



# AUSTRALIAN MILITARY MEDICINE

**June 1994**

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# Australian Military Medicine

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### June 1994

Patron: Major-General D.G. Rossi RAAMC, Surgeon General,  
Australian Defence Force  
President: Squadron-Leader James Ross RAAF  
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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

## From the Editor

The editor, about to embark overseas for a while to pick up the first of the RAN's second-hand USN tank landing ships (to be named HMAS Kanimbla), is lost for a controversial topic to write about (and those who know the editor will be surprised to learn that he is lost for words!).

The two ships (the second is HMAS *Manoora*) that are to be bought (US Congress agreeing) will add a significant capability to the ADF. Not only will they provide a platform for appropriate helicopter support to operations, and transport for up to 900 troops, but it is planned that at least one of them will incorporate a level 3 health facility, with 2 operating tables, 8-

bed high dependency unit, and up to 40 medium to low dependency beds. For the first time for many years, therefore, the ADF will have the infrastructure to effectively meet any casualty outcome likely to occur in maritime or amphibious operations.

It will be nearly two years before the ships are modified, but the wait will have been worth it.

*Russ Schedlich*

## CONTRIBUTIONS

Contributions for the October issue should be forwarded to:

The Editor  
*Australian Military Medicine*  
PO Box 373  
MOONAH TAS 7009

Deadline is 15 September 1994

## President's Message

During the recent College of Physicians meeting, Military Medicine received a compliment, which while pleasing to hear, came as a bit of a surprise to me and to many of the delegates. It related to the military's advances in the prevention and management of Critical Incident Stress Debriefing/Post Traumatic Stress Disorder. That the military was doing some ground breaking work in the field, actually leading civilians in certain areas, was seen as being unusual. My surprise was not that there were areas that the military had expertise beyond civilian practitioners, but that it was receiving some recognition. The reality is that those practicing in health fields in the military are often viewed as doing something that is somehow beneath them, that their talents are being wasted, or that they are only in the military because there is a lack of talent.

The only way of convincing our colleagues that we have legitimate and often unique skills is by having a far higher profile. I hope that AMMA will be able to contribute to this process, but to some extent, in this forum, only the converted are being

reached. There is a need for greater communication of the projects, activities and research conducted by military medical professionals. The main forums for this are other professional bodies. Not only will these disseminate valuable information to a wider audience, but they could stimulate further interest in military medicine.

This publication, *Australian Military Medicine*, is also very important to grow and flourish, as it will develop further into something of a flagship for AMMA and by proxy for the military medical community in general. It is in the public domain for scrutiny and comment, either positive or negative. It is in all our interests to see it continue to strengthen.

The range and quality of papers submitted for this years' annual conference is extremely heartening. Forty-six papers were received, nearly twice the number of last year. It is clear that the capacity for a high quality journal is present.

I look forward to seeing you in Melbourne, July 22-24.

*James Ross*

### 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.

# Letter to the Editor

## Specialist health care at sea

*From: Colonel Rob Atkinson RFD, RAAMC*

*Commanding Officer, 3 Forward General Hospital*

I note with interest your article on specialist healthcare at sea.

28 April 1994

In a small country such as ours with huge distances both at sea and on land, we need to maximise the efficiency, integration and multi-tasking of all our military assets. This applies most certainly to military medicine, and I would like to remind you of the development of the Mobile Field Surgical Team concept over the last ten years at 3 Forward General Hospital, Adelaide.

There are now three such teams of 25 beds, one operating theatre, two surgeons, anaesthetist and 25 people overall. This team is designed to be air and rail portable, and particularly could be placed on a platform at sea.

You have mentioned the 1 000 bed United States Hospital Ship *USNS Comfort* and the first of these vessels was in fact a naval vessel with a US Army Field Hospital on board during the Second World War. Unfortunately it was hit by a kamikaze and sunk.

There is no doubt that the naval platform needs to have some dedicated aspects to provide specialist health care at sea but the basic military medical unit should be tri-Service in staffing and of one flexible concept, and I would put it to you that the Mobile Field Surgical Teams fulfil this.

At 3 Forward General Hospital we are working towards developing varying specialist modules - for example, a Burns module - and, once again, these can be used to augment any medical facility depending on predicted need; if all the specialist modules are combined, hey presto! a fully functioning modern hospital.

My plea is for tri-Service co-operation in development and let us not re-invent the wheel.

### The author replies

*Colonel Atkinson makes a useful contribution to the discussion on the provision of specialist health care at sea, but he should not presume that I am totally parochial in my pursuit of this capability.*

*It is true that hospital ships in the past have generally drawn their medical manpower from the Army, but there is no logical reason as to why this should be so. Indeed, in the more recent past there has been a tendency for Navy medical personnel in both the USN and RN to provide the manpower for Primary Casualty Reception Ships and Hospital Ships (in both the Gulf and Falklands Wars).*

*Of course, there is no logical reason as to why this should be so either. Suffice it to say that, whilst allowing, accepting, and encouraging the three Services to share their knowledge and experience, and to assist each other in operational deployments, there is widespread acceptance that each Service should also be capable of providing the appropriate level of health care support within its operational environment. And that is merely what Navy is now seeking to do.*

*There are vast differences between operating in the field and at sea. Obvious considerations are the lack of space on board a ship, and the constant motion of the sea. Less obvious are such things as relative isolation, and the impact of operational constraints on the health care process (holding policies are much more susceptible to operational requirements at sea than on land).*

Colonel Atkinson also suggests that a Mobile Field Surgical Team is designed to be placed on a platform at sea. This would presume that the facilities and equipment are already in place; if not, I suggest that any land based surgical unit would find it almost impossible to adapt its facilities and equipment to the maritime environment - containers made of aluminium-sandwiched cardboard are not durable enough to stand the external and internal stresses caused by constant rolling and pitching, and some medical equipment will fail in similar circumstances.

Finally, we are not reinventing the wheel. But nor are we blindly accepting doctrine and practices developed in an operational environment completely different from the one in which we work. The practices of any organisation benefit from outside scrutiny, ours no less than the other Services'. This is not to be feared, but to be encouraged. I have no doubt that in both operational and exercise play, Army and Air Force will be welcome to participate in Naval casualty management, but they should acknowledge that Navy are the experts at putting to sea.

Note from the Editor

Controversy and discussion at last! And note that one of the joys of being editor and author is a totally free hand in reply!!

