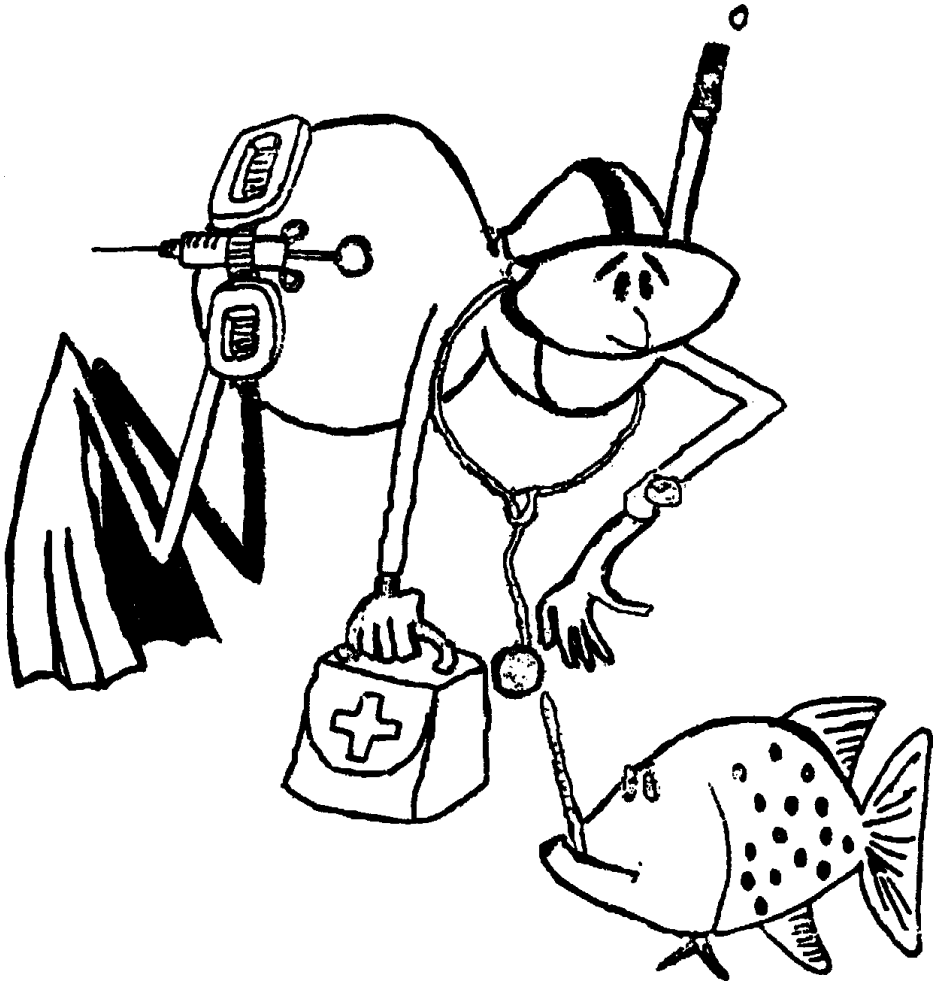
# S P U M S

NEWSLETTER DEC '72



VOL. 2 Nº. 4

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## 1. EDITORIAL

It is with deep regret, and a sense of loss, that I edit my last Newsletter - at least for some time to come. The two short years during which I had the pleasure of burdening other diving medicos with my prejudices resulted in many fond friendships. Often these have been with correspondents whom I have never met. The pleasure and responsibility associated with the Newsletter now passes to my two partners, Bob Thomas and Chris Lowry. The decision was made in the usual democratic manner, over a few beers at 6A Mistral Avenue. During 1973 I shall be touring North America, and may be fortunate enough to get some of my reports published in the Newsletter.

