



SOUTH PACIFIC UNDERWATER MEDICINE SOCIETY

NEWSLETTER

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CONTENTS

1. Editorial Page 2

2. Correspondence Page 2

3. Personality Profiles - Robert Thomas Page 4

4. ECG Changes and Myocardial Damage Following Decompression Sickness Page 4

5. Management of Chlorine Gas Poisoning, R Tuck Page 6

6. Labyrinthine Dysfunction during Diving (Symposium Report) Page 7

7. Diploma of Diving & Hyperbaric Medicine Page 10

8. Sharks in San Diego Page 14

9. Bubbles Page 14

10. A SPUMS Presidential Trip Report Page 15

EDITORIAL

The South Pacific Underwater Medicine Society has moved relentlessly onwards towards recognition and responsibility. It is rather saddening for some of us old timers to observe the change from an informal beer-drinking, fun-loving group into a Society which has a lengthy constitution, complex entrance requirement, a costly Newsletter, and sponsors a Diploma of Diving and Hyperbaric Medicine. The Society now has 86 financial members, with more likely before the June Conference. Many members of the Society insist upon having current research material made available to them, in the form of private correspondence and also via the Newsletter. Others wish that the Society would involve itself in legal and administrative aims related to diving medicine - and such requests appear to have validity in the framework of our constitution. This all adds up to a change in the spirit of the Society, which some of us may regret although we cannot alter it, and nor would we. As a bouncing bright-eyed little boy grows up to the conservative grey-coated man, so also do professional societies. Many of us still have our dreams of donning a scuba tank and dropping off the end of the wharf to look at the pretty fishes, and some of us actually revert back to our childhood by doing so. But it is only temporary. I am reminded of Henry Lawson's reference to 'sitting in my dingy little office, where a stingy ray of sunlight struggles feebly down between the houses tall. And the fetid air and gritty of the dusty dirty city through the open window floating spreads its foulness overall'.

We pay the price for maturity, not only in the subscription rates, but also in the relinquishing of our hedonistic aims. The Society has changed, and in the long term view it is almost certainly for the better. It will require also a change of personnel. Perhaps now the reins of responsibility should be passed from the sub-aquatic psychopaths to the professional committee men. I cannot help feeling that the same personalities who were needed for the forming of the Society are very different from those who are now needed for its progress and maturation. Perhaps the members at the Annual General Meeting should consider this when re-electing officers of the Society.

As the Editor for 1973, Bob Thomas did a miraculous job, during the last editorial he suggested that the fees of the Society should rise from \$2.00 to somewhere between \$3.00 and \$5.00 per annum. Unfortunately one person cannot make such a decision any longer, and the Society itself took over - with the result that fees are now \$15.00 per annum, for Australian and New Zealand members. Your new Editor, who was also your old one, wonders if this fee raising business has not got just a trifle out-of-hand. Do the members really want colour-plates, at the expense of our less affluent non-medical members? Perhaps these flippancies reflect the slap happy attitude of the Editor, and perhaps I am sentimentally looking back to the past when the Society was only an egg.

This Newsletter differs slightly from the previous ones in that we have included a few new sections. The first one is termed 'Personality Profile', which I would have preferred to have called 'Dangerous Marine Animals I Have Met', and I am delighted to introduce this by presenting my colleague and conspirator, Bob Thomas. This section shall be repeated each Newsletter with a different SPUMS personality. Those members with a variety of odd 'aliases' and 'non de plumes' shall be eligible for only one presentation, and bribes for book inclusion and exclusion are acceptable to the Editor. It is anticipated that this section will not be used in a blackmailing capacity.

It also appears that the Society itself is becoming very well known. Ian Unsworth, acting as the enthusiastic Secretary that he is, informed various people and establishments about the Society and its history. Copies of the replies, some of which are genuine, are included in the section on Correspondence.

CARL EDMONDS

CORRESPONDENCE

Dr IP Unsworth
Secretary, South Pacific Underwater Medicine Society

21 March 1973

Dear Sir

Consideration has been given to the matters raised in your letter of 21 August 1972 and it has been agreed that the Royal Australian Navy will assist to the extent that up to 5 civilians could be accepted on a normally programmed Naval course conducted by the School of Underwater Medicine for Naval Medical Officers. The content and syllabus for the civilian section will be as decided by that School who have also advised that the additional one week practical training course could be conducted without undue detriment to other activities. The Commanding Officer, HMAS Penguin has been requested to contact you direct with the details of these courses including dates, etc.

Civilian personnel attending these courses will be expected to accommodate themselves as this is not available in HMAS Penguin except that midday meals may be provided on a re-payment basis. It is also expected that any 'out of pocket' expenses incurred by the RAN directly resulting from the participation of civilian students in the course will be recovered from your Society.

With regard to indemnities, it is considered that the attendance of a member of your Society at these courses should be on the following conditions, namely, that your Society agrees to indemnify the Commonwealth, its officers, servicemen, employees and agents against any liability, including liability for negligence, in respect of any injury or damage suffered by, or caused by an act or omission of, your member during or in connection with his attendance at that course and that your Society will not itself, have or make a claim against the Commonwealth, its officers, servicemen, employees or against, in respect of any such injury or damage. It is not proposed to prepare a formal document. A letter containing the acceptance of your Society to the foregoing conditions and signed in a manner to bind your Society contractually would be sufficient.

Yours faithfully
(Sgd) R Martin
Secretary, Department of Navy

I must thank you for your letter of 17 December conveying your Society's kind offer of assistance in relation to underwater and hyperbaric medicine.

I would be glad to avail myself of this offer when the occasion arises.

Yours sincerely
(Sgd) DM Storey
Commissioner for Environmental and Special Health Services

I refer to your letter dated 17 December 1973, concerning the South Pacific Underwater Medicine Society and its offer of professional assistance.

As you may be aware, my officers - in consultation with officers from other State Governments and the Commonwealth Government - have recently prepared draft regulations for diving associated with offshore petroleum exploration.

In this work these officers have had the benefit of discussions with authorities in the United Kingdom and Norway and with the United States and Royal Australian naval officers. Advice from RAN medical officers has been invaluable in this connection and I have no doubt these men are well known to you.

I enclose a copy of the prepared draft and will be pleased to receive any comments you may care to make on it.

I do thank you for your offer of assistance. In connection with future revisions of diving regulations or with problems in diving operations that may arise from time to time, my officers will be pleased to avail themselves of your Society's offer of assistance. They would also be pleased to receive advice of any literature that may become available through your Society which you consider might be helpful.

Yours faithfully
(Sgd) JCM Balfour, Minister of Mines, Victoria

Thank you for your letter outlining the organisation and functions of the South Pacific Underwater Medicine Society which was formed three years ago and covers the whole of the South Pacific region.

I was interested to learn of the existence and work of this Society and your offer of assistance in any matter on underwater and hyperbaric medicine is very much appreciated.

I shall refer your letter to the appropriate officers of the Health Commission for their information

Yours sincerely
(Sgd) JL Waddy, Minister for Health

I refer to your letter of 17 December in which you offered to provide information on aspects of underwater and hyperbaric medicine.

You will be interested to know that at a recent meeting of State National Fitness Executive Officers, it was decided that this Department should gather information relating to safety standards for Scuba diving, including instruction and training.

With this in mind, it would be appreciated if you could provide any information that may be of assistance in this matter.

Yours sincerely
(Sgd) LF Bott, Secretary, National Fitness Council

Reference is made to your letter of December 17, 1973, wherein you advised of the existence of the South Pacific Underwater Medicine Society, and to your offer of any assistance which the Australian Medical Association might require at a national level on the question of providing information on applied underwater and hyperbaric medicine.

It could well be that questions could arise where the Association may be in need of expert advice on matters relevant to these specialised aspects of medicine, and the Association is grateful for your offer of assistance should such an occasion arise.

Once again, many thanks for your advice.

Yours sincerely
(Sgd) DF Spark, Australian Medical Association

I wish to acknowledge your letter of 17th December 1973 advising details of the formation of the South Pacific Underwater Medicine Society and offering professional assistance where required.

I have read the contents of your letter with interest and the offer of assistance from the Society has been noted for future reference.

Yours sincerely
(Sgd) FM Hewitt, Minister for Labour and Industry & Consumer Affairs

Dr Carl Edmonds
OIC
School of Underwater Medicine

Dear Sir

Here, as promised, is the outcome of the case of the poisoned crocodile.

Unfortunately in giving you the history regarding the speed of poisoning taking effect, it turned out that I was taking the owner's word for what happened. As it finally was dragged out of the owner the crocodile was fed the toad fish on the evening of 6th March. The owner next saw the croc. only on Thursday night 7th when he found it to be 'dead'. On the Friday morning he was preparing to skin the animal, when it looked accusingly at him, so it was then he presented it at the surgery.