## Review Articles

### Combat related military roles and early pregnancy. A review

Stephen Robson, BMedSc, MB BS

#### Introduction

Deployment of female members of the Australian Defence Force (ADF) in combat related roles is finally a reality, and much has been done to dispel the cultural myths which formerly enshrouded the matter. It is clear that there are no reasons why women cannot effectively serve alongside men in combat, provided some differences in physiology and strength are recognised. Reviews of the health of combatants in Operation Desert Storm have now been published, and confirm that few differences exist between the stamina and health of men and women on active service<sup>1</sup>. An area of especial importance is the effect of military activities on early pregnancy, a subject that has not been specifically addressed in the recent literature of military medicine. This paper will review two high profile combat related activities - diving and fast jet aviation - and what is known of their effects on early pregnancy. Suggestions for further research will be made.

#### Diving and Early Pregnancy

The uteroplacental and foetal circulation in humans is still poorly understood, despite recent advances in technologies such as Doppler waveform analysis. Interference with the uteroplacental circulation in early pregnancy has now been linked with foetal wastage and some congenital abnormalities, such as limb reduction defects, as analyses of pregnancies subjected to early chorionic villus sampling are now revealing.<sup>2,3</sup>

Underwater diving invokes several potential mechanisms which could conceivably interfere with uteroplacental circulation and foetal circulation: compression, decompression, and the treatment of decompression sickness with hyperbaric oxygen. It is worthwhile noting at the outset that reviews of perinatal outcomes in women who have dived during pregnancy are scanty and suffer from quite major selection biases and poor control matching. For example, Bolton<sup>4</sup> published a survey of 208 female divers selected by their responses to magazine advertising. He found that there was a significantly greater incidence of 'birth defects' in women who have dived, although the numbers were small, and women who had children born with birth defects would be much more likely to respond to such a survey.

Assali and colleagues<sup>5</sup> have detailed their experiments on pregnant ewes near term, subjecting them to hyperbaric oxygen. They were able to demonstrate a decrease in uteroplacental blood flow in response to the hyperbaric insult, but the experimental methods were crude, involving spinal anaesthesia and marsupialisation of the foetus to the maternal abdominal wall. The following year (1969), Telford's group from Washington showed an increased foetal wastage in early pregnancy in the rat subjected to hyperbaric oxygen, but not to hyperbaric air or 100 percent oxygen at normal atmospheric pressure<sup>6</sup>. Their conclusion was an emotional plea:

"The clinician, who contemplates placing a pregnant patient in a hyperbaric chamber, should weigh seriously the possible tragic effects that such treatment may have on the foetus".<sup>7</sup>

A quite remarkable paper appeared in *Undersea Biomedical Research* in 1978<sup>8</sup>, reporting the results of elaborate experiments on pregnant sheep. The foetomaternal circulation in the pregnant ewe is dynamically similar to that of humans, and the group set out to elucidate the effects of compression and decompression on this circulation. Seven pregnant sheep, all within seven days of term, underwent hysterotomy and exteriorisation of the umbilical cord. The cord vessels were dissected out for a length of 5cm, and Doppler transducers were attached to them in an attempt to assess bubbling in the foetal circulation. Their experiments demonstrated massive bubbling and foetal decompression sickness if the mother was subjected to a simulated no-decompression dive to the equivalent of 100 feet of seawater (30.48mSv) for 25 minutes.

This result was dramatic and unexpected, and was quite at variance to clinical experience. Stock's group, from Wisconsin, repeated the experiments using non-invasive monitoring of the foetal circulation and found no evidence of any increased foetal susceptibility to decompression sickness<sup>9</sup>. The inescapable conclusion was that the major surgical manipulations to which the sheep foetuses had been subject were entirely responsible for the quite artefactual results.

The group did concede, however, that:-

"Our results do not apply to diving during early pregnancy when it is possible that bubbling may result in birth defects and possible abortion. In addition, our evidence should not be used to defend the safety of SCUBA diving during pregnancy because the foetus may be uniquely vulnerable to injury by intravascular bubbles should they occur".<sup>10</sup>

Gilman and colleagues published the results of a study of pregnant hamsters subjected to repetitive dives to 140 feet of seawater (42.67 mSv) in 1982<sup>11</sup>. They did not note any increase in malformations or perinatal deaths as compared to their controls. Likewise, exposure to hyperbaric oxygen did not seem to increase the rate of malformations or foetal loss. Their major finding was a marked increase in foetal malformations if the hamsters developed decompression sickness in early pregnancy.

In summary, the data on the effects of diving on early pregnancy are scanty and contradictory, and studies on perinatal outcomes on humans who have dived during pregnancy are lacking. The most consistent theme is that uteroplacental circulation in early pregnancy may be sensitive to the effects of bubbling and that there is clear evidence that such insults (for example, by chorionic villus sampling) may increase foetal wastage and render the developing foetus prone to congenital malformations.

#### **Military Aviation and Early Pregnancy**

A significant number of females are currently engaged in both commercial and military aviation, and some aspects of aviation medicine in later pregnancy have been well described. Potential problems arise when the specific effects of acceleration and +Gz forces, cosmic radiation and acute hypoxia are encountered, since there is very little research into any of these areas.

The state of pregnancy is associated with a number of important physiological adaptations in women, and some of these are manifest in the first trimester. Orthostatic compensatory mechanisms are of particular significance; for example, there is a measurable decrease in peripheral vascular resistance due to a decreased reactivity to Angiotensin II as early as eight weeks gestation<sup>12</sup>. This has drawn some to speculate that the pregnant woman, even in early pregnancy, may have decreased tolerance to the +Gz forces encountered in military fast jet combat manoeuvres<sup>13</sup>. Non-pregnant women tolerate these forces well, and if fitness and other anthropometric parameters are taken into account, there is no difference between men and women.

Conversely, the effect of accelerative forces on the foetus is unknown, and there appears to be no research ever published on this subject.

Concerns regarding the exposure of pregnant women to cosmic radiation have been voiced for some years. Barish<sup>14</sup> found that aircrew in commercial aviation were commonly exposed to as much as 10 rad per year, although the recommended maximum exposure is 6 rad per year; exposure can be particularly high during solar proton events. The United States National Council on Radiation Protection and Measurement recommends that total exposures during pregnancy do not exceed 0.5 mSv<sup>15</sup> and Barish has found that a pregnant aviator may well be exposed to a dose of 0.5mSv during a single solar proton event<sup>16</sup>. Furthermore, evidence exists that women exposed to radiation during pregnancy may deliver offspring who have an increased risk of childhood malignancy in the first decade of life<sup>17</sup>.