The last month has seen the usual run of diving deaths, two in New South Wales and three in South Australia. None of these occurred during training, but all were associated with a flagrant disregard of the safety principles of diving. The New South Wales deaths were in 'experienced' divers, who simply refused to use buddy lines. They were therefore deprived of any assistance when they got into difficulties, however we are pleased to announce that both bodies have been found. The three deaths, in the Mount Gambier ponds, would have been, had justice been served, a quartet. They were idiotic enough to enter caves with neither buddy lines, exit lines nor surface lines, nor did they feel the need for the customary spare set of equipment or lights, when diving under those conditions. There is little point in further criticising the dead, but a word or two about their teachers would not go amiss. Although both FAUI and SDAA have attempted to improve diver training, neither seemed to have learned from the ghastly errors that have already occurred in divers under training in Australia. Nowhere is this more obvious than during the coroners' inquiries, when a whole series of rationalisations, better known as lies, are used to exonerate the survivors. When a thin child, carrying 15lbs of weight, sinks below the surface and his alleged instructor has no method of assisting him, eg. by a surface line, and he has no companion diver attached by a buddy line, then the only word that I would use to describe it is 'negligence'. Similarly when your 'buddy' needs either air or buoyancy while you are diving off the Birchgrove Park, and you hightail it out of the area without giving him either, then it is little consolation that you are prepared to search later for his body. It is this refusal to learn from past mistakes that has prompted me to insert in the Newsletter one of my lectures to an instructors' meeting. The two major blocks to obtaining any worthwhile change in attitudes to diver safety are as follows: courageous megalomaniacs and extroverted medicos. I have dealt with the latter group in Volume 2 Number 1 of the Newsletter, and usually with the former group in the recompression chamber at HMAS Penguin. A list of the patients who have been carried into that chamber reads like a 'Who's Who' of Australian diving.

One cherished delusion of most diving instructors is that diving is safe. Hour for hour it must have one of the greatest morbidity and mortality rates of any sport, and I speak with personal knowledge of skiing, judo, squash, surfing, mountain climbing and racing. Any fool who tells you that it is safer to dive than to drive is showing his ignorance of statistical interpretation, or his ability to lie. There can be no doubt that is can be made much safer, and it is my personal desire to see it accepted as a normal family pastime, with its participants taking adequate safety precautions. These unfortunately will only be learned if there are instructors responsible and stable enough to prepare the trainees to escape emergencies efficiently, and not pretend that they don't happen. A laissez-faire attitude towards the 'good old days' is a manifestation of the retrograde amnesia that appear to be an occupational disorder of divers. The one common message which divers, and especially instructors, seem to radiate is that they personally are tremendous people; fearless rascals with a heart of gold. With their common attitude towards safety precautions, one can reasonably presume the brain is made of the same material. This is not meant to infer that they be antagonistic to all safety measures, however it is of interest to note that far more are impressed with the seventy dollar buoyancy vests than with the one dollar buddy line. This unnecessary choice is not supported by the analysis of diving accidents, but it does have certain financial advantages.

Finally, a farewell to all my good friends, both instructors and doctors, and I hope that 1973, also known as the Year of the Fiji, is kind towards you.

Carl Edmonds

## 2. MINUTES OF THE MEETING OF THE NEW SOUTH WALES SUB-GROUP, SOUTH PACIFIC UNDERWATER MEDICINE SOCIETY

21 August 1972

PRESENT: Drs. Edmonds, Hazel, Unsworth, Thomas, Walker, Roe, Messrs. Fitzgerald, Blackwood, Pennefather and Ashmote.

BUSINESS:

There were now so many prospective members applying that it was decided a Membership Committee consisting of the Secretary (Dr Unsworth), Dr Hazel and Mr Fitzgerald be set up, to whom applications be referred. It was pointed out that the Society exists for medical and paramedical personnel only, and as yet will not have social members, though associate members may be of value to the Society.

The constitution of the membership committee will initially be composed of Sydney members but at the next Annual General Meeting, it should be composed of members from other states.

The idea of subscription to the Newsletter without full membership of the Society was approved.

The venue for the Annual General Meeting in 1972 was best considered to be Fiji from reports available at that time. Lord Howe and Norfolk Islands' water and air temperatures were considered to be too low at that time of year, and no facilities on the Trobriand Islands for cylinder charging.

A conference committee was suggested of three members to arrange travel, accommodation and the conference. The members suggested were Drs Hazel, Thomas and Unsworth.