On presentation there was no evidence of muscle tone and the respiration was very slow - though not timed, estimate RR at 1/10-15 minutes. Unfortunately I don't know the normal respiratory rate of crocodiles. There was what I would consider to be a very slow corneal reflex, but nothing else that indicated life.

Having carefully predicted death, and before contacting you, I treated the animal with:

6mg Dexamethasone 1/peritoneal; 2/100mg Atropine; 2 minimums 1:1000 Adrenaline 1/peritoneal and 20mg Doxapram HCl 1/peritoneal. This was obviously based on the principle of 'kill or cure', and only the adrenaline appeared to produce much response, basically an improved resp. rate for a short period.

Endotracheal intubation was performed and initially oxygen administered but the basic inability of the practice to supply someone to give 1 pump to a respirator bag each 15 minutes for an indeterminate but obviously long period meant that we finally disconnected the oxygen though the tube remained in place.

After your advice, we then did nothing further but admit the animal and keep a watchful eye, and occasionally prod it to be sure life still remained. It got gradually more limp - if such was possible - slower corneal reflex and dehydrated looking over the period, and was finally declared dead on the morning of 11th March.

No post mortem examination was made as the owner wanted the skin. If I never see another crocodile I will be quite happy.

This may be something to add to knowledge of tetradotoxin poisoning of crocodiles.

Sincerely
(Sgd) E Fisher, Veterinary Surgeon, Deagon, 4017

PERSONALITY PROFILES

(or Dangerous Marine Animals That I Have Met)

Robert Thomas is a graduate of the University of Queensland (1968) and a self confessed victim of the RAN Short Service Contract, involving 4 years naval service for 3 years undergraduate training. He married Denise, an exuberant and attractive arts graduate, now extending her university training in Brisbane, and they have a bouncing baby tadpole named Natalya. Although having an interest in diving, RT was unknown in the diving medicine field until he joined the RAN School of Underwater Medicine - following negotiations which were



fully explained - for a period 'which must not exceed 6 months, I don't want to be a specialist'. He then became involved in a series of publicity gimmicks centred around the emergency decompression sickness treatments to both divers and caisson workers. There is no acknowledgment of his relationship between his enthusiasm in making emergency dashes to Melbourne, and the fact that his family now live in the same capital city. Then came a series of publications, in both medical journals and books, which demonstrated that RT could write as well as he could cure. One of his books soon topped the best selling list of the Australian Medical Publishing Company, and one of his articles had reprint requests exceeding 600, within the first 12 months of publishing. As a non-specialising general practitioner, this is not a bad effort.

His work was acknowledged when, following 2 years full-time work at the School of Underwater Medicine, he became classified by the Australian Navy as a Specialist in Underwater Medicine. During this time he became the Officer-in-Charge of the School, and a Consultant and Adviser to many Government Departments in both diving and hyperbaric medicine. He was one of the foundation members of SPUMS and sat on the executive committee for 2 consecutive years. He was a prime mover in the Diploma of Diving and Hyperbaric Medicine, and one of the main organisers of 2 consecutive Annual General Meetings. During 1973 he also took over the editorial post of this Newsletter and was responsible for its improvement from an anecdotal loose leaf rag to a high quality bulletin. He was co-founder of the Diving Medical Centre, which now utilises temporary centres in the eastern states of Australia, and received rapid acclaim from the civilian and commercial diving community, although the Diving Medical Centre is geographically located in Sydney, with the recent move of RT to Queensland, it is likely to flourish in that state.

Bob left the Navy in December 1973 and entered the underwater life of Brisbane with limited capacities. One was as a General Practitioner with interests in hyperbaric medicine and a doctor to diving medicine. The other was as a flood victim with all his uninsured equipment and furniture at the bottom of a rather expanded Brisbane river. These floods were the only State disaster in the last decade, which cannot be directly attributed to the activities of the Premier Bjelke-Petersen. Undaunted, although perhaps a little soggy, we expect Bob to emerge and keep up the activities of 1970-73. A hard worker, a brilliant organiser and a most competent writer, we can expect to hear more from RT in future - but at this time we acknowledge the debt that diving medicine in the South Pacific area owes this man.

ELECTROCARDIOGRAPHIC CHANGES AND MYOCARDIAL DAMAGE FOLLOWING DECOMPRESSION SICKNESS

R John Knight, FFARACS, Surgeon Lieutenant-Commander RANR, Royal Australian Navy School of Underwater Medicine

Summary

Three Australian divers developed ECG changes following severe decompression sickness. The aetiology of the condition is discussed and the literature reviewed. Two case histories are presented.

In the past four years, three cases of divers who had severe decompression sickness followed by changes in the electrocardiogram have come to the notice of the Royal Australian Navy School of Underwater Medicine at HMAS Penguin. None of these divers was servicing in the RAN. The three men were commercial divers diving from oil exploration rights in widely different parts of Australia. They all developed severe decompression sickness with involvement of the central nervous and respiratory systems. Involvement of the cardio-respiratory system in decompression sickness is accepted as evidence of gas bubbles in the blood, the symptoms of 'the chokes' being attributed to bubble emboli blocking the passage of blood through the lungs. Under these circumstances, it is possible for bubbles to pass into the arterial circulation through a patent ductus arteriosus, an atrial or a ventricular

septal defect or via the pulmonary plexuses. It is possible for bubbles to form in the blood which has passed through the lungs. These bubbles may embolise throughout the body and occasionally the area affected is the coronary circulation.

This is not a new observation, however, it has seldom been reported in divers, and most of the reports deal with caisson workers (Breu 1940; Caccuri and Graziani 1950; Zannini 1954; Caccuri et al. 1956; Aston 1957; Zannini and Odaglia 1958; Zannini 1967). As many of the reports are in Italian or German, the work reported will be reviewed as an introduction to the Australian case reports.

Breu in 1940 reported that 41% of caisson workers complained of 'hyperexcitability of the heart'. ECGs showed abnormally high T waves which were interpreted as signs of myocardial damage.

In 1950 Caccuri and Graziani reported their findings in 28 caisson workers affected by decompression sickness. Several had myocardial 'trouble' and a tendency towards deviation to the right of the QRS axis. This became a more frequent finding and was more accentuated the longer the men worked in caissons.

Zannini reported in 1954, 14 workers treated for decompression sickness of whom 7 showed right axis deviation, 2 had ST depression, 2 had inverted T waves which reverted to normal in 3 days and 5 had intraventricular conduction defects.

In 1956 Caccuri et al. published their findings in 90 workers treated for decompression sickness. The ECG changes included 20 diagnosed as auricular and ventricular hypertrophy, intraventricular conduction defects (1 with intermittent bundle branch block and 2 with partial bundle branch block), abnormal rhythms including ventricular extrasystoles and nodal rhythm, signs of subendocardial ischaemia and two unsuspected myocardial infarcts. Using the vector cardiogram they diagnosed 'myocardial trouble' in 40 cases.

In 1957 Alston reported a case of severe decompression sickness in a Norwegian diver treated on board HMS Adamant. The case report is of interest as the man was relieved of all his symptoms on recompression to 165'. He was decompressed on the RN Table III and for the first 6 1/2 hours his progress was excellent. At that time when he had been at 30' for 3 hours, there was 'sudden onset of severe cardiac and respiratory embarrassment, the patient becoming almost unconscious. His heart was fibrillating and pulse almost imperceptible at over 100. On recompressing to 60' he recovered rapidly but felt again a pain in his left lower limb, which, however was only temporary'. There was no ECG being taken, so the diagnosis of atrial fibrillation is purely clinical. The retrospective diagnosis to explain his collapse rests between the sudden onset of a cardiac arrhythmia and the sudden onset of the 'chokes'. As he has been at the same pressure for three hours, it seems unlikely that there was a sudden large increase in the rate of bubble formation in his blood, especially as the rest of his decompression was without incident. It would seem more likely that as the result of a bubble embolus in a coronary artery he developed an anoxic area in the conduction path and that this led to the sudden onset of arrhythmia. Prompt recompression presumably restored the blood flow to the anoxic area and cardiac rhythm reverted to normal. It is of interest that this man's ECG was normal approximately 4 days after his collapse. Zannini and Odaglia reported 11 cases of decompression sickness in caisson workers. These patients had had the ECG's recorded before, during and after recompression. Any changes in the pre recompression tracings had reverted to normal after recompression and therapeutic decompression.

In none of these series is there information about the ECG's before the episode of decompression sickness.

In 1965 during a symposium on decompression sickness, Zannini summarised much of the preceding work and presented his findings in 74 patients with decompression sickness. Of these 33 showed ECG abnormalities (Table 1). He summarised his views on the causation of these changes.