One of the risks of military aviation is of exposure to acute hypoxia, and no work has been published which addresses the risks of this in early pregnancy. Certainly studies of women who live at high altitude and who are thus in a state of mild chronic hypoxia are reassuring, in that there appears to be no increase in the incidence of congenital malformations in their offspring<sup>18</sup>. Pregnant rabbits maintained in an atmosphere containing 15.5 percent oxygen had offspring with a mean 17 percent decrease in birthweight as compared to controls, and a neonatal mortality of 19 percent (compared to one percent in controls), but this is rather an unlikely set of circumstances in the normal adult female<sup>19</sup>.

A recent study has demonstrated a slight increase in spontaneous foetal loss in female flight attendants, but the application of this to military aviation is not clear and more work is needed to clarify the possible aetiologies<sup>20</sup>.

In summary, the possible risks to an early pregnancy in women involved in military fast jet aviation are accelerative forces, radiation and hypoxia. There is very little data on the first two, while the effect of acute hypoxia may well be damaging, but this has not been experimentally tested. It is clear that research into these areas may clarify some thorny issues

#### **Conclusions**

The participation of women in combat roles is a relatively recent advance. Studies are emerging which demonstrate subtle differences between the sexes in combat conditions, but if strength and physiology are taken account of, most differences disappear. The most important physiological division is that women may become pregnant, and in certain circumstances the effects of early pregnancy on a woman's tolerance of certain stresses, in particular those encountered in

military aviation, are uncertain. Furthermore, the effects of activities such as diving and aviation on the subsequent outcome of early pregnancy have not been well studied.

### About the Author

Steve Robson was formerly a full time medical officer in the Royal Australian Navy, serving at sea in HMA Ships Sydney and Success, and during the 1990-91 Gulf War. He is currently Registrar in Obstetrics and Gynaecology at Flinders Medical Centre in Adelaide, and is a Surgeon Lieutenant in the Royal Australian Naval Reserves.

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# Rocky Mountain Spotted Fever

Sue Sharpe

## Aetiology

Rocky Mountain Spotted Fever (RMSF) is caused by the rickettsial pathogen *Rickettsia rickettsii*, an obligate, intracellular parasite. These microorganisms are very small (0.3µm-0.5µm).

Extracellular *R. rickettsii* cease metabolic activity and leak cellular components, losing infectivity within a short time.

The organism possesses several virulence factors, including surface proteins, a lipopolysaccharide (LPS) cell wall, and (probably) a slime layer which appears to increase in size with virulence<sup>1,2</sup>.

## Epidemiology

RMSF is transmitted from wild rodents or dogs to humans by the bite of a tick. The disease is widespread in the United States, Canada, and South America. It is most prevalent in summer months (coincident with maximum tick activity).

Transmission via aerosols is unlikely, although laboratory acquired illnesses have occurred in this way.

Infected ticks maintain the microorganism efficiently, and usually are not adversely affected by it. Transmission to other ticks is primarily transovarial (i.e. by producing rickettsial-infected eggs), although immature ticks can acquire *R. rickettsii* from the blood of rickettsaemic animals (not dogs)<sup>3,4</sup>.

## Pathology

Between 24 and 48 hours after the tick has started feeding on its host, *R. rickettsii* changes from a dormant form to a highly virulent one. A further period of time is required for the microorganism to be released from the salivary glands of the tick<sup>5</sup>.

After inoculation into the skin, rickettsia multiply and enter the lymphatic system and blood stream. Dissemination to all parts of the body (especially the brain, heart, lung, skeletal muscles, liver, kidney, gastrointestinal tract, spleen, pancreas and skin.)

*Rickettsia* primarily infect endothelial cells. After attachment to the plasma membrane, the microorganism induces phagocytosis by the host cell. Pathogens then multiply in the cytoplasm of endothelial cells, which eventually swell and lyse, releasing the parasite. The microorganism may then spread to adjacent endothelial cells or cells deeper in the blood vessel wall. If the latter occurs, vascular smooth muscle tissue may become infected.

Organisms proliferate in the endothelium of small blood vessels, causing inflammatory vasculitis. Increased vascular permeability may cause oedema of the surrounding tissues, hypovolaemia, and hyproproteinuria<sup>6</sup>.

It is suspected that host defence factors contribute significantly to the physiological manifestations of RMSF<sup>7</sup>. Infection activates platelets, coagulation and fibrinolytic pathways<sup>8</sup>.

No exotoxin or other important immunopathological component has been associated with the pathogen<sup>9</sup>.

## Clinical Manifestations

RMSF is usually an acute self-limiting disease, but may be life-threatening if treatment is not prompt. Most patients experience a mild to severe illness. Asymptomatic infection is uncommon.

The average incubation period is six to seven days, but can be from one to ten days<sup>10</sup>.

Initial symptoms are nondescript. The disease is often characterized by the sudden onset of headache, myalgia, weakness, and high fever. Muscle pain, anorexia, nausea, photophobia, vomiting, and abdominal pain may also be evident<sup>11,12</sup>.

A rash usually appears three days later, and consists of small (1mm-5mm diameter) lesions with a surrounding pink colour. If pressure is applied to the spot, blanching will occur<sup>13</sup>. Later, the lesions may develop a pin-point haemorrhage in the centre, with no blanching occurring with pressure. Approximately half of untreated RMSF cases will reach this stage, which has a mortality of approximately twenty percent if untreated<sup>14</sup>. The rash is evidence of direct rickettsial damage to local tissue<sup>15</sup>.

The rash usually begins on the extremities (palm, soles, forearms), and spreads within 48 hours to the trunk and buttocks<sup>16</sup>.

If a rash **does not** appear (in approximately 10% of cases), a poor prognosis is indicated<sup>17,18</sup> as the absence of rash is often associated with a fatal outcome.

Several factors appear to be related to a life-threatening illness, including absence or late appearance of rash, no history of tick bite, host features (male, over 50 years old, black American), wrong antibiotic regimen, and atypical presentation of symptoms<sup>19</sup>.

**Pulmonary** involvement may cause oedema into interstitial tissues and airspaces. Symptoms may

include cough, dyspnoea, and chest infiltrates, and may result in respiratory failure. Mechanical ventilation may be necessary, although a 90% mortality is associated with patients who reach this stage<sup>20</sup>.

