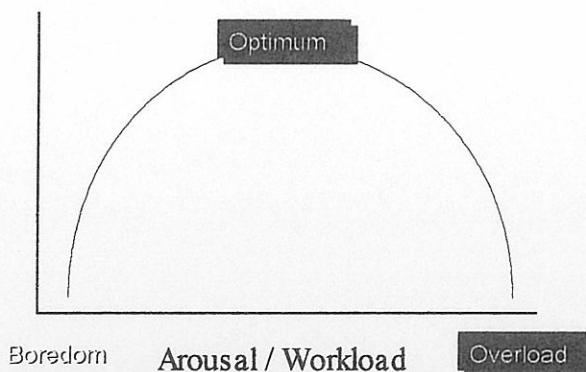


Figure 1

- **Environmental stress** is closely linked to specific activities (such as flying), and includes (for the sake of this article) fatigue, heat and noise.
- **Cognitive stress** is related to the specific activity being undertaken by the individual (ie the flying task itself).

Figure 1 illustrates the relationship between workload and performance. This shows there is an optimum workload level that gives maximum work performance. On either side of this happy medium work performance is reduced as the individual either becomes bored or overloaded.

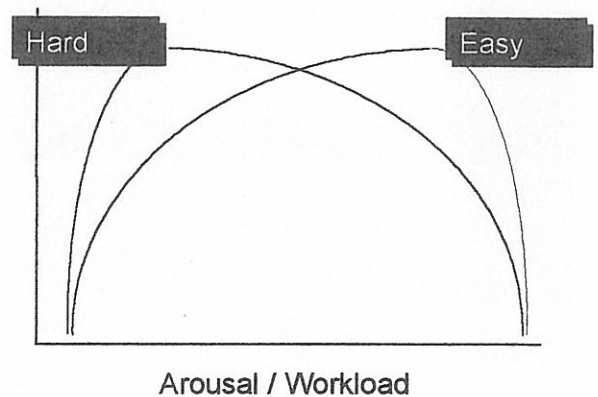


Figure 2

Figure 2 shows that the optimum workload also depends on task difficulty. Easy tasks are usually performed better at high workloads, while hard tasks are best performed at low workloads. Put another way, it's fairly self evident that it's easier to overload someone doing a difficult task than an easy one.

<sup>1</sup> Westphalen N. Stress, workload, and fatigue. Keeping on top of it all. *Aust Mil Med* 1998; 7(3):18-20  
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<sup>2</sup> Reprinted by kind permission of the Editor, Touchdown, the safety magazine of the Naval Aviation Force.  
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### Effects of Fatigue, Heat and Noise on Workload

Let's have a look now at some environmental effects on workload:

- **Fatigue.** If you're tired, your arousal level is reduced, and your performance is re-

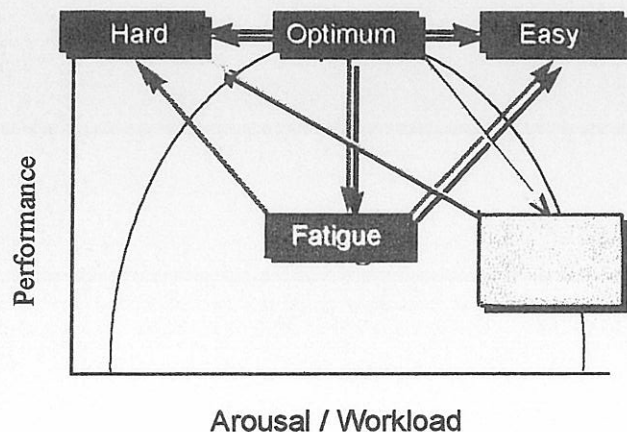


Figure 3

duced per Figure 1. Fatigue effects however do depend on the type of task being done. Performance while fatigued is **worse for long boring tasks than short interesting ones**, because of underarousal. On the other hand, **complex decision making tasks are affected more than simple, well known tasks** - it's harder to think through a complicated task if you're tired.