1. Changes in rhythm and heart position during the stay at high pressure. These were bradycardia, right axis deviation, ST elevation, clockwise rotation of the yeart. They were attributed to changes in autonomic tone, increased oxygen tension, reduction of abdominal gas and lowering of the diaphragm. The changes could regress on return to atmospheric pressure or persist for some time.
2. Changes due to the workload. These were increased potentials from left or right or both ventricles with an enlarged QRS complex and flattening of the T wave in left leads. He was unable to explain why caisson workers developed these changes more often than workers doing similar jobs at atmospheric pressure. The changes were transitory.
3. Changes usually detected in decompression sickness, but which can occur without decompression sickness. These include pulmonary P waves, notched P waves, depressed ST segment, flattening or inversion of the T wave in leads 2 and 3, and lengthening of the PQ interval. These may be due to bubbles interfering with the pulmonary circulation.
4. Changes due to coronary or myocardial damage due to aeroembolism. These are rare.

TABLE 1		
	Notched P waves	8
	Pulmonary P Waves	7
	Right ventricular hypertrophy	2
	Inverted T waves	2
	Flat T ₁ to T ₁₋₂	3
	Nodal rhythm	2
	Partial bundle branch block	8

ECG abnormalities detected in 33 out of 74 patients treated for decompression sickness.

The Australian cases differ from the previously reported series as two of the men are known to have had normal ECGs before their episodes of decompression sickness. One man developed ECG changes which later disappeared. One man developed multifocal ventricular extrasystoles. The third man developed chest pains and 2 1/2 years later had ECG changes consistent with either an old inferior infection or posterolateral cardiac ischaemia. As is to be expected in a disease with the protean manifestations of decompression sickness the three men sustained differing amounts of cardiac damage. All three men had an interval of days between finishing therapeutic recompression and the onset of their symptoms. A similar delay in the onset of ECG changes in carbon monoxide poisoning has been reported by Hayes and Hall.

CASE REPORTS

CASE 1 Diving on compressed air to 160', with surface decompression. In the interval between surfacing and entering the recompression chamber, he complained of pain in both knees and then collapsed. He was placed in the recompression chamber where he recovered consciousness. His symptoms were relieved at 60' and he was decompressed on a minimal recompression oxygen table (Table 6 USN). Following this he was easily tired, and a week after the incident he was exhausted after a simple surface swimming job and climbing back to the diving platform.

Nine days after his episode of decompression sickness his ECG showed ST depression in lead 2 and an inverted T wave in leads 3 and AVF. A week later the report read "T wave inversion in L3 and AVF is now less obvious suggesting a recent cause". Later he was investigated in hospital. The resting ECG showed ST and T wave abnormalities. An effort test ECG showed increased ST depression. He did not complain of chest pain during this exercise, however, immediately after stopping the exercise he had an episode of bradycardia and hypotension. During this time he experienced the same symptoms as had occurred while he was swimming after his episode of decompression sickness. Coronary arteriography showed normal coronary arteries.

A year and a half after the incident he was getting chest pains on exertion and his ECG showed T wave inversion in leads 3 and AVF, and ST segment changes in V5 and V6. The report stated that 'these changes are consistent with either old inferior infarction or with postero lateral ischaemia.'

This man had a normal ECG eight months before his decompression sickness.

CASE 2 Dived on compressed air to about 180', 22 minutes bottom time. Decompression stops in the water according to USN Diving Manual as for a 25 minute dive at 180'. While undressing, he noticed paraesthesiae and numbness in his loins, then he developed pains in legs and shoulders, difficulty in co-ordination, severe malaise, tiredness and nausea. This was followed by difficulty in taking a deep breath precipitating a coughing spasm. He also developed a rash.

He was recompressed, 27 minutes after surfacing and his symptoms were relieved at 40'. He was treated on a minimal recompression he had a recurrence of the malaise and the onset of swelling over large parts of his body. He was then again submitted to therapeutic recompression, this time without obtaining symptom relief.

The next day he noticed a 'fluttering' in his chest. It only lasted a few seconds, came on at any time and was unrelated to physical exercise. This occurred about 100 times a day. He had never experienced such a sensation before. He felt slightly faint and had a mild headache during the palpitations. An ECG taken 4 weeks after the onset of palpitations showed ventricular extrasystoles. After exercise the ECG showed slight depression of the ST segment in leads 2, 3, AVF, V4, V5 and V6 and slight elevation in AVR. The T waves became inverted in V1, slightly bifid in V2, biphasic with predominant primary inversion in V3 and biphasic with less deep primary inversion in V4.

A week later his resting ECG again showed occasional ventricular extrasystoles while after exercise there were more frequent multifocal ventricular extrasystoles, blunt slightly bifid T waves in V4 and very slight depression of ST segments in leads 2, AVF and V5. As the man had had a normal ECG recorded two and a half months before his episode of decompression sickness the final diagnosis was decompression sickness involving the skin, joints, abdomen, cardiac and neurological tissues.

On the basis of the above every deep diver and commercial diver should have an ECG recorded and retained for reference. If he is unfortunate enough to develop severe decompression sickness his ECG should be recorded when he finishes therapeutic recompression and again a week later. In this way there will be objective evidence of the presence or absence of myocardial damage due to decompression sickness available to assist in the assessment of any Workers Compensation claim that is made.

While it may be that these three cases represent the total Australian experience of cardiac changes following decompression sickness, it is possible that there are other men similarly affected whose case histories have not reached the School of Underwater Medicine.

ACKNOWLEDGMENT

The author wishes to thank Surgeon Rear-Admiral JAB Cotsell, QHP Medical Director-General, Royal Australian Navy, for permission to publish. Author's address for correspondence: Dr RJ Knight, 4/106 Wellington Parade, East Melbourne 3002.

MANAGEMENT OF CHLORINE GAS POISONING

At 9.00am on 6th June 1973, fourteen men were admitted to Western Suburbs Hospital following exposure to Chlorine gas. The men were working in the vicinity of a chlorine supply tank which was being loaded from a road tanker. Apparently, the outlet valve was not closed before the tanker was disconnected. The result was that chlorine escaped under pressure into the area in which the men were working.

All the affected personnel left the area immediately (except one who donned a gas mask and attempted to close the valve).

On arrival, all showed signs of varying degrees of respiratory distress. All were tachypoeic and had audible rhonchi and coarse crepitations throughout their lung fields. None were clinically cyanosed. Each were given oxygen to breathe at two to three litres per minute through Edinburgh masks. A chest x-ray was taken of each patient on admission. None showed signs of recent lung disease.

Spirometry (FEV and Vc) and peak flow (PF) measurements were made on all the patients. These showed that there was a considerable degree of bronchospasm in all the patients. Twelve of the men were selected randomly and divided into four groups of three. A single dose of Orciprenaline 20mg was given to group A, Aminophylline 100mg to group B, Choline Theophyllinate 200mg to group C and Terbutaline Sulphate 5mg to group D. The FEV₁ Vc and PF were measured again at one and two hours after administration of the bronchodilators.

All of the patients showed a considerable improvement over this period. Six hours after the first dose of bronchodilator was given, the parameters, FEV₁, VC and PF were measured again one and two hours after the doses. This procedure was repeated after a further six and then nine hours so that each of the four medications was given once to each patient.

Had the effects of the chlorine been more prolonged, it may have been possible to use this information as the basis of a clinical trial to determine the relative efficacies of the four medications. As it happened, all but one of the men were fully recovered within six hours so that the last three doses of medication had no significant effect. They were discharged after 24 hours with the exception of the one man. He developed a cough and crepitations in his lung fields. He was treated with IPPR and tetracyclines and discharged the following day.

In summary, the management of acute chlorine gas poisoning was as follows:

1. History - initially brief with reference to severity of symptoms, previous history of heart and lung disease and smoking habits.
2. Physical examination - a rapid assessment of pulse, BP, cyanosis, respiratory rate was made together with auscultation and percussion of the lung fields.
3. Investigations - Chest x-ray, FEV₁, Vc and PF rate.
4. Treatment - oxygen, bronchodilators, antibiotics (in one case)

All but one of the patients were clinically recovered within six hours and discharged in 24 hours.

Dr Roger Tuck, BSc, MB, BS

NOTE: Dr Roger Tuck is an intern of the Professorial Unit of Sydney Hospital on secondment to the Western Suburbs Hospital, Croydon.
Sent in by Dr P Hamilton.

LABYRINTHINE DYSFUNCTION DURING DIVING - SYMPOSIUM 1973

This is a very subjective and personal impression of the papers at the workshop sponsored by the Undersea Medical Society on Feb 1 and 2, 1973 at Duke University Medical Centre, Durham, North Carolina.

The meeting was chaired by Joe Farmer, Assistant Professor in the Division of Otolaryngology. The opening remarks by David Elliott suggested that the proceedings of the meeting would not be published as such, as this would allow more genuine discussion on the controversial issues. For the sake of the South Pacific Underwater Medicine Society, these rough notes were made:

Lecture 1 - Dr Hugh Barber, Professor of Otolaryngology, University of Toronto. Barber described the functional anatomy of the vestibular endorgan proposing that this be looked upon as a transducer. The central connections were considered to be programmed to compare the vestibular input on each side.