CNS manifestations may occur if the blood vessels in the brain become infected, causing a rickettsial encephalitis. As many as 28% of RMSF cases show some CNS involvement<sup>21</sup>. This indicates a poor prognosis<sup>22,23</sup>. Symptoms may include confusion, stupor, delirium, ataxia, seizures, and coma.

**Renal failure** may occur as a result of hypovolaemia due to leakage of blood vessels. Renal dialysis may be necessary if urea and creatinine levels are high. Severe involvement may induce hypotensive shock and necrosis of renal tubular cells<sup>24</sup>.

**Gastrointestinal** problems can arise if the blood vessels of the stomach, intestines, liver and pancreas become infected<sup>25, 26</sup>. Symptoms include nausea, vomiting, and abdominal pain.

## Diagnosis

### Laboratory diagnosis

Serological testing is the best diagnostic method at present. Methods used include indirect immunofluorescent antibody assays (IFA), indirect haemagglutination assays (IHA), latex agglutination, and enzyme-linked immunosorbent assays (ELISA). However, diagnosis is not usually early enough to influence the management of the illness, as specific antibodies to *R. rickettsii* are not usually produced during the acute stage of the disease<sup>27</sup>. Therefore, serology should only be used as confirmation.

Cultivation and isolation of *R. rickettsii* from clinical specimens is not a practical diagnostic method because of the specified growth requirements of the organism, and the highly infectious nature of the pathogen in laboratory environments.

*R. rickettsii* DNA has been identified in acute phase specimens using PCR (Polymerase Chain Reaction) technology<sup>28,29</sup>. This allows the amplification and identification of the pathogen's nucleic acid in minute quantities in a very short period of time.

### Differential diagnosis

Diagnosis of RMSF, especially in the early stages, is very difficult because of the non-specific symptoms and range of different manifestations. The classic signs of fever, rash and history of tick bite only appear together in 3% of patients in the first 3 days<sup>30</sup>.

RMSF may be confused with influenza, measles, Gram-negative bacterial sepsis,

Staphylococcal sepsis, toxic shock syndrome, rubella, leptospirosis, typhoid fever, gastroenteritis, acute surgical abdomen, bronchitis, atypical pneumonia, meningoencephalitis, viral encephalitis, immune complex diseases (e.g. SLE), infectious mononucleosis, drug hypersensitivity reactions, other rickettsial diseases, viral syndrome, or secondary syphilis<sup>31,32</sup>.

## Treatment

Fatalities from RMSF are low if treatment is started promptly. Death within the first four days of onset of symptoms is rare, even without antibiotic treatment, but initiation of antibiotic therapy after six days is associated with a mortality rate of around 50%<sup>33</sup>. Most antibiotics have no effect on *R. rickettsii* - tetracycline and chloramphenicol are the recommended drugs.

### Recommended therapy

25-50 mg/kg/day of Tetracycline OR 50 mg/kg/day of chloramphenicol<sup>34</sup> OR 25 mg/kg or oral tetracycline, followed by 500mg every 6 hours until 24 hours after the patient has become afebrile<sup>35,36</sup> OR 100 mg of doxycycline every 12 hours<sup>37</sup>.

### Susceptibility of population

Males account for around 60% of cases. Higher incidences are reported in children between five and nine years and males over 50 years old<sup>38,39</sup>. Fatality rates are increased in American black males (due to a genetic condition in 12% of this population<sup>40</sup>).

## Prevention

No effective vaccine is available<sup>41</sup>. Killed *R. rickettsii* derived from ticks, and cell and embryonated egg cultures have failed to protect humans from challenge with a virulent strain of the pathogen<sup>42,43</sup>.

Chemical vaccines involving two *R. rickettsii* surface proteins have been shown to protect mice and guinea pigs from RMSF<sup>44</sup>. Guinea pigs have also been protected from RMSF by vaccination with a recombinant surface protein of *R. conorii*<sup>45</sup>.

Avoid tick bites would appear to be the most effective means of preventing RMSF.

Immunity acquired after an infection is usually solid and appears to involve both humoral and cell-mediated mechanisms<sup>46</sup>.

### Potential as Biological Warfare Agent

Although the pathogen is highly infectious in aerosol form, it loses virulence quite rapidly outside the cellular environment. It would therefore only be infectious for a limit period of time after release.

There is a delay of about one week before symptoms start to appear, so the pathogen would be of little use if a rapid onset of disease was the objective of the attack.

Mortality is usually low, particularly if treatment is prompt. However, the illness can be quite debilitating and may seriously reduce effective manpower and strain medical resources. The symptoms are non-specific, and rapid laboratory diagnosis is not yet available. Any delay in correct identification and initiation of effective therapy increases the chance of the patient developing potentially fatal complications.

### Future Directions

An effective vaccine and rapid diagnostic procedures should be developed. Recombinant and subunit vaccines are currently being developed, and show some potential.

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## From the 1993 Conference

### High velocity missile wounding using military projectiles

Corporal Martin Andrew

This paper discusses high velocity missile wounding caused by military projectiles. For the purpose of this paper, military projectiles considered will be those of eight mm diameter or less, fired from small arms like rifles, sub-machine guns and machine guns. High velocity is defined as a speed in excess of  $750 \text{ m sec}^{-1}$ .

#### Explanation of Ballistic Terms

##### Rifling

Rifling is the grooves that are machined inside a barrel, designed to impart a spin on the projectile as it leaves the barrel. Rifling imparts a gyroscopic effect on the projectile, giving it stability in the air. The tighter the twist of the rifling, the greater the stability of the projectile, since the rate of spin is faster. A one-in-seven twist is tighter than a one-in-twelve twist.

##### Bullet Construction

There are two main types of bullet construction in military projectiles. These are single and dual cores. The single core uses lead, whereas dual core uses a combination of lead and another material, usually steel. Projectiles using lead at the rear have improved stability in flight due to the rear centre of gravity. The jacket thickness is also important. The thicker the jacket, the less likely will the bullet fragment on impact with human tissue. Under international law, all military projectiles must have a jacket covering the nose and sides, hence the term 'full metal jacket'.

##### Trajectory

The trajectory of a projectile is the path the projectile travels through the air until it impacts against a surface. The angle that a projectile impacts upon a body is important in wound ballistics. The greater the impact angle, the more likely will the projectile pass through the body tangentially.

##### Drag

Drag is the resistance to movement on an object in a medium. The greater the density of the medium, the greater the drag. A projectile upon entering human soft tissue goes from a medium (air) of  $1.2 \text{ kg m}^{-3}$  to one of  $1,000$  to  $1,100 \text{ kg m}^{-3}$ .