- **Heat.** If you're in a hot environment, your performance is also reduced, this time because of overarousal, and **performance of hard tasks** is more likely to be impaired.
- **Noise.** Noise is similar to heat. Older aircrew would probably be familiar with trying to concentrate on a difficult job despite their youngest and brightest making with the boom box in the next room.

### Overload

Aircrew routinely operate in a high workload environment and overload is a significant concern. Even in normal cruise rotary wing pilots are using all four limbs to fly the aircraft, while simultaneously looking in and out of the cockpit for orientation, using the radios and intercom, while sitting in a noisy, vibrating, often ill-lit and frequently hot and uncomfortable environment.

The workload increases further even in normal phases of flight (eg takeoff and landing). It becomes a real problem when things

are suboptimal, such as a deck landing at night in bad weather with a concurrent in-flight emergency.

Means of coping with overload include:

- **Omission** - some signals or responsibilities are ignored (usually when fatigued).
- **Error** - incorrect information processing.
- **Queuing** - delay during peak loads, catch up during lulls.
- **Filtering/Loadshed** - systematic omission of info categories according to priority (in the aviation context 'Aviate, Navigate, Communicate').
- **Approximation** - ('near enough's good enough').
- **Regression** - back to previously learned habit patterns (eg if recently converted to a new aircraft, performing actions appropriate to the **previous** aircraft type).
- **Escape** - eg, prayer.

Most of these mean things get missed. You may remember such incidents with aircraft you've been working with. It's evident that most of these coping mechanisms increase the likelihood of an accident.

### Workload Reduction

The scope to reduce workload is therefore somewhat limited once you're at the coalface. It can be reduced by:

- Good ergonomic design and attention to controls and displays,
- Selecting the right operators on entry and
- High levels of training, as this reduces the amount of mental effort required.

The name of the game therefore is to avoid getting overloaded in the first place.

### Fatigue

Aircrew should be familiar with the effects of fatigue. It is significant factor in aircrew error and accident causation. If you're not convinced, it is a factor in **30%** of all confidential incident reports in the UK.

Fatigue refers to a reduction in performance due to a combination of:

- Inadequate rest - ie no sleep!
- Disturbed biological rhythms - where people get their sleep but it's out of synchrony with their body clock, most likely in the RAN context due to shift work.
- Work overload has already been mentioned, but this time to point out that as well as creating problems **from** fatigue, it

also **contributes** to fatigue, thereby creating a vicious circle.

#### How Much Sleep?

US studies indicate five hours sleep per day can maintain performance (but not mood) for up about two weeks, after which it has to be made up somehow.

However, mood changes have significant implications in the aviation context as it affects crew teamwork and cooperation, aka Crew Resource Management (CRM). Good CRM is important both for flight safety and mission effectiveness. To avoid this problem, for **optimum performance the full eight hours sleep is required**.

Just as importantly, sleep is most effective in alleviating fatigue if it's all in one go.

On less than five hours sleep per day, reasoning and judgement are particularly affected early on, affecting performance of complex tasks as previously discussed. Ongoing sleep deprivation will result in decreasing alertness and increasing susceptibility to:

- Disorientation,
- Work overload and
- Motivation (and effects on mission accomplishment).

The key issue is that the **actual motor skills required for flying are the last to be affected**. This means that a tired pilot may be able to physically fly the aircraft, but his/her reasoning and judgement is significantly impaired, reducing their ability to meet mission requirements or cope with emergencies.

Perhaps less obviously, because judgement is affected first tired people **cannot assess how tired they are**. Even if you feel OK, it is possible to detect significant decrements in psychomotor performance due to fatigue.

That's why minimum rest periods are spelled out as SOP's in aviation organisations

(in our case ABR 5150). It explains why CO's are responsible for authorising all aircraft operations, and why delegated Authorising Officers should **not** normally be a crewmember for a particular flight.