Lecture 2 - Dr Brian McCabe, Professor of the Department of Otolaryngology, University of Iowa. McCabe described also the functional anatomy of the central vestibular system supporting the concepts of Barber. He reiterated that there was a resting discharge in the vestibular system which increased on one side as it decreased proportionately on the other. In normals the vestibular responses are considered to be equal and opposite and if this does not occur then is orientation and vertigo would result.

Lecture 3 - The Clinical Evaluation of Vestibular Dysfunction. The Clinical Evaluation of Vestibular Dysfunction was again given by Brian McCabe. McCabe described two axioms in clinical history. Firstly that continuous labyrinthine vertigo cannot last more than one to three weeks. Secondly, that labyrinthine vertigo of any consequence will always have labyrinthine nystagmus. He then described the vestibular function tests.

Lecture 4 was from Hugh Barber again, and this was on the principles and clinical uses of electronystagmography.

Lecture 5 was also from Hugh Barber, and was on the symptoms, signs and pathology of vestibular end-organ disease. This was a classical textbook description of the symptoms and signs of this disorder. The only new feature to this narrator was the information that occasionally when one inserted a needle in the oval window one could obtain endolymph. This occurs when the saccule is greatly expanded with the endolymph.

Lecture 6 was from Hugh McCabe on central vestibular disease and was a reiteration of the textbook teaching.

Lecture 8 The eighth lecture was given by Dr Robert S Kennedy, Lieutenant Commander and head of the Human Factors Engineering Branch at the Naval Missile Centre, Point Mugu, California.

Dr Kennedy reiterated and summarised the work that he has already presented in his NMRI Report - certainly the most complex bibliography on vestibular function abnormalities in diving.

Lecture 9 was given by Dr Carl Edmonds, School of Underwater Medicine of the Royal Australian Navy, and five cases of inner ear damage from the effects of barotrauma were presented. Audiogram and electronystagmograms were presented showing that the effects of middle ear barotrauma of descent may have either temporary or permanent damage effects on the cochlea and/or the vestibular apparatus. In the 5 cases, 3 were shown to have surgically correctable lesions by repairing the round window perforations. The clinical history of these cases all seemed consistent, ie. there was initially a difficulty in equalising the pressures within the middle ear clefts during descent, and usually there was an excessive attempt at forceful Valsalva manoeuvres. Following the dive there was usually a history of tinnitus with or without vestibular and cochlear damage; in the cases of round window fistulae the vestibular and cochlear damage progressed following the dive and was corrected only after the surgical repair was performed. Another case demonstrating the effects of ascent on middle ear pressures and the production of nystagmus was illustrated with ENG's performed during compression and decompression. A case was made for the inclusion of 2 other provocative tests in electronystagmography as it applies to divers. The first was the use of bilateral equal and simultaneous caloric stimulation thus mimicking the environment of the diver, the second was the use of electronystagmography while undergoing compression and decompression changes. This was termed 'dysbaric ENG' tests and again mimics the influence of pressure changes on the diver it is pointed out that the latter test could only be performed with the diver in the upright position whereas the former test ie. the bilateral simultaneous caloric could only be performed in one of the Hallpike positions. Following this lecture there was some degree of criticism regarding the absence of any publications from the Australian workers. However this was considered invalid as the work is mentioned in at least 3 medical journals and one book.

Lecture 10 was the vestibular disorders occurring at stable depths and this was prepared by Dr Sundermacher of the University of Pennsylvania and Dr Lambertsen, the Director of the Institute of Environmental Medicine at the University of Pennsylvania.

This was a reiteration of the well known concepts of isobaric counter diffusion of gases. It originally was proposed when 4 subjects were subjected to a 1200 ft dive. Three obtained vertigo while breathing heavy gases such as neon in a light gas environment. The first patient was said to be breathing neon and then went on to helium for a short time, then commenced breathing nitrogen, and he then developed severe vertigo. The acute phase lasting for approximately 5 days. There was no tinnitus or auditory symptoms. The second case was breathing neon and then 4 1/2 hours later he was quite well between these times, he then developed nausea, lightheadedness and dizziness. He also suffered a mild upper respiratory tract infection as well. The third case was breathing neon when he developed acute vertigo. Caloric tests performed on these patients were of the iced water type with 0.4mls given in 20 seconds. In the first case there was no function on the right side and this was demonstrated in 3 tests each a few months apart. In the second case there was a questionable response in the left side with decreased response to cold and bilateral decrease response to warm. The third case there was a slight decrease in response to cold water and 2 weeks there was a decreased response to cold and no warm water and later on there was recovery in other words no abnormality in the caloric tests. Isobaric counter diffusion was postulated and in this situation a soluble heavy gas, eg. nitrogen or neon was used for breathing while the animal was in an environment of a light gas eg. helium. It was through under these conditions that the gases may come out of solution at the interface in the form of bubbles. Discussions on these cases after the lecture revealed that there were many discrepancies and disagreements regarding both the clinical findings and the history eg. Dr Lambertsen pointed out that the second case was 'feeling bad' the whole time and had no latent 4 1/2 hours of well being between breathing the neon and developing the lightheaded and nausea and dizzy symptoms. Also, apparently, the subjects were not actually surrounded by helium at all. In fact they had bags with breathing gas in over their body and the only area exposed to heavy gas was the head and neck, and therefore the external ear canal. They got lesions of the skin, of the scalp, of the face, and these were thought to be due to intradermal bubbles. They were white raised lesions, and very similar to those that Joe Idekula later demonstrated in his pegs.

Lecture 11 was the investigations of vestibular interactions in the high pressure neurological syndrome. This was given by Jim McCormack, Research Assistant Professor of Otolaryngology and the Director of the Otological Laboratories, Department of Surgery, Bowman-Gray School of Medicine, at Winston Salem, North Carolina.

McCormack opened the middle ears of guinea pigs to eliminate the possibilities of barotrauma. He then compressed the animals at 24 atmospheres per hour giving them half an atmosphere of oxygen. The ventilation was performed by a myringotomy tube originally but now tubes are placed through the mastoid a few days before the dive. The animals finally reached 80 and 90 atmospheres. Depths. he used 6 guinea pigs each dive and did 4 dives ie. there were 24 animals in all. He observed convulsions and twitches, etc. One animal was thought to have had a decompression sickness with a severe vestibular episode, however in discussing this with McCormack later it appeared that his animal did not have the ventilation of the middle ear which was given to the other animals. This animal fell to the right and left and did complete back flips. On inspection of his tympanic membrane there was no obvious evidence of barotrauma, but it was also noted that he tended to drag one hind leg. The auditory function 16 days later demonstrated decreased auditory acuity and this was thought to be a total damage to the auditory system on that side. Auditory testing was performed by several Bell electrodes implanted in the round window to measure the potential generated by the hair cells of the auditory nerve. The voltage potential thus recorded is graded according to the intensity of the sound stimulus given and the frequency of the stimulus is the same as the frequency of the voltage potential. McCormack also produced deafness in another animal. he then induced decompression sickness in a group of guinea pigs and progressive hearing damage was noted in these animals. He observed that the administration of heparin protected these animals from hearing loss. he reiterated the work done on porpoises which were trained to dive to 1000 feet but did not develop decompression sickness and had no hearing losses whatsoever. In discussions on the animal described above, it was ascertained that there was haemorrhage into the inner ear. It was made clear during the discussions on the animal described above, it was ascertained that there was haemorrhage into the inner ear. It was made clear during the discussion that there was no unanimous agreement that the cochlear potential microphonics represented first hair cell potentials and that therefore there was some doubt regarding the components that were actually being measured.

Lecture 12 There was one lecture given by Dr Peter Bennett who is now the Professor of anaesthesiology in the FG Hall Environmental Laboratory at the Duke University Medical Centre. This was on the current concepts of CNS dysfunction in diving. It included a summary of diving and the possible central nervous involvement obtained from diving. It was therefore more along the lines of an inert gas narcosis and high pressure nervous syndrome resume.

FEBRUARY 2

Lecture 1 by Joe Farmer, Assistant Professor Division of Otolaryngology, Department of Surgery and FG Hall Laboratory for Environmental Research, Duke University Medical Centre.