##### Yaw

Yaw is the deviation of a projectile in its longitudinal axis from the straight line of flight. At close range, under 30 m, high velocity projectiles exhibit a large amount of yaw as the stability effect of rifling has yet to start. Due to insufficient twist, some projectiles never become stable in flight, and yaw continually

until impact. Yawing determines the surface area of the projectile upon impact.

##### Tumbling

Tumbling is the forward rotation around the centre of gravity of a projectile. Tumbling is determined by a projectile's yawing, drag, and design. A greater angle of yaw increases the drag and promotes quicker tumbling. Dual cores by their nature cause quicker tumbling. Jacket construction also contributes to quicker yawing, as a projectile may be more likely to break up upon impact.

##### The Mechanics of Wounding

The Hague Convention of 1899 stated that:

*'the contracting parties agree to abstain from the use of bullets which expand or flatten easily in the human body'.*

This was subsequently written into the 1949 Geneva Convention. To adhere to this, all military projectiles became fully jacketed, and are so to this day. The exception to this are shotgun rounds, which are able to be legally used without a jacket.

When the Hague Convention was drafted, nearly all nations went from round nosed to spitzer projectiles, that is, ones with pointed tips. Round nosed bullets have poor long range ballistics due to drag, but excellent penetration on soft tissue as they have minimal yaw, thus also having poor tumbling characteristics. Spitzer bullets exhibit better yawing, thus better tumbling effects on soft tissue.

In all high velocity missile wounding, the two major mechanisms of wounding are cavitation and the effect of secondary missiles.

##### Cavitation

There are two types of cavitation, permanent and temporary.

The permanent cavity is tissue crushed during a missile's travel in the body. This is determined by tumbling, bullet deformation, secondary missiles and the missile's weight upon impact. The greater the penetration and surface area of the missile, the larger the permanent cavity.

The temporary cavity is the momentary stretch or acceleration of tissue away from the bullet track. It might be thought of as blunt trauma surrounding a portion of a missile's travel in soft tissue. Elastic tissue like lung, bowel wall and muscle tolerate

stretch much better than non-elastic solid organs like liver, kidneys or a full bladder.

### Secondary Missiles

Secondary missiles are objects which perforate tissue away from the main wound track. These fragments increase the amount of blood vessels injured, tissue perforated and organs damaged. Examples of secondary missiles are bone splinters, missile fragments, zips, buckles, buttons and pieces of hard body armour.

Projectiles can be designed to break up, or fragment. Projectiles such as the German 7.62 x 51 mm NATO bullet, and its Swedish counterpart of the same calibre, have a deliberately thin jacket when compared to the United States equivalent. The Australian 7.62 mm round has a thick jacket similar to the US bullet.

By incorporating a lead core in the rear of a dual core projectile, it is made stable in flight. Upon hitting tissue, however, it quickly tumbles due to its rear centre of gravity. Dual core rounds also tend to break up at the join of the cores, causing greater wounding with two main wound channels and numerous smaller ones.

Historically, wound ballistic studies have over-rated the temporary cavity at the expense of the permanent cavity and secondary missiles. There are many variables that affect the temporary cavity size and its effects. These need to be taken into consideration when studying reports about the effects of missiles fired into gelatine blocks simulating human tissue.

The effects of secondary missiles and temporary cavities are synergistic in high velocity missile wounds. Secondary missiles cause multiple tissue perforations away from the wound track, which are then stretched by the temporary cavity. The weakened tissue splits in many places and pieces of muscle become detached. This creates a larger permanent cavity. At velocities over  $900 \text{ m s}^{-1}$ , in conjunction with the temporary cavity, secondary missiles cause explosive type wounds, even if bone is not struck.

A large, heavy, slow moving missile will have similar effects to a high velocity round, excepting that the permanent cavity is due to the missile's surface area and weight, not its velocity.

### **Wounding Effects of Military Projectiles**

To establish the effects of missiles, the then Colonel Fackler at the United States Army Letterman Army Institute of Research, established the Military Trauma Research Division in 1981. He developed the Wound Profile. This is a method that allows tissue disruption by missiles in soft tissue to be presented graphically. This part of the paper has been written

using notes and wound profiles provided by Dr Fackler when he was in the US Army.

Dr Fackler's work has removed many of the misconceptions of wound ballistics. The wound profile enables the physician and researcher to establish why missiles behave differently at different depths of penetration, without bias. The following wound profiles describe the military projectiles most likely to be encountered. They describe the effects of projectiles fired three metres from a gelatine block.

The 7.62 mm NATO projectile as used by the Australian Defence Force, and the Russian 7.62 M43 projectile as used in the SKS and AK 47 family of assault rifles have similar wound profiles. The NATO bullet yaws and causes a large temporary cavity and a medium sized permanent cavity, and ends up travelling backwards. The Russian 7.62 machine gun and sniper projectile is similar, yawing twice with a small permanent cavity initially, and a larger one after it.

Both projectiles only tumble deep inside the body if soft tissue is involved, and thus cause uncomplicated wounds in most cases of soft tissue injury. In many instances, the Russian projectile only causes wounds that resemble much lower velocity hand gun wounds. Both the NATO and Russian projectiles have thick jackets and have a forward centre of gravity which gives them stability in soft tissue.

Comparing the Russian M193 and NATO 5.56 mm projectiles, the M193 yaws at 90 degrees early in its travel, flattens at the tip, and breaks at the cannelure. The rear of the projectile breaks into multiple fragments. The NATO 5.56 projectile's tip does not deform, but separates from the rear lead core. This creates two deep wound channels and multiple fragments. Both bullets will break up on contact with soft tissue at up to 200 metres.

The 12-gauge solid slug and 12-gauge number 4 buckshot produce the most devastating close range small arms wounds. In each case the permanent cavity through soft tissue is 6 cm square in cross sectional area. The tissue destruction produced by buckshot is massive when compared to other small arms projectiles, despite its low velocity, and is a good example of multiple projectile paths in a small area.

### **Conclusion**

Much can be learnt of the likely nature and extent of individual wounds by studying experimentally the effects of various types of projectiles impacting upon synthetic tissue substances. Detailed graphic analysis of these effects can assist in predicting the threat to troops in an operational environment.