#### **Conclusion**

OK you all have a job to do, but at least some of you operate this asset which has within it a large part of your ship's capabilities. The problem is that, while the aircraft may be capable of 24-hour operation, you and (just as importantly) your maintainers aren't. Unfortunately, this will continue to limit operational flexibility unless there are sufficient personnel to match the aircraft.

From a medical viewpoint there's a need to bear in mind the following:

- Firstly, flying is not a normal physiological activity. This particularly applies to helo operations, even without the added complications from operating off the back of a small ship in frequently adverse conditions.
- The importance of human factors in accident causation cannot be overstated. Overload, fatigue, heat, noise and disorientation are only some of many factors, all of which interrelate with each other in ways which have considerable potential to link together into an accident chain. Recent ADF incidents well demonstrate what can happen if the aviation environment is taken for granted.
- SOPs are therefore in place to reduce the risk, but they will only work if they are actually followed, both by the Command and by ship's flight personnel.

The advice overall therefore has to be for all players to accept the resulting limitations and plan accordingly.



## Book Review

### Jutland. The German Perspective. A New View of the Great Battle, 31 May 1916 by V.E. Tarrant

Reviewed by Vic Jeffrey<sup>1</sup>

It is now history that Australia's first flagship, the battlecruiser HMAS *Australia*, missed the Battle of Jutland after a collision in fog with her sister ship HMS *New Zealand*.

*Australia's* withdrawal for repairs saw the RAN not represented at one of the greatest naval battles of all time. However, Australian ships to have carried the battle honour "Jutland 1916", inherited from RN ships participating, have been the survey ships HMAS *Moresby* I and II, HMA Submarines *Onslow* and *Orion*, and HMA Ships *Nestor*, *Ardent* and *Attack*.

Like the still unsatisfactorily explained loss of the cruiser HMAS *Sydney* II more than 56 years ago, the 82 year controversy of who won the Battle of Jutland still arouses much debate and intrigue among students of naval strategy and history.

Surprisingly, this classic sea battle has never been studied from a German perspective previously. Now, for the first time in the English language a unique and balanced assessment of the German view of the Battle of Jutland is possible.

Well-known British naval historian V.E. Tarrant has created a commendable new study of the Battle of Skagge (as the Germans know Jutland). In his normal impeccable style, Tarrant has drawn on many official archives, action reports, High Fleet Operations staff papers, many other sources and translations of documents about the battle and the results of this clash of the two most powerful navies afloat at that time.

The battle was itself inevitable after years of competition with each other in construction design and armament, which one day would lead to a final decisive showdown that would decide the war at sea.

Up until Jutland, the single decisive battle hoped for by British strategists remained elusive as the Germans carried out a

series of bold hit-and-run bombarding raids on British coastal towns. This stung the pride and sense of fair play of the Royal Navy. Until Jutland, fleeting chance encounters between isolated British and German units and the missed opportunities of Dogger Bank and Heligoland Bight, saw the ultimate decisive battle remain elusive.

History records that the Battle of Jutland finally took place on 31 May to 1 June 1916 in the North Sea as the German High Seas Fleet planned precisely their concentration against the numerically superior British Grand Fleet. The time and place was of German choice, having successfully lured the bulk of the British Fleet into a trap in German waters.

A combination of bad weather, bad luck and the permanent weakness of Great War battles – poor communications – meant the battle became a confused, illogical but desperately hard fought conflict.

The Battle of Jutland was claimed as a victory by both sides. The Germans claimed success as the Royal Navy lost more ships and men, whilst the British based their claim on the fact the German fleet never again ventured out of harbour to seek battle. In reality, it was a defeat for the German High Seas Fleet.

British losses were 6 945 (6 094 killed, 674 wounded and 177 taken prisoner) whilst German casualties were 3 058 (2 551 killed and 507 wounded). The major British casualties occurred when the battlecruisers HM Ships *Queen Mary*, *Indefatigable* and *Invincible*, blew up, losing 3 309 men.