This paper dealt with vestibular and auditory problems during decompression. It summarised the literature involving cases all of which occurred with subsaturation dives. It was stated that non had difficulty in performing autoinflation, although this was questioned in later discussions, and that none had symptoms during descent. There were other symptoms similar to decompression sickness manifestations in 4 of the cases. Eight cases had isolated vestibular lesions, ie. they had nystagmus and vertigo and of these, 3 had relief with recompression, 2 cases were not given recompression and the other 2 cases presumably had no relief. Case 17 was given particular attention. He was a New Zealand diver diving to 450 ft and changing chambers at 150 ft. The vestibular symptoms occurred during the switch from helium breathing mixture to air and there was a non-function labyrinth demonstrated on year later. Another case as due to 30 dives of the breathhold type resulting in decompression sickness. Case 17 turned out to be described by 3 different authors, all with rather different slants. The case of breathhold diving was thought by some not to be decompression sickness. Farmer also described 6 case of pure hearing loss. These occurred with deep helium dives, 2 improved with recompression therapy, and 4 cases without treatment had a sensorineural loss. Case 12 described symptoms at 56 feet from a 400 ft dive and was found to have a persistent unilateral sensorineural loss. Six cases had combined symptoms both hearing and vestibular. Treatment gave a good recovery in these cases. These were thought to have a sensorineural type loss, 3 ascertained by audiometry and 3 by clinical tests. Thus the relief of symptoms with recompression therapy was strongly supportive of the aetiology of decompression sickness due to bubbles. Farmer did not claim to have had personal knowledge of most of these cases as they were obtained mainly from the literature and from other sources.

Lecture 2 was from Hugh Barber and was titled "Vestibular Symptoms associated with Deep Diving". Barber described 4 cases. The first had a half hour descent to 340 ft on helium/oxygen and developed vertigo, nausea and hearing loss during the ascent at approximately 60 ft. He reached 20 ft and had severe joint pains and loss of consciousness. He was extremely vertiginous and vomiting, and still had hearing loss and tinnitus when he reached the surface. Six weeks later the Weber tuning fork test was preferred to the left hand side. The electro-nystagmogram showed left beating positional nystagmus with a peripheral disorder on the right hand stand, with

very sluggish caloric responses. The audiogram revealed a flat sensorineural loss in the right ear. The second case occurred during decompression. He had reached 150 ft and then complained of severe vertigo and this persisted, 1 hour later he developed pain in the knee and this improved with treatment at 60 ft in a recompression chamber. Six weeks later he had a normal audiogram with spontaneous left beating nystagmus and a decreased caloric response on the right hand side. The third case dived to a depth of 30 minutes to 500 ft with helium/oxygen and at 50 ft developed vertigo. This persisted a little but was not bad. Audiometrically he was normal except for a 40 decibel loss at 8000 cps on the right side and electronystagmograms revealed decreased caloric response on the right side with positional nystagmus. Follow up 12 months later revealed an unchanged audiogram and a normal nystagmogram. He resumed diving and performed chamber dives which gave no vestibular decompression sickness despite other decompression sickness symptoms. The fourth case had 2 episodes, one during decompression from a helium dive to develop vertigo nystagmus and vomiting which persisted for 10 to 14 days. After 4 months he resumed diving. A year later almost identical symptoms occurred. This was in a recompression chamber during the decompression. Twelve months later the audiogram revealed bilateral upper sensorineural hearing loss worse on the left side and electronystagmogram showing no proof of a nystagmus but marked decreased caloric response on the left hand side. In summary Barber described 4 cases of experienced divers performing deep dives, 3 of the 4 were on helium and 2 episodes occurred in 1 of the cases. Three had sensorineural hearing loss. It was stated that none of the cases had difficulty in performing the Valsalva manoeuvre during compression although as was pointed out that one of the cases was Mark Fritag and during the compression of the dive in which he was affected, the chamber had to be stopped because of his specific problems in clearing his ear, that there was in fact an episode of barotrauma involved.

Lecture 3 The next lecture was from Ted Langley of Ocean Systems Union Carbide Technical Centre, Tarrytown, New York, and this was on vestibular function in commercial diving. Langley also had cases, some of which had been previously described by Barber, some by Farmer. The first diver affected descended to 700 ft for 25 minutes and during decompression 290 feet he developed vertigo. He was given a slow recompression to 320 feet with an increase in the oxygen administered to 1 ATA. Then he was more slowly decompressed. The second case also on helium/oxygen was at 130 feet and he was changed to air. He became very dizzy, he then required treatment with oxygen during which time he vomited. He later developed knee pain and required treatment according to Table 1 in the United States Navy Manual. Vertigo did not respond to treatment although the knee pain did, nystagmus was noted. Two months later his audiogram was said to be normal, he was ataxic, there were decreased caloric responses on the one right side and there was a left beating nystagmus, also positional nystagmus.

Case No. 2 and 4 have already been described by Barber but with different diving details. Case 3 went to 340 ft for 40 minutes in a hard hat equipment. As is customary with helium/oxygen he was changed to air at 50 ft and had nausea, vertigo, loss of consciousness, then conscious but unable to move. This was also classified as Barber's Case 1. He was then subjected to multiple compressions and decompressions.

Case No. 4 which was equivalent to Dr Barber's Case no. 3, it was pointed out the Fritag did have difficulty clearing his ears and that he was breathing air by mask and within 15 months of the changeover he developed his symptoms. He was then recompressed to 200 ft. Langley had therefore concluded that cases of vestibular dysfunction do occur, and especially with the shifting of a breathing medium from a less dense medium to a more dense medium. It was thought that slow shifts from one inert gas to another would tend to overcome this but when it did occur the treatment was recompression and oxygen. Elliott supported this view and stated that he was aware of another 6 cases in which the changeover from helium/oxygen to air appeared to be the major precipitating factor in the production of symptoms although these symptoms were not specifically vestibular ones.

Lecture 4 on the second day was from Dr Ross Coles of the Institute of Sound and Vibration Research, University of Southampton, and Consultant to the Institute of Medicine at Alverstoke, United Kingdom. The paper was entitled 'Labyrinthine Disorders in Divers' and Coles repeated the work which he had described in 1961 with Knight. He reiterated that the conclusions in the RNPRC 61-101 report was that there was no evidence of progressive conductive deafness in divers and that the sensori-neural losses noted in divers was attributable to noise exposure. He also pointed out that he regretted now having made this type of statement and that recent work has disproved this. He also stated that his own experience also throws doubt upon the original conclusions.

The Royal Navy instituted a 10 year prospective study into the hearing acuity of divers. Coles appeared to use the word 'alternobaric vertigo' to describe a permanent damage to the inner ear and he divided his cases of vestibular dysfunction into 3 types, alternobaric, peripheral labyrinthine injury due to decompression sickness and central nervous system injury in the cochlear vestibular tracts due to decompression sickness. He proposed that bilateral hearing loss was possible with central lesions above the cochlear nuclei, that these would mimic peripheral lesions. He pointed out that it must affect both ears and that it must be approximately, although not absolutely, equal in severity in each ear. He then gave a case report of a diver who had bilateral symmetrical decompression from treatment of a spinal bends. The patient described deafness and tinnitus in both ears with slight vertigo on leaving the recompression chamber. He showed what superficially appeared to be a typical conductive loss bilaterally which improved greatly within 4 days and further still within 2 months. Audiograms unfortunately were not presented, only the rough sketches. He postulated a bilateral cortical hearing loss although in the opinion of Farmer and Barber the case was by no means a good example or proof of this concept. The second case which was the same as Case 11 of Farmer's, and complained of fluid in the ear on surfacing. He had apparently attempted forceful exhalations during the dive and on examination there was said to be a fluid level noticed. There was a hearing loss, it was low frequency much more on the right with improvement to a considerable degree 2 months later. There was a right canal paresis initially but not 2 months later. The third case was Sharpshouse who during the RNPL dive to 1500 ft developed severe vestibular problems resulting finally in a canal paresis with no reactivity to 30°C or 44 °C. Apparently Sharpshouse has been submitted to further diving and was asked to manipulate himself underwater in such a way that he would become disorientated. Apparently disorientation did not occur and 1 year later the ENG's still showed no response on that side until the temperature was dropped to 15°C in which there was probable pseudo caloric nystagmus resulting. The Meeting seemed to agree that his probably was a pseudo caloric response, ie. an alerting device of any type would have produced a similar response.

The remainder of the meeting was involved with panel discussions, firstly on the prevention and management of vestibular disorders. There was a consensus of opinion that the transition from some inert gases in the breathing mixture should be slow. There was also agreement that divers, at least at this stage of our knowledge, should not breathe heavy gases while in an environment of light gases. There was far less agreement regarding the importance of ensuring Eustachian tube patency prior to the diving. Most members of the US Diving fraternity who spoke on this seemed to think that this was not practical and that difficulty with autoinflation of the middle ear cleft was almost an inevitable result of diving, others including McCabe and Edmonds believe that his problem would result in serious complications of the vestibular system unless there was equality and ease in middle ear autoinflation. The recommendations in the pre-diving investigations proposed by Barber and McCabe were as follows: Firstly there should always be a good clinical exam including a neurological prior to diving. Secondly as regards specific audiometric investigations it should be a pure tone air conduction without the need for auditory discrimination if there was no loss of above 15 decibels. If it is abnormal then auditory discrimination

and decay together with bone conduction must be performed. Electronystagmography was important in the pre-diving medical and this should be done in a darkened room or with infra-red lighting with the eyes closed and by using a mentally alerting technique with different head positions perhaps with the use of an optokinetic drum and ocular tracking. Barber suggested standard caloric tests but only using the 44°C and to calculate the right/left difference he pointed out that in his own laboratory if the difference exceeded 20% then they also performed a 30°C caloric test. McCabe used a 5cc of iced water. Coles requested that optic fixation reflex be added to the calorics. The other suggestions made were for sonomanometry to be performed (this was suggested by Edmonds) and that lipid profiles be performed (this was suggested by McCormack and Holland). The meeting seemed not to endorse these suggestions. Other statements which were made that could certainly not be included in recommendations was the methylprednisolone given half to one hour prior to the dive would be very effective in ensuring Eustachian tube patency, and that this may be given if needed to relieve the blocked ear sensation of which some divers complain. On this dangerous note the meeting ended.