# Abstracts from the Literature

Submitted by James Ross

**Burnett JW, Fenner PJ, Kokelj F, Williamson JA, 1994. Serious *Physalia* (Portuguese man o' war) stings: implications for scuba divers. *J Wilderness Med*; 5:71-76.** The objective of this study was to describe a serious jellyfish envenomation in a scuba diver by an Atlantic *Physalia physalis*, to review the related literature and to recommend safe diving practices that may reduce the risk of serious jellyfish envenomation in divers. A healthy scuba diving instructor wearing a full wetsuit and gloves but no hood ascended from a night dive and surfaced directly under a large Atlantic *Physalia* jellyfish. He suffered multiple severe stings to the unprotected areas of his face and neck. He developed acute subjective respiratory distress with hyperventilation, muscle pain and spasms, and impaired consciousness en route to hospital, more than 10 min following envenomation. He recovered quickly in hospital with oxygen, aminophylline and intravenous fluid administration. Delayed recovery of the envenomated skin took several weeks and serology was positive for *Physalia* venom antibodies. Full protective clothing (e.g. a full, long sleeved wetsuit, plus gloves and hood when appropriate) should be worn by scuba divers on all dives. Ascent routines in diving should include looking directly upwards at the surface with one wetsuited arm outstretched towards the surface throughout the ascent. Removal of tentacles should not be attempted by the diver until he or she has exited from the water.

**Steffen R, Lobel HO, 1994. Epidemiologic basis for the practice of travel medicine. *J Wilderness Med*; 5:56-66.** The major health risks for travellers to developing countries include injuries, malaria, hepatitis A, hepatitis B, rabies, AIDS and travellers' diarrhoea. Most illnesses can be avoided by use of preventive measures including use of seatbelts in cars, hygienic measures and use of effective immunisation and chemoprophylaxis. Practitioners of travel medicine need to know the health risks that confront travellers in order to advise which preventive measures should be used. Most available data apply to travellers visiting developing countries.

*Comment: An article couched in very practical terms, which reinforces that vast majority of the health problems of travel are common problems, with well recognised, simple and practical methods of prevention. A wonderful way to keep a sense of perspective.*

**Reid LD, Carter KA, Ellsworth A, 1994. Acetazolamide or dexamethasone for prevention of acute mountain sickness: a meta-analysis. *J Wilderness Med*; 5:34-48.** Acute mountain sickness (AMS) describes a constellation of symptoms that is usually self-limited and benign. However, it may impair judgement and physical abilities at high altitudes and interfere with the pleasure of recreational activities. Severe cases may be fatal. Acclimatisation is an effective prevention, but is not always practical or possible. Therefore, pharmacological prophylaxis of AMS is an active area of research.

This study used meta-analytic techniques to evaluate the published literature regarding pharmacological prophylaxis of AMS with acetazolamide and dexamethasone. Twenty eligible reports were located via a computer-assisted search, reference lists and review articles. Dependent measures for this study were the percentage of patients with specific symptoms associated with AMS.

An effect size (ES) is the standardised mean difference between experimental and control groups or the conversion from the point-biserial correlation between treatment and effect and allows integration of the results of independent studies. In this study, a negative ES indicates that the prophylaxis regimen exerted a protective effect; the greater the magnitude of the ES the greater its effect. The overall average weighted ES was -0.59 (95% confidence interval (CI) = -0.41 to -0.77) when both drugs' results were pooled. The average weighted ES for studies comparing acetazolamide to placebo was -0.61 and it was -0.32 for studies comparing dexamethasone to placebo. The average ES was -0.38 when all the reported symptoms were pooled together.

This report confirms the effectiveness of pharmacologic prophylaxis against AMS with acetazolamide or dexamethasone. Acetazolamide appears to be more effective, but inconsistencies in dexamethasone dosing, environmental conditions and rate of ascent confound interpretation. This meta-analysis points out areas for future research.

**Warfe PG, 1994.** Military medicine and peacekeeping. *Aust Def Force J*; 104:60-67. Covers the doctrinal basis of the ADF military medicine support of peacekeeping and details the contribution of the ADF to Operation *Habitat* (Kurdish refugees in Northern Iraq) and Operation *Solace* (Somalia).

**Duncan D, 1994.** Operation *Restore Hope*: military medicine practice in Somalia. *Med J Aust*; 159:739-744. A review of the ADF medical activity in Somalia; paper follows the presentation by Major Duncan at the 1993 AMMA conference.

## Book Review

### Gallipoli: the medical war

Reviewed by Bryan Gandevia, Sydney

Michael B. Tyquin, *Gallipoli: the medical war. The Australian Army Medical Services in the Dardanelles campaign of 1915*, New South Wales University Press, Sydney, 1993, 278pp., illustrations, bibliography, index, hardback, rrp \$39.95.

The research for this book has been wide-ranging, with extensive use of Australian and British archival material, notably diaries and letters held by the Australian War Memorial. It therefore adds immeasurably to the restrained, usually anonymous and largely unreferenced account given by Butler in the *Official History*, quite apart from the use of secondary sources published subsequently.

The medical chaos was probably neither more nor less than that of the campaign as a whole. By the end of the book the author has reviewed the issues comprehensively, from the inadequate selection of recruits and the difficulties of the campaign itself to the complexity and confusion of higher command, aggravated at all levels by poor communication. On the ground, Tyquin acknowledges that the 'medics' (a term which those involved, and many Royal Australian Army Medical Corps personnel since, would not appreciate) did the best possible in the difficult terrain and with limited supplies (notably of stretchers). In view of the excessively high morbidity from gastrointestinal diseases, lack of hygiene training was probably a major weakness. Otherwise, Tyquin adds little to Butler's account of medical and surgical management; a critical technical appreciation in the light of modern concepts would still be worthwhile. It deals thoroughly with the appalling lack of planning and cohesion in the evacuation of casualties, not only from the beach to the ships offshore (with or without proper medical facilities and staff) but also in their transport to Lemnos, Egypt or Malta.

From an Australian viewpoint, perhaps the fundamental oversight was the failure of governments to identify the need for senior support staff to provide effective liaison and integration with British organisation. The failure of Surgeon General Williams (who accompanied the troops to Egypt but himself proceeded onto England) to liaise with his British counterparts in Egypt is incomprehensible.

It left a vacuum which the opportunistic and ambitious J.W. Barrett attempted to fill without adequate authority and only limited success. At a

lower level, another unresolved question relates to the refusal of Neville Howes, VC, to accept appointment as Deputy Director of Medical Services, ANZAC, when the New Zealand incumbent resigned on the eve of the operation. Were both reluctant to become the senior medical scapegoat for what they saw as an inadequate medical plan?