In 16 chapters this book cleverly shows the lead up to the Battle of Jutland, the action, and the aftermath. It is supported by 10 excellent appendices which cover the numbers of hits sustained, shells and torpedoes fired, casualties, ships involved, etc.

<sup>1</sup> Vic Jeffrey, OAM, is the Navy Public Affairs Officer in Western Australia. Address for Correspondence: Mr V. Jeffrey, Navy Public Affairs, HMAS STIRLING, Rockingham WA 6158

Supporting this most authoritative text are 85 detailed action maps, accurate scale drawings, and silhouettes of all major warships and classes from each side.

Published by the acclaimed Arms and Armour press of London, and distributed in Australia by New Holland Publishers of 3/2

Aquatic Drive, Frenches Forest, NSW, this 318 page book retails at \$54-95: not cheap but worth every cent. Apart from being a most engrossing read, "Jutland, The German Perspective", fills a void in the history and understanding of this great action.



# *7<sup>th</sup> Annual AMMA Scientific Conference Report*

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## Swiss Grand Hotel, Bondi Beach

Russ Schedlich

The 7<sup>th</sup> Scientific Conference of the Australian Military Medicine Association was held from 16 to 18 October 1998 at the Swiss Grand Hotel, by the beach at Bondi, Sydney.

The official opening, by Rear Admiral Peter Briggs AO CSC, Head Strategic Command Division, took place on the Friday evening, and was followed by a paper by Dr Richard Morris on the issues facing him as the medical commander at the site of the 1997 Thredbo landslide disaster. Dr Morris's dissertation was an illuminating insight into the similarities between the medical management of a disaster site and many aspects of operational military medicine.

The first day opened with an Address by the Association's new Patron, and Surgeon General of the Australian Defence Force, Major General John Pearn. The Keynote address was given by Captain Art Smith, USNR, and focussed on the challenges unique to military medicine, and in particular naval medicine. Alluding to the logistic challenges facing medicos at sea, he demonstrated clearly the problems and limitations imposed in adequately caring for the large numbers of casualties that are inevitable in war, and occur on a regular basis in peace.

The papers read over the two days of the Conference maintained a very high standard, and covered a wide variety of subjects, including operational support, clinical specialties, occupational and environmental health, history, psychology and preventive medicine.

The 'Weary' Dunlop Award was won, for the second time, by Squadron Leader Dave Newman RAAF, who spoke on the physiologi-

cal challenges of supermanoeuvrable flight. This type of flying is the face of the future of military aviation, and solutions to the problems faced by pilots will be demanded.

The Conference proceedings were interspersed with refreshment breaks for social interaction, where delegates had the opportunity to visit the Trade Display led by the Association's principal sponsor, Smith Kline and Beecham.

The Conference Dinner was a great affair, with much conviviality. As a change in format, a military medicine quiz was conducted. With self-assessment, scores ranged from a respectable (and honest) 25 to 253 (there were only 18 questions). Fortunately, any disputation on scores was academic as there was no prize. The questions and answers are included in this Issue.

At the end of the Conference, delegates returned to the mundane affairs of their profession refreshed and invigorated. Next year's Conference will be held in Adelaide from 8 to 10 October.

### Conference Exhibitors:

- Smith Kline Beecham – Major Sponsor
- Astra
- Roche
- Ego
- CSL Pharmaceuticals
- Defence Health
- Essex Pharma
- ParkeDavis
- GMS Marketing
- Uvex Safety

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# The Role of Viagra Eye Drops in Australian Military Medicine.

## President's Welcome to the 7<sup>th</sup> AMMA Conference

Nader Abou-Seif

Good morning and welcome to the 7<sup>th</sup> National Conference of AMMA. Why this title for a President's Address? As anyone who has been subject to the media of late has seen, Viagra has recently been introduced to Australia. In keeping with tradition this has been associated with a number of jokes – not all of which are suitable for public consumption. One of these is – Have you heard of the use for Viagra eye drops? It's for those who need to have a long hard look at themselves.