SUB-COMMITTEE REPORT ON THE DIPLOMA IN DIVING AND HYPERBARIC MEDICINE

Introduction

The present increase in underwater and hyperbaric activities overseas has led to a concomitant increase in Australia. At present the medical facilities available for both civilian and military ventures are very limited, and since these facilities must be expanded in order to cope, it was thought wise to institute a course of instruction for medical practitioners involved either fully or part time in this field in Australia or the Indo-Pacific area. It was considered essential that some uniformity of instruction was necessary, and in order to achieve both uniformity and a high degree of technical and clinical acumen, the institution of a recognisable post-graduate Diploma in Underwater Medicine was proposed.

As far as is known, there are no similar qualifications available anywhere else in the world, however, the US Navy does conduct an extensive course of instruction for Naval Medical Officers in Submarine and Underwater Medicine. The scope of the proposed Australian course hopefully will cover not only Underwater Medicine as related to military and civilian diving, but will also include hyperbaric therapy and caisson work. It is envisaged that the standards achieved will equal or surpass any that exist elsewhere, and that medical knowledge in this field will keep pace with the commercial and experimental developments as they occur.

Recognition of post-graduate training in this field may eventually become a commercial proposition, similar to that of the holders of Diplomas of Aviation Medicine, however this is not envisaged in the immediate future.

In establishing such a course, consideration was given to the affiliation of the South Pacific Underwater Medicine Society, with both the Post-Graduate Federation of Australia and a University. Since the Society already affiliated with the Post-Graduate Federation of Australia, it was decided to approach the University of New South Wales, since this is the only University with facilities related to hyperbaric work. Macquarie University and Townsville University were suggested as alternatives because of their enthusiastic approach to new concepts of education in general. This liaison will be investigated in the near future.

The Sub-Committee, being in general accord as to the need for establishing a post-graduate course, then set about investigating the possibilities of nomenclatures, and it was decided that the title Diploma in Diving and Hyperbaric Medicine (Dip. DHM) would best cover these two essential and related aspects of medicine.

Recommendations by Sub-Committee:

1. All Candidates to take out personal insurance policies against death and disability (minimum value AS100,000) for a period of attendance at courses at, HMAS PENGUIN and The Prince Henry Hospital.
2. Forms of indemnity to be signed at HMAS PENGUIN - despite accompanying letter from Navy board - and at The Prince Henry Hospital, also indemnifying SPUMS.

Aim

The aim is to train a physician to be capable of acting as a Consultant in Diving and Hyperbaric Medicine to individuals, diving bodies, Government Departments, professional organizations and hospital units.

Requirements for Candidates

- (a) The course is available to qualified medical practitioners registered or capable of being registered in Australia.
- (b) All candidates must be medically fit before commencing the course. The standards of fitness required is that recommended by the Standards Association of Australia in Code CZ 18/72. In addition, applicants for the course are to demonstrate a capability of undertaking a recompression chamber dive to 100 feet before acceptance. The medical examination and recompression chamber test will be conducted soon after application is made for the course.
- (c) An upper age limit of 45 years is set, but consideration of previous experience in a hyperbaric environment will be given to older applicants.

Course

(a) General

- (1) Four weeks compulsory attendance at lectures, discussions, films and practical demonstrations. This period will commence at the beginning of each calendar year, and will be conducted at the RAN School of Underwater Medicine, HMAS PENGUIN, Balmoral, Sydney.
- (2) A nine month study course by correspondence may follow. Compulsory assignments in the form of a thesis, based on reference material and/or individual research in various aspects of diving and hyperbaric medicine are to be included.
- (3) Following the completion of the above there will be a compulsory two week full time attendance at practical demonstrations. This will include one week of diving and underwater medicine at HMAS PENGUIN, and one week at the Hyperbaric Unit Prince Henry Hospital, Sydney. An oral and practical examination will be conducted at the end of each week.

- (4) The final examination will be conducted approximately four weeks after completion of practical training will consist essentially of multiple choice questions and clinical cases, in which management of the patient: be involved. Results of compulsory assignments and practical examinations will be included in the overall estimation of suitability of the candidate for the Diploma.
- (5) Award of the Diploma shall be made by an examination board who shall consist of specialists in this field who are members of the South Pacific Underwater Medicine Society. The examination board members will be awarded a Foundation Diploma in Diving and Hyperbaric Medicine. Provision will be made for an external examiner who is a specialist in an associated clinical field to be nominated by the University sponsoring the Diploma if considered desirable by the University. The awarding of honorary diplomas will be the prerogative of a majority decision by the executive committee of the Society.
- (6) The Treasurer of the South Pacific Underwater Medical Society shall administer the financial aspects of the Diploma. A course fee of approximately \$20-30 is envisaged to cover costs of postage, printing, stationery and correspondence. Accommodation costs will be met by the individual concerned. A further examination fee may be necessary to cover University supervision, etc. in accordance with current University practice.
- (7) The examination will be held at a University or other approved centre in each state.
- (8) Lectures and practical tuition will be given by specialists in each field on an honorary basis. Pre-requisite recognition of these specialists by the sponsoring University may be required.
- (9) A comprehensive list of reference material in addition to course notes will be available to all candidates. The Hyperbaric Newsletter and the South Pacific Underwater Medicine Society Newsletter will also be available to all candidates.

(b) Syllabus

- (1) Introduction
 - a. Complete registration form
 - b. Issue course notes and list of references. Discuss availability of references.
 - c. Outline the course.
 - d. Detail necessity for diligent application to the course and the importance of observing all safety precautions.
 - e. History of diving and hyperbaric medicine.
 - f. Outline present and future concepts of the hyperbaric environments.
- (2) Principles of Diving Physics
 - a. Properties of liquids
 - b. Gases of concern to divers
 - c. Gas Laws, Kinetic theory, Gaseous diffusion and solubility.
 - d. Definition of terms and units used with air and water pressures, such as partial, atmospheric, gauge, absolute pressures, and psi, feet of sea water, atmospheres, and millimetres of mercury, with emphasis on metrication.
 - e. Diving Ventilation formulae.
 - f. Mechanical effects of pressure
 - g. Buoyancy
 - h. Thermodynamics
- (3) Gas Analysis and Gas Hazards Oxygen, carbon dioxide, nitrogen, helium, carbon monoxide, chlorine, hydrogen sulphide, explosive, gases.
- (4) Bioelectronics.
 - a. Theory
 - b. Instrumentation
 - c. Practical applications.
- (5) Breathing Gas Specifications
 - a. List
 - b. Reasons
- (6) Medical Examination of Divers
 - a. Procedure
 - b. Diver selection
 - c. Disqualifying conditions
- (7) Diving Regulations
 - a. Aims
 - b. List
- (8) Breathing Apparatus
 - a. Snorkel
 - b. Open circuit demand system
 - c. Semi-closed circuit
 - d. Closed circuit
 - e. Standard diving dress

- (9) Recompression Chambers
 - a. Types
 - b. Construction
 - c. Safety features
 - d. Ancillary equipment and its operation
 - e. Function
 - f. Operation
 - g. Environmental control
 - h. Emergency procedures

- (10) Submersible Habitats and Submarines
 - a. Types
 - b. General construction features
 - c. Safety aspects
 - d. Environmental control
 - e. Emergency procedures

- (11) Biochemical and Physiological Effects of the Hyperbaric Environment

The effect of temperature, pressure and gases on:

 - a. Central Nervous system
 - b. Cardiovascular system
 - c. Respiratory system
 - d. Haemopoietic system
 - e. Endocrine system
 - f. Genito-urinary system
 - g. Gastro-intestinal system
 - h. Ophthalmic

- (12) Decompression Theory, Tables and Procedures
 - a. Air
 - b. Helium

- (13) Specific Medical Conditions

History, aetiology pathogenesis, pathology, symptoms and signs, diagnosis, treatment and prevention of the following:

 - a. Avascular necrosis of bone
 - b. Barotrauma - sinus, pulmonary, aural, body, skin, ophthalmic, dental and gastro-intestinal.
 - c. Decompression Sickness
 - d. Inert gas narcosis
 - e. Oxygen toxicity
 - f. Hypoxia
 - g. Drowning
 - h. Salt water aspiration
 - i. Hypercarbia
 - j. Carbon monoxide intoxication

- (14) The Effects of Cold and Immersion
 - a. Physiology
 - b. Prevention
 - c. Treatment
 - d. Modification by variables - water temperature, duration of exposure, insulating materials, activity, cold adaptation.