While there is much to commend in the content of this book, the author is not a master of historical narrative. The arrangement of the material - roughly, by subject - is confused, involving some overlap and repetition, and leading to difficulty in coping with temporal fluctuations. I found it necessary, after a first reading, to re-read Butler's lucid exposition before reading the book a second time (and perhaps gaining thereby a little sympathy for the author's difficulties). Nonetheless, it is a serious mistake to plunge the reader into essentially anecdotal notes of the landing, the August offensive and the evacuation without introduction to the overall plan for the campaign, the medical plan or plans, and the proposed, as distinct from the actual, roles of the various units mentioned (CH. 2). In effect, the anecdotes, which certainly illustrate the problems and the attempts to cope, lack context. Thus, some of the interspersed critical and analytical paragraphs cannot be seen in perspective. In fact, the medical 'arrangements' as expressed by the Director of Medical Services, are eventually to be found as an appendix. They are wholly inadequate, and one can only assume that there are no records of the medical plans at lower levels, down to individual units. The author gradually works his way up to higher levels of command and administration but, for clarity and easy understanding, these considerations should have preceded the examination of 'life on the ground'. Military history cannot be written effectively from 'below up', whatever the contribution that may be made by the lower orders.

It must also be said that the author has not been well served by his publisher (who might have provided an editor). The type is pallid, and the page layout is excessively mean. The maps are inadequate copies from Butler. The bizarre typographical affectations in the side-headings are unnecessary and, to this reviewer, exemplify irritating 'typopathology'. I found the index reliable and invaluable but, overall, the presentation is not worthy of a university press.

## News and Views

### New Books for Library

The following publications, three of which were kindly donated by Association members, have been added to the library of the Australian Military Medicine Association. Notes are from the endleaves of the respective publications.

**Pearse CD, 1993. Beyond the lagoon. Hoverdoctors to Papua New Guinea. Hodder and Stoughton; Rydalmere NSW.**

*This book was kindly donated to the Association's library by Flight-Lieutenant Rachel Grimmer RAAF, who was a member of the expedition team and presented a paper, recounting her experiences, at the 1993 Association Conference (and reprinted in the March issue of Australian Military Medicine).*

"The vast tropical swamplands of the Fly River Delta in the Western Province of Papua New Guinea is the setting for this remarkable and inspiring story of a group of people from diverse backgrounds who join together to bring Hovercraft medical services to the remote jungle communities of one of the most inaccessible regions on earth.

"This is the fourth international Hoverdoctor expedition. The others were to the Kali Gandaki River in Nepal, the Amazonian headwater in the Peruvian Andes and the Yangtze River in China."

"Cecil Pearse is a regional director of the National Trust of Britain and an active member of his local Baptist Church. He and his wife, Kathleen, live in Herefordshire and have two grown-up children."

**O'Keefe BG, 1994. Medicine at War: Medical Aspects of Australia's Involvement in Southeast Asia 1950-1972. Allen and Unwin; St Leonards NSW.**

"*Medicine at War* is the third volume of the Official History of Australia's involvement in Southeast Asian conflicts from 1948-1975. It deals with the medical aspects of Australia's military involvement in the Malayan Emergency, the Indonesian-Malaysian Confrontation and the Vietnam War. Spanning the period from the initial despatch of Australian service personnel to Malaya in 1950 to the aftermath of Vietnam, the book details the medical experiences of the Australian Army in all three conflicts, as well as those of the Royal Australian Air Force in Malaya and Vietnam, and the Royal Australian Navy in its operations in Vietnamese waters. The volume presents for the first time a comprehensive account of the range of injuries and diseases to which Australian servicemen and servicewomen were exposed in Southeast Asia, and documents the measures that were taken to provide them with medical services. A

special section of the book, written by FB Smith, a distinguished historian of medical issues, analyses the Agent Orange controversy that followed the Vietnam War.

"*Medicine at War* draws upon an immense range of published and unpublished material, including archival sources and specialist medical literature, much of it hitherto unknown and inaccessible to the general public. Eschewing technical language wherever possible, the book transforms this highly complex material into a clear and readable narrative. Sensitive and controversial medical issues, such as the control of sexually transmitted diseases, the prevention and treatment of multi-drug-resistant malaria and the effects of exposure to chemical agents in Vietnam, are explained with clarity and precision."

"Brendan O'Keefe was born and grew up in Sydney. A graduate of the Universities of Sydney, New South Wales and New England, he holds qualifications in the fields of both health and history, and post-graduate qualifications in archives and medical history. As an historian, he has researched and published across a wide spectrum embracing medical, maritime, media and local history, and has undertaken a number of heritage conservation studies. His thesis on sexually transmitted diseases among Australian soldiers in Southeast Asia won the L.T. Daley Prize for history at the University of New England. In the field of health, he has ten years' experience of clinical practice and has worked on several studies of the post-war health of Vietnam veterans. He lives in Queanbeyan, New South Wales, with historian Sandy Blair and their two children."

**Cole M, 1981. Journey to the Fourth World. Lion; Tring, Hertfordshire, England.**

*This book was kindly donated to the Association's library by Wing Commander Robin Dugdale RAAF, who was a member of the expedition team.*

"*The Kali Gandaki is one of the world's most violent rivers. To the people of Nepal it is the Goddess of Death, yet another hazard in a country burdened with disease and infant mortality. But to the country's pioneering medical missionaries it has always been seen as a potential agent for life - a possible highway through the mountains, linking homes with hospitals.*

"Taking specially-designed new hovercraft, a 26-man British Joint Services Expedition set out to try to harness the previously unnavigable river. *Journey to the Fourth World* is the leader's account of this adventurous and testing expedition and its results in and beyond Nepal. It is also the account of his determination to use all means possible to help Christian relief work in the world's poorest countries - the Fourth World."

"Michael Cole is a Squadron Leader, teaching leadership to officer cadets at the Royal Air Force College, Cranwell. In his spare time over many years he has been involved in a large number of adventurous expeditions, sometimes simply 'climbing the mountain because it is there', but more often combining life-saving humanitarian work with adventure. He is married with two teenage children."