I suggest that the annual AMMA Conference provides us all with the opportunity and the venue to do just that.

If you ask anyone in the Australian Military Medical Community: What is the state of military medicine in Australia today? I believe that their answer would depend on the kind of day they had been having.

We have had a period of profound change within the military part of our community. Many people have reported uncertainty in the effect that the day to day changes will have on their abilities to carry out their primary roles.

What does this mean to us? Where does military medicine, in both the service and non-service communities stand?

Those of you who have heard me speak in the past may have noted a certain theme in my presentations. These are heritage, commitment and achievement. Those who attended last night's presentation on the Thredbo disaster would have heard terms familiar to us all – command and control, rapid mobilization, casualty evacuation. Modern health services owe a huge debt to practitioners of the art of military medicine.

EMST, medical evacuation, triage are things we all think of as having their roots in military medicine. Trauma surgery whether general, orthopaedic or maxillofacial has by

its very nature a military nature to it. Modern nursing has its historical origins in the Crimea. Human Factors and ergonomics have their roots in safety management issues arising during the Second World War. Tropical medicine has developed with contributions ranging from those of Walter Reed to those of our own Malaria Research Institute.

AMMA is a relatively new organisation. In our short time we have attempted to provide a focus for the excellence that exists in the Australian Military Medical Community and also in the wider international arena. Our practitioners have served in numerous areas of the world. Providing disaster support, in fields of conflict, in a peace-monitoring role, in clinical situations often in the most difficult of circumstances and in research in all fields of military medicine both in and out of uniform.

This year's conference program promises to add to a growing tradition. We are fortunate to have as our guest speaker this year Captain Arthur Smith whose experiences and thoughts on Casualty management will be of interest to us all. Research and training in the Armed Forces are highlighted, as are recent experiences during overseas deployments. We look at two extremes of stress management dating from the Boer War to the present day. As always lessons from history are not to be forgotten, for in looking forward we must take aboard the lessons of the past.

I look forward to joining with you in both the academic and social parts of this conference. Our traditions are young but solid and growing. Which brings me back to my opening remarks. The role of Viagra eye drops in Australian military medicine: we are getting bigger and better.

Thank you.



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## Opening Address

Rear Admiral P.D. Briggs AO, CSC, RAN

Thank you for this opportunity to present the opening address to the seventh annual conference for the Australian Military Medicine Association. Admiral Barrie extends his apologies and wishes you well for the conference.

The program for the conference appears interesting and diverse and should provide the basis for plenty of thought provoking discussion. Whilst personally relating to the nautical topics such as the after-math of the tragedy aboard Westralia and Appendicitis at Sea. Having experienced the occasional drama whilst serving as the XO of a submarine, and therefore allegedly the Medical Officer - a misdiagnosed appendicitis and an anxious 30 hour dash for shore, it is the PNG Tsunami disaster that strikes a particular chord.

When the magnitude of the Tsunami disaster was finally realised, little doubt existed that support would be immediately required and, typical of the professionalism and willingness that has become the hallmark of the ADF health services, we were able to put the first of the health teams on the ground in Vanimo within 48 hours of the disaster occurring.

Initially working in conditions must have been similar to those experienced in this region during World War II. ADF health teams were able to treat and sustain the lives of survivors, until a more sizeable relief effort was mounted. It should be mentioned that 155 operations were performed, most in the first 4 days and 270 people were treated. International accolades reflected positively on the ADF.

It is this ability to perform under arduous and rudimentary conditions that has won the ADF health services the affection and admiration of countless survivors of war and natural disasters at home and the world over. You have some marvellous role models to aspire to, epitomised by such names as Weary Dunlop and Vivian Bulwinkle.

Associations like AMMA provide the forum for the exchange and promotion of valuable research in such fields as aviation, underwater, tropical and trauma medicine. Health is a vital component to the support of ADF personnel engaged in combat and op-

erations other than war, and at times will lead the nation's response in such areas as Humanitarian operations.