- (15) Underwater Blast
 - a. Incidence
 - b. Pathology - respiratory, gastrointestinal, CNS.
 - c. Symptoms
 - d. Variables - nature, amount and depth of explosive, distance, depth of swimmer, type of bottom, salinity of water.
 - e. Protection
 - f. Treatment

- (16) Otolological Aspects of Diving
- (17) Disorientation and Vertigo
 - a. Definitions
 - b. Aetiology
- (18) Unconsciousness in Divers
 - a. Aetiology
 - b. Management
- (19) Dangerous Marine Animals
 - a. Classification and Identification
 - b. Each animal effect toxicology - symptoms, signs, treatment, prevention.
- (20) Psychological Disturbances
 - a. Introduction
 - b. Phobic anxiety state
 - c. Claustrophobia
 - d. Agorophobic reaction
 - e. Over-reactive anxiety state
 - f. Illusions
 - g- Psychological responses to physiological abnormalities.
- (21) Resuscitation
 - a. Indications - respiratory failure, sudden asystole, ventricular fibrillation
 - b. Experimental asphyxia
 - c. History
 - d. Current practices of resuscitation
 - e. Certificate of competence by recognised authority
- (22) Clinical Hyperbaric Oxygenation
 - a. History
 - b. Physiology
 - c. Indications
 - d. Management
 - e. Dangers
 - f. Current research
- (23) Medico-legal Aspects of Diving and Hyperbaric Medicine
- (24) Diving Accident Investigations
 - a. Incidence of diving accidents. Sources of information
 - b. Introduction to statistics. Collection of data
 - c. Forms in use in the RAN
 - d. Procedure
 - e. Case histories
- (25) Forensic Pathology
- (26) Deep and Saturation Diving
 - a. History
 - b. Current state
 - c. Research concepts
- (27) Research in Diving

World picture - research establishments, current work being undertaken, current projects at RAN School of Underwater Medicine.
- (28) Practical Work at the RAN School of Underwater Medicine and the Hyperbaric Unit, Prince Henry Hospital.

SHARKS IN SAN DIEGO

by Carl Edmonds

The activities of the above reporter during the first three quarters of 1973, were dutifully recorded and dispatched to the editor of the newsletter. On the grounds of literary demerit they were not included in previous editions of the newsletter, but with the change of editorial staff, this can be remedied at least in part.

With wife and four children in-tow, I arrived in San Diego, intent on looking up some criminal associates, both south of the border and at San Clemente. Two surprises awaited me. The first derived from my propensity to over-indulge in Vodka drinking parties with other countries' expatriates, and the second was the high cost of accommodation. These were in some way related. I finally left the luxury shores of La Jolla and leased a delightful house overlooking the sunset cliffs, at the moderate \$900.00 per month. Initially there was some doubt as to whether the US Navy required a loud-mouthed vodka drinking Australian who hob-knobbed with Russians and elected Labour Prime Ministers. While they were making up their minds, I proceeded on a series of short lecture commitments to the local universities and medical groups. Some of the most intriguing aspects of that location are the superb marine life sanctuaries, and the Scipps Underwater Canyon. A lecture on Dangerous Animals was an obvious goer, and this was very well received. In the anecdotal chit-chats following my lecture, I was informed that there was no accurately recorded shark attack in the area, and that even though one had been reported a decade previously, it was almost certainly a guise to exploit insurance companies - with the alleged victim being seen in Mexico with his de facto (on subsequent investigation, this rumour turned out to be entirely untrue). Indeed, it seemed that everyone shared a most casual attitude towards a danger which, although perhaps exaggerated in Australia, definitely exists. The result was that I did receive some well-natured taunting regarding this particular marine hazard. One cannot buck the locals, especially if one is relying on lecture fees to ensure one's subsistence. I decided to hold my peace.

Over the next week or so, while co-incidentally pottering around the local coroner's office, I came across many interesting reports of diving deaths, and became on more-or-less first name swearing terms with the coroner's staff. Then came the interesting request. Would I mind coming down to the autopsy room to inspect a body? It appears that the local whips had already been in and diagnosed a diving accident with "death from lacerations due to the safety boat running over the diver" (not an infrequent event in any country). Well, the story from the diving partners was slightly different. So the obvious procedure was to examine the body. It was a fairly well-developed 39 year old male, with multiple concentric lacerations over both sides of one leg, and a distance of approximately 12 inches between the 2 major areas. Rolling up shirt sleeves and disappearing into the wound, I finally came up with 4 pieces of shark teeth, one triangular with serrations along the edges. The locals were rather taken aback by a small exclamation on my part "Ah yes a classical Isuridae, judging by the jaw separation, about 12-16 feet long, or do you measure them in meters?"

There was the odd altercation or two and even an attempt at rebuttal, e.g. "How do we know the shark didn't bite him after the propellers sliced him up?" This needed no answer other than my five minutes uproarious laughter.

When one adds the actual story, as given by his diving buddies, it does seem as if San Diego must claim to have shark attacks. What apparently happened was that the divers, who were not spear-fishing and who did not carry any abalone or shellfish, entered the water for their only dive, late in the afternoon, and swam some way from the boat. The deceased rose to the surface within minutes of leaving it, and exclaimed "Shark! Tourniquet!" He was then pulled on board the boat, bleeding profusely, but with no-one taking notice of his request. No tourniquet was used and the patient bled to death. The incidence has thrown some doubt on the safety of the San Diego area regarding shark attacks. In the past, one local expert claimed that sharks don't actually bite, they are just trying to dislodge their older teeth! This rationalisation gives no solace to the widows. However, before we are too critical of the reporting of marine animal injuries from other countries, we could perhaps look at our own most ineffectual and sloppy system of documenting these injuries. What usually happens in Australia is that the descriptions are despatch by word of mouth, and through dribbles of beer. During 1973, I have been informed of one severe injury from a diver being run over by his safety boat, and therefore I do not ridicule the San Diegians' hypothesis, only its applicability in this particular case. I have also been informed that during 1973 there was severe morbidity from both Ciguatera and Tetrodotoxin poisoning from fish. I can find no area where these events were recorded and so passed them on to Doug Walker for inclusion in his stickbeak system. Where were our observer members of SPUMS in 1973! Also, how many of us, even in SPUMS, would be adept in the diagnosis and treatment of these conditions? More anon on this topic.

BUBBLES

Avascular Necrosis of Bone

A certain past editor of the newsletter, is said to have moth balls throughout his bone structure, and there is a suggestion that he is trying to pass this off as dysbaric osteonecrosis. On a quick run through the differential diagnosis of these bone lesions, one finds reference also made to obesity, alcoholism and syphilis. Come on now Bob, let's see us check the different diagnosis out first, before we pay worker's compensation.

Advertising

A dymo tape fiend has been at work desecrating one of our more illustrious Australian research units. On the scientific officer's door, there is the comment "don't blame me for going so slowly, as I'm probably going in the wrong direction". Outside the administration door, is the quote, plagiarised from Pogo, "we have found the enemy, and it is us". The head of the unit has such a large office, with so many cupboards that he had to label the last one as an AA Milne type "useful cupboard". On his door is the warning "No trespassing, Violators will be eaten", and halfway up the stairs, which one has to climb to read the notice, there is a large hand, pointing upwards and labelled "upstairs", no decks on that ship!

HMAS NEVERBUDGE, ie. THE PRINCE HENRY HOSPITAL HYPERBARIC UNIT

Seen in the Director's office is the following list of rules and regulations.

- Rule 1 the Chief is right;
- Rule 2 In the improbable hypothesis that a subordinate may be right, rule 1 becomes immediately operative;
- Rule 3 the Chief does not sleep, he rests;
- Rule 4 the Chief is never late, he is delayed elsewhere;

- Rule 5 the Chief never leaves his work: His presence is required elsewhere;
- Rule 6 the Chief never reads the paper in his office, he studies;
- Rule 7 the Chief never takes liberties with his Secretary, he educates her;
- Rule 8 whoever may enter the Chief's office with an idea of his own, must leave the office with his Chief's idea (Editor's note: Even though they may be identical);
- Rule 9 the Chief is always correct, even in his bathing trunks.