**Dixon P, 1984. Amazon Task Force. Hodder and Stoughton; London, England.**

*This book was kindly donated to the Association's library by Wing Commander Robin Dugdale RAAF.*

*"High in the Peruvian Andes, glaciers bleed white water. Trickle becomes stream, stream becomes river - and the 'Great Speaker', Rio Apurimac, the Amazon source tributary is born.*

*"It was to this forbidding terrain that the combined services expedition came in a specially*

*designed hovercraft. Through the territories of primitive tribespeople, guerillas and cocaine drug runners, they successfully extended the navigable length of the Amazon.*

"Medical services were provided where none had existed before. Water supplies were purified and freed from parasites, and countless Indians were treated. The work of Christian missionaries was greatly advanced, and a positive legacy, both spiritual and material, was left behind.

*"Amazon Task Force* is a story of breathtaking Christian adventure, described by the BBC as the 'most positive British action for restoration of good relations during a difficult year in South America'."

"Peter Dixon is a serving Royal Air Force officer from West Yorkshire. With an engineering degree from Bristol University he has travelled widely as a pilot of Hercules transport aircraft. In 1979, after taking part in the hovercraft expedition to Nepal, he trained as a flying instructor and subsequently served for three years with the East Midlands Universities Air Squadron. He is now involved in the training of officer cadets at the Royal Air Force College, Cranwell, and lives near Nottingham with his wife and two small children."

## New Members of AMMA

The AMMA would like to welcome the following new members:

SBLT Darin Brumby  
LT COL Andrew Crompton  
WGCDR David Emonson  
FLT LT Karen Gisler  
CAPT Michael Higgs  
Dr Tamaris Hoffman  
LT COL Stuart Inglis  
CAPT Malcolm Johnston-Leek  
Dr Ian Maclean  
LT COL Barry Morgan  
MAJOR Emmet Murphy  
Mr Robert Neil  
Dr Christopher Oates  
LT COL Ian Parkin  
Capt Michael Penman  
Capt Pawel Prociuk  
MAJOR Janet Scott  
Dianna Seychell  
LT William Starmer  
WGCDR Lydia Stevens  
CAPT Carol Vaughan-Evans  
LT COL Stuart Wilson

Canberra, ACT  
Malvern, Victoria  
RAAF Williams  
RAAF Townsville  
Liverpool, NSW  
Westmead, NSW  
Bedford Park, SA  
Hobart, TAS  
Glenhuntly, VIC  
Canberra, ACT  
Canberra, ACT  
Melbourne, VIC  
Parramatta, NSW  
Fitzroy, Victoria  
Linton Camp, New Zealand  
Wattlegrove, NSW  
Wayville, SA  
RAAF Williams  
Mosman, NSW  
RAAF Williams  
Duntroon, ACT  
Linton Camp, New Zealand

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## Do you know where these members are?

We have had mail returned for the following members, if you know of their whereabouts, could you please get them to contact the AMMA Secretariat, on (002) 471850.

FLT LT Roger Bernard  
LT Geoffrey Day  
LT COL J.W. Kelly  
DR LT Nicolle Leeks  
MAJOR Mark Little  
LT COL. Robert Millar  
CAPT Frank Scalzo

RAAF Williams  
Rowville, VIC  
Malvern, VIC  
Quakers Hill, NSW  
Subiaco, WA  
Melbourne, VIC  
Abbotsford, VIC

## **The Australian Military Medicine Association**

Notice of  
3rd Annual General Meeting  
to be held at  
0800 Saturday 23 July 1994  
at the Ballroom, Sheraton Towers Hotel, Southgate  
Melbourne

### **AGENDA**

1. Minutes of 2nd Annual General Meeting
2. President's Address
3. Secretary's Report
4. a. Treasurer's Report  
b. Fees for 1995
5. Association Council for 1995
6. Conference 1995
7. Other matters addressed to the Secretary prior to the Meeting
8. Open Forum on AMMA's directions and plans

# AUSTRALIAN MILITARY MEDICINE ASSOCIATION

## Application for Membership

I wish to become a full/student/associate member of the Australian Military Medicine Association. I submit the following details so that accurate membership records and academic status of the organisation be maintained.

Name			
(Title/Rank)	Surname	Given Names	
Date of Birth	____ / ____ / ____		
Business Address		Suburb	
	State	Postcode	Country
Business Telephone		Home Telephone	
Postal Address		Suburb	
	State	Postcode	Country
Primary Qualifications			
University		Year	
Qualifications to be obtained and year anticipated for completion (student membership only).			
Other Qualifications			
How long have you been interested in Military Medicine?			
What is your experience in Military Medicine (list publications if any)?			
_____			
_____			
_____			
_____			
_____			
Currently serving in a Defence Force? Yes/No (please circle as appropriate)			
If yes, which country?			
If yes, Permanent / Reserve / Navy / Army / Air Force			

Signed: \_\_\_\_\_ Date: \_\_\_\_/\_\_\_\_/\_\_\_\_

Please return this form with a cheque in Australian dollars made out to AMMA for:-

**\$80 full Members (\$50 joining/\$30 annual)**  
**\$30 Student/Associate (\$20 joining/ \$10 annual)**  
**To: Dr M. Skinner, Secretary, AMMA, PO Box 373, Moonah, TAS 7009 Australia**

**NOTIFICATION**

**ALL MEMBERSHIPS WERE DUE FOR RENEWAL  
IN DECEMBER 1993**

To retain current membership, please complete the form below and return it with a cheque for \$30.00 to:

Dr M.W. Skinner  
Secretary, AMMA  
PO Box 373  
MOONAH TAS 7009

**ARE YOU STILL FINANCIAL?**

**AUSTRALIAN MILITARY MEDICINE ASSOCIATION**

**Renewal of Membership**

Rank/Title: \_\_\_\_\_ Name: \_\_\_\_\_

Old Address: \_\_\_\_\_

State: \_\_\_\_\_ Post Code: \_\_\_\_\_

New Address: \_\_\_\_\_

State: \_\_\_\_\_ Post Code: \_\_\_\_\_

Enclosed is a cheque for \$30 being payment of membership fees up to and including 31 December 1994.

\_\_\_\_\_  
Signature

**AUSTRALIAN MILITARY MEDICINE ASSOCIATION**

**Notification of Change of Address**

Rank/Title: \_\_\_\_\_ Name: \_\_\_\_\_

OldAddress: \_\_\_\_\_

State: \_\_\_\_\_ Post Code: \_\_\_\_\_

New Address: \_\_\_\_\_

State: \_\_\_\_\_ Post Code: \_\_\_\_\_

\_\_\_\_\_  
Signature