The health service focus is therefore clearly and correctly in support of operations. Its vision is to be "a world class Military Health Service" and I think there is evidence to suggest that this vision is well on the way to being achieved. It is no accident that the UN regularly requests ADF health support for its operations, recognising the quality of the support that can and has provided.

The 5 Defence Health Service goals of:

- providing a fit and healthy Defence Force,
- casualty prevention,
- casualty treatment,
- development of health capabilities to support the ADF into the next century, and
- maintenance of the ADF health system,

are well advanced and support the current environment of change afoot in the ADF today.

Goals such as these will optimise individual health readiness, which contributes to mission success and maximises manpower available for duty. They also enhance health or recovery from illness, providing a quality of life for the individual whilst reducing health related costs. Key stake holders such as CDF, are able to view the Defence Health Service as adaptive to change and committed to delivering cost effective health care and promotion, along with prevention of disease and injury.

The health service is well advanced in the DRP and the change imperative entailed. Perhaps the most striking challenge is the establishment of a truly joint organisation. Outcomes to date include the formulation of a medical categorisation system common to the three Services, the streamlining of health administration, and the ability to seamlessly deploy health elements staffed by members from all three Services on operations. The medical service has always shown the way in utilising the skills of our reservists, I note the recent appointment of Major General Pearn as Surgeon General and three Assistant Surgeons General, Commodore Habersberger, Air

Commodore Short and Brigadier Atkinson, all reserve officers.

The health service has also adopted a forward-looking stance. Whilst the ADF's primary focus is on war fighting, there is little doubt that factors such as environmental threats have to be recognised in the military context. Recent examples that spring to mind are the PNG Tsunami and drought, and Bougainville chemical pollution.

Projects such as JP 2060, commissioned to look into the ADF deployable Medical Facility, are playing a vital part in analysing the role of the health service in the next century and positioning the organisation to be ready to meet those challenges . . . both in terms of people and equipment. The commissioning of HMA Ships *Manoora* and *Karimbla* will provide a new dimension in provision of health care with their afloat support capability.

Despite the heavy constraints evident in the post DRP environment, ADF Health has continued to provide excellent support. This achievement is largely the result of the quality of the people, their commitment, dedication and tenacity contribute to the team approach in which interdependent members from each of the three services, Active and Reserve, work shoulder to shoulder to achieve the outcome.

As the Chinese curse foretells, we live in interesting times. As the ADF's strategic level crisis manager I can attest to this, in the past 20 months we have prepared some 16 operations, in each there has been key health service input and involvement. To mention a few:

- Op Pollard - the deployment to the Gulf, required preparation to operate in an NBC environment;
- Op Blazer - health support to UNSCOM (primary health care and expert inspectors);
- Op Aus Indo Jaya - drought relief in Irian Jaya;
- Op Bel Isi - the PMG in BGV, with a level 3 health facility deployed as an integral part of the mission, has made a very significant contribution to the peace process.

In addition, there has been an increased incidence of the ADF deploying to provide humanitarian aid, an area in which the Defence Health Service has been a major contributor. This has seen a shift away from the ADF's traditional role of the Defence of

Australia to an increasing emphasis on supporting Australia's global interests.

These are exciting yet turbulent times.

We have seen our region change from prosperity to uncertainty, requiring what seems to have been our continuous attention and aid over the past 12 months. Places such as Indonesia and PNG required drought relief, tensions have emerged between Malaysia and Singapore and there is the long term, complex problem of bringing peace to Bougainville. Further afield, are the ever-present uncertainties in countries such as Korea, the Indian Sub Continent and the Gulf, which continue to require our attention.

Let us not forget the uncertainties created within our own Defence Force by the elements of change, compounded by for the ADF to transition into a new millennium, continuing to support operations such as those mentioned and project a force capable of deterring an attack on Australia's sovereignty.