A SPUMS PRESIDENTIAL TRIP REPORT IN THE USA

(Taken from poor quality tapes, with unexplained absences)

With a family of four, and 22 pieces of hand luggage, this innocent and naive traveller arrived at Kennedy Airport. Given a few months in the USA, we would have arrived (sic), but at that stage we were not yet contaminated with the rebellious attitude to the English language. I have always shown an independent attitude to spelling, and to this one must now add speech. When this is supplemented with a newly acquired typewriter, which vacillates between accurate subservience and complete independence, the written word must be held suspect.

To return to the scene of the indiscretion. Arrival on the New Year's Day, in the middle of a blizzard, and during a taxi strike with an entourage as described above, should have rung the warning buzzers that the tokens of good tidings were absent. Not so. With undaunted enthusiasm for our new home, I tipped a bus driver \$5 to go a little out of his way, and finally arrived at Pilgrim Airways. The reader would be excused for not immediately experiencing flashes of recognition at the name Pilgrim Airways, and had I been more knowledgeable of them, I would not have been so concerned at their lack of seating reservations. I might even have welcomed this information. Also I would not have striven so gallantly and successfully for cancellations. On arrival at New London airport, we were met by the same cold bleak conditions that existed in New York, but without the people. Apparently, for some reason best known to someone else, they had expected me the previous night. It is of interest that not once during the trip across the Pacific, nor in Mexico or the USA, were the airline reservations of any actual value when it came to the nitty gritty of getting on the plane!

Fortunately for us, a guardian angel by the pseudonym of LCDR Ken Schultz had contacted me privately before we left and supplied me with the names and phone numbers of valuable and helpful people. After a brief confused interaction between the public telephone, Australian and US currency, and I, the smooth wheels of the USN started to grind, slowly and without confidence. An hour later a USN truck and car, with one set of headlights between them, and an irate local constable, arrived to speed us on our way. With much explaining and puffing, we were escorted to our lodgings, The Navy Lodge. A well equipped and warmed establishment equal to any commercial motel in Australia. I smiled benevolently at the hostess, as she demonstrated her rapport by asking for my orders. I ordered two steaks, lightly done, for myself and wife, and cereals for the kids, to be served at about 8 o'clock. This was followed by a brief period of confusion, followed by a request for my official orders. Feeling as if this was getting out of hand, I drew myself up to my full 5 feet, 10 1/2 inches and rapped out a repeat of my menu, but adding that it did not really matter if it could not be obtained at this late date, and that I was quite prepared to scavenge for myself. The local lads were brought in and after a foray into the respective travel administrations of both navies, and phone calls to the key persons mentioned in Ken Schultz' letter, it was apparently settled and, with neither orders nor menu, we retreated to our accommodation.

It took no Einstein to realise that 6 months in New London would not be productive unless one became involved with a special project - and this investigator has long since relinquished the belief that any research can be time limited. It would also counter the main value of a US trip, to acquaint oneself with other workers' activities. My boss who had instigated most of the planning for the tour, had believed that once in the States, it would be a simple matter to home in on wherever the action is. I was a victim of the same delusion. It took about a month to sort that problem out.

When any request was received to visit another establishment - navy or other - I would explain the difficult situation I was in and point out that whereas they may achieve a much more sympathetic and rapid hearing by making the request to the Embassy, I was incapable of achieving the same result. A surprising array of fan mail then descended on the Embassy, with the following result. The first quarter really started in February. I wiped the slush from my shoes and visited Duke University, where I received extremely generous responses to our rather heretical views on hearing loss in divers, and limited acceptance of our concepts on Vertigo and Disorientation in Divers. The proceedings of the meeting are described elsewhere, but it was a good start to the US tour proper. It was also to brand me as a specialist in otological disorders, which I am certainly not. Our other work, which is at least as good, has suffered from the front runner. Time will erase the disproportion.

At Durham, the home of Duke Uni, I learnt a few new words. The first was "precipitation" which meant, I later found a torrential downpour. Others were immediately understood without any synonyms being required; empathy was spontaneous with two; "chill factor", and "Boondoggle", although I am told that I have my own unique interpretation of each. To those friends at home, I had best explain. Chill factor is a way of saying it is bitterly cold, even without a low temperature. A boondoggle is a pleasurable egocentric activity which exploits situations for the benefit of all.

Another discovery was that one may travel hundreds of miles and remain in an area for many days, without ever coming into contact with the locals or viewing their city. Days can be spent between the motel and the conference rooms. This was no Boondoggle as it lacked the essential element of pleasure. One night was spent in obligatory entertaining; the others were a source of some compensation. David Elliott, Bob Bornmann, Ralph Brauer and I, after a perilous journey in Ralph's car, sampled the culinary arts of North Carolina, and also some of its imported French beverages. Ralph gathers disasters as others do possessions. Not that they ever seem to influence his good humour. Cholera epidemics, earthquakes, dives over 1000 ft; if one looks closely into the centre, there will be Ralph. His next scheduled disaster is when we meet in early June. Another delightful night was spent with that boondoggler extra-ordinaire, the man who introduced me to the term and its lesser known virtues, Dr David Youngblood and his attractive wife. A riotous evening was spent in educating me about American philosophy and Bourbon, which I find tend to merge as one goes deeper into them.

Good news on my arrival home, for want of a better word, to New London. Someone has given the authority to let me travel to the various research units. This beats the alternative, telepathy, by a mile. So much for faith in the old bosses. I should have despaired. We buy an OPEL station wagon which I mistakenly assume will hold my expanding family. Now there is an element of pleasure in our snow bound life. I am assured that whenever I wish to use the vehicle in excess of 50 miles, whether on business or not, the naval attache must personally transmit the request for approval by the Ambassador, presumably with only the slightest hint of genuflection.

Although I have no proof of this, it is my belief that the approval is finally gained by the simple act of a few of the lesser lights getting off their bums. I have considerable doubt whether either of the heavies have ever sighted my requests. We now let bygones be bygones, and start the real work of casing the USN diving medicine program.

Visits were quickly arranged to DCIEM, at Toronto, Taylor Diving and Salvage, Michel LeClear, HydroLab in the Bahamas, and the Ocean Simulation Facility at Panama City. Also a few days at Harvard, in Boston. Most of the technical data is recorded elsewhere, but a few words of social activities will not go amiss. New Orleans, apart from being the centre of hydrogen diving and sequential gas decompression, also has a French Quarter that leaves Kings Cross at the starting gate. This is real colour. Cynthia joined me at that holiday city, and it was just as well. We visited Peter Edel and his wife for dinner and then went with Bob Workman to sample the famed local sea food cuisine. After the inevitable discussion on tetrodoxin poisoning, we moved into the decompression regimes and how they developed. A wise and humble man is this one. Even his prejudices are well based on experience.

The Bahamas despite a disastrous interlude at the casino, was a delight. John Clement took me in two and apart from his preoccupation with Prince Charles, who was also visiting in his capacity as a RN lieutenant, was a superb host. Unfortunately some good diving weather was wasted on polo, but all in all the visit restored my faith in diving medicos. Bob Wicklund and Geraldine smooth talkers that they are, lured me into a diving set and off to the Hydrolab. What a sight. A real workhorse of a habitat. Submerged for 17 continuous months, in use full time, and only a small fraction of the cost of purchase and maintenance of the more illustrious glamour boats. Too long was spent underwater and I had to defer my flight back to Miami, to avoid being their first decompression victim. Instead we all went off to a Folklore show, followed by dinner at the Stoned Crab, with drinks the compliments of the house. This type of living I can take. An interesting sidelight on the island life was observed when, for reasons that would take too long to explain, I found myself in one of the Bahamian wharf dives (surface type), where the locals were drinking and dancing with zealous enthusiasm. Off to one side there was a young man, slumped over the table, quite dead. In the ensuing investigation it appears that as he was not occupying a table for which there was much demand, no one interfered and he had been dead for about 8 hours! Even during the police investigation witnesses had to be dragged from the dance floor. They take their pleasure seriously, these Bahamians.

Return to New London via Panama City was the highlight of the quarter. This is George Bond country, and great country it is. Others talk of research planning. This man does it. His fights against a viscous administration are now history. Perhaps they let him run his own race now. I know not. He attributes the Ocean Simulation Facility to the activity of a board of management, but I feel this is modesty. The OSF is a 1980 dream, and committees do not dream. Only men do that. This is the Master Dream that started with Sea Lab. There is a USN aphorism that if you wish to delay a project, put it under committee control. The rough rule of thumb is for every man on it, a delay of one month ensues. After 12 are appointed the project is doomed to extinction. There is a parallel to our own government departments, although I feel the delay to be an under-estimation in our case.

A new quarter dawns. April the 1st was symbolically selected as my date of moving to Washington. Cherry Blossom time. Outside a robin can be heard, coughing up his little brains. Spring is about to commence, and hope springs eternal. A lousy pun, but extenuating circumstances are invoked. We are almost ready to depart, south west to Washington (by car, with ambassadorial approval and waving the flag upside down), as a tornado heads north east, to Washington. We converge at Maryland, at the start of next quarter.

CARL EDMONDS