In this climate of change it is ironic that one of the smaller branches has had the most sizeable chunk of operational experience over the past decade - a branch that relies heavily upon the cooperation and expertise of its reserve officers. In this regard I note some progressive work on Conditions of Service for reserve officers, but would observe that progress in this complex industrial realm has been slower than ideal.

In the present climate of change, the challenge for AMMA is to continue to maintain professional knowledge and expertise at high levels, encouraging the development of new ideas which improve the provision of health care to personnel in the Defence forces. In playing a pivotal role in retaining within the medical community at large, an awareness of the special needs of military medicine, it can positively contribute to ADF capability.

AMMA and conferences such as this must strive to be instrumental in smoothing the process of jointery and the cooperation between the three Services to achieve a common goal. It must acknowledge the worth of all aspects of health care that comes together in situations such as Vanimo, Rwanda and Bougainville.

As I said, these are exciting, yet turbulent times. Challenges that I am sure you will rise to.

General Pearn, it now gives me pleasure to officially open the 1998 and 7th annual Australian Military Medicine Conference. I wish you well for the weekend.



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## AMMA Official Dinner – Quiz Questions

1. What two British military calamities occurred in the same month, exactly one hundred years apart? What vitally important medical aspect was associated with one of these?
2. What type of warfare was first used at Caffa in 1346? What was the weapon system used?
3. In what years and what cities and venues were the first 6 AMMA Conferences?
4. Who was the Japanese medical officer in charge of the infamous Unit 731 biological warfare unit between 1938 and 1942?
5. Who was the medically trained pilot who was the first aviator to die in WWI?
6. What characteristic is shared by two of the three double VC winners? What lesson does this portray?
7. What animals were used in early diving decompression experiments? Why?
8. What was the fate of the third of what arguably was the least successful class of passenger liner? What function was she performing at the time?
9. What was the name of the theme song for MASH?
10. What were the three biological agents weaponised by Iraq in 1990?
11. What gas was used in the first gas attack in April 1915?
12. Name the month and year of the sinking of the *Centaur*?
13. Why was Corporal O'Reilly known as 'Radar'?
14. How was Achilles (apart from his heel) protected from injury during combat?
15. What two unusual animals did Hannibal utilise in his military career?
16. What Quixotic military medical incident occurred in Port Hedland in 1983?
17. What was the name of the last Royal Navy submarine to sink? Where did this occur?

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*The answers will be included in the next edition of the Journal.  
There is no prize (and there wasn't on the night).*

## Conference and Meeting Calendar

Conference	Venue	Date	Contact No.
SPUMS Annual Meeting	Malaysia		(03) 9885-8863
AFOM Training Course	Perth, WA		(02) 9247-8082
RACP Annual Scientific Meeting	Perth, WA		(08) 9322-2666
Controversies in Civilian and Military Trauma	Brisbane, QLD		(07) 3395-5743
AAPM Conference	Melbourne, Vic		(02) 9439-6744
8th AMMA Conference	Adelaide, SA	8-10 Oct 99	(03) 6247-1850

### AMMA on the Net

A few useful internet addresses:

Australasian College of Tropical Medicine - <http://www.jcu.edu.au/dept/PHTM/actm97.htm>  
International Society of Infectious Diseases - <http://www.isid.org>  
NEJM Journal Watch - <http://www.jwatch.org>  
Medical Journal of Australia - <http://www.library.usyd.edu.au/MJA/>  
SPUMS - <http://www.spums.org.au>  
RACP - <http://www.racp.edu.au/>

# AMMA Update

News and information for members of the Australian Military Medicine Association

## Successes

The following AMMA members have achieved success through honours, awards, promotions, publications, etc.

Members will note that, while these items are more accurate, they are not complete. The Assistant Editor needs sources of information from the three Services and from our civilian members as well, so that this section of your journal can truly reflect the cross-section of our membership. Updates can be faxed to CMDR Andy Robertson on 09-5532600 or e-mailed to: [agrobert@vianet.net.au](mailto:agrobert@vianet.net.au)

## Defence Force Promotions

The following AMMA members have been selected for promotion in the Defence Forces:

- WGCDCR Tony Austin to GPCAPT
- CMDR Graeme Shirtley to CAPT
- MAJ Darren Keating to LTCOL
- MAJ Carmel Van Der Rijt to LTCOL
- CAPT Nerida Burnie to MAJ
- WO Steve Prigg to CAPT

## Defence Force Awards

The following AMMA members have received awards:

- Peter Mitchell Prize for the best RAN officer for 1998 - LEUT John Lodder RAN

- Prince of Wales Trust Award LCDR Fabian Purcell RANR
- AMMA NBC Prize - Awarded to WGCDCR John Turner

## Defence Force Movements

The following AMMA members have posting/deploying to new roles and functions:

- MAJ Mike Rowell deployed to Iraq in Sep 98. He is the UNSCOM SMO for the next six-month tour.
- SQNLDR Mike Seah returns to RAAF Pearce after six weeks in Bougainville.

## AMMA Conferences

### 1999 Conference

The 8th AMMA Scientific Conference will be held in Adelaide on 8-10 October 1999.

## AMMA Contacts

For all general AMMA enquires contact the Secretariat:

Paula Leishman

Tel: (03) 6247-1850

(0412) 875 390

Fax: (03) 6247-1855

## Research Grants

Details of the AMMA Research Grant programme are included in this journal. Members are reminded

that applications for the 1999 Research Grant must be received by 30 April 1999. Further details on the Grant can be obtained from:

Janet Scott:

Tel: (08) 8272-7399

## Journal

Journal's for 1999 will be published as follows:

Issue	Copy Deadline
March 1999	31 January
August 1999	31 June
December 1999	31 October

All queries regarding the Journal should be directed to:

Russ Schedlich

Tel: (02) 9563-4504

(018) 47-3133

Fax: (02) 9563-4519

## Library

The Association's Library is located at the Fleet Medical Officer's office, Maritime Headquarters Sydney. Any member who wishes to browse through the Library (and visit the Librarian for coffee) is welcome to call.

Books from the library are available for loan of up to 12 weeks. Contact:

Russ Schedlich

Tel: (02) 9563-4504

(018) 47-3133

Fax: (02) 9563-4519



## **CONTRIBUTIONS**

*for the April issue should be sent to:*

The Editor  
Australian Military Medicine  
PO Box 730  
PYMBLE NSW 2073

***Deadline is 28 February 1999***

### **Instructions for Authors:**

Articles submitted for publication in *AMM* should conform to the following guidelines:

- two hard copies should be submitted, typed double-spaced on A4 paper (single-side)
- if possible, an electronic copy on an IBM formatted 3.5 inch floppy disc in a standard word processing programme should be submitted
- the text in both hard and electronic copies should be unformatted
- references in the text should be numbered consecutively as they are cited and annotation of the references should accord with the style given in *Index Medicus*. Where there are seven or more authors, list only the first three then *et al*. For example:  
Szilagyi M, Dawson RM. Phosgene - A research review. *Aust Mil Med* 1995; 4(2):16-19
- figures and tables should be submitted separately with an indication in the text as to where they should be located
- the originals of all photographs, ECGs, EEGs etc should be submitted to allow high quality reproduction

Articles submitted may be subject to peer review. Articles which have been published elsewhere will only be considered if they are of importance to the field of military medicine, and publication will only proceed with the prior approval of the original publisher.



# Australian Military Medicine

## Volume 7 Number 3

### December 1998

The Australian Military Medicine Association  
Patron

Major General J.H. Pearn, AM RFD  
Surgeon General, Australian Defence Force

President Nader Abou-Seif  
Secretary Fabian Purcell  
Journal Editor Russell Schedlich  
Assistant Editor Andrew Robertson

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### DISCLAIMER

The views expressed in this journal are those of the authors and do not reflect in any way official Defence Force policy or the views of the Surgeon General, Australian Defence Force or any military authority.