An urgent point was raised - that members of SPUMS should not speak on behalf of the Society or to represent SPUMS under any circumstances without full executive committee approval. Harm to the integrity of the Society could be done by unauthorised representation.

The present Editor of the Newsletter put in a plea that financial assistance be sought for the Journal's publication from, perhaps, industry, either by a single company subsidy or through advertising. This would aid in improving the standard by better quality paper and printing.

The matter of the Diploma DHM was raised. The Secretary said that a letter requesting naval assistance and approval had been sent to Canberra but no reply was to hand.

The last business was the possible institution of an interstate social meeting to which as many members from all states would be invited, and if possible accommodated by Sydney members. The conference sub-committee agreed to look into this.

There being no further business, the meeting was closed.

IP Unsworth
Honorary Secretary
SPUMS

3. MINUTES OF THE MEETING OF THE VICTORIAN SUB-GROUP, SOUTH PACIFIC UNDERWATER MEDICINE SOCIETY

PRESENT: Mr Keith Batchelor (Underwater Instructors' Association of Victoria representative), and the following Doctors: Phillip Rubinstein, Peter Ots, Bill Elrick, Geoff Westwood, John Silver, Cyril Holsman and Bob Emmanuel.

APOLOGIES: Drs Lander, Shepherd and High Millar

A syllabus of regulations pertaining to minimum instruction for novice divers in the use of open circuit, compressed air type, self-contained underwater breathing apparatus was presented by Mr Keith Batchelor.

It was accorded general approval.

Discussion of objectives of the local section touched:

Medical examination of divers - a group comprising a diver, a medical officer and a naval expert will investigate the adoption of physical standards.

Theory teaching by diving instructors.

Safety procedures during instruction.

Examination of theory comprehension of pupils.

Certification of diving instructors.

Upgrading of medical education in Victoria.

Treatment facilities in Victoria for diving mishaps.

A recent Victorian drowning where on a first open water dive, 8 trainee scuba divers, with one underwater supervisor and one supervisor on the surface, in 15-20 feet of water, one of the trainees drowned. There appeared to have been no self-inflating life jackets, no shot line or buoy, no buddy lines and relatively dirty water.

Liaison with Diving Associations in a consultative capacity.

Non-members of SPUMS were encouraged to join.

PHILLIP RUBENSTEIN

## 4. FIRST AID AT THE TIME OF THE ACCIDENT

by Surgeon Lieutenant Commander Carl Edmonds

*(Note: Lecture given to the Instructors' Meeting, early 1972)*

I am delighted to be able to attend this meeting and discuss some of my problems with the very group of people that cause the problems. The standard of diving around the coast of Australia never cease to surprise me. Everyone seems to be a good diver, or so they tell me, and almost without exception each diver has a fund of thrilling escapes and brilliant individual activities which support his view of himself as an underwater genius. Unfortunately the enthusiasm engendered by these anecdotes tends to be inflicted upon the younger, more gullible divers under training. I am heartily sick of hearing about one crummy free ascent from 150 feet or what have you, performed once by one guy and therefore proposed by him for every diving accident thenceforth. I am also a little tired of hearing reports of an instructor being 'Navy trained', when in fact he has completed one amateurish three week course in compressed air diving, and thus has achieved, at least in the Navy estimation, the lowest qualification of all Navy divers, and certainly is not qualified to instruct others. The third factor which also causes dyspepsia is the statement that precedes most diving instructors' viewpoints, namely 'I am all in favour of safety, but ...'; they then proceed to do whatever they want to do, absolutely irrespective of axiomatic safety precautions.

Having made this criticism, let me reassure you that I am not suggesting that the instructors available today are not good divers. In many cases they are superb divers in their own right. They are just lousy instructors. To take this matter a little further, I would like to explain in what way the instructors do not come up to obvious standards. Most of them will spend a considerable time teaching the novice diver techniques of diving which are of considerable importance. They may even teach techniques which will decrease the possibility of diving accidents occurring, eg. adequate planning of the dive including depths and times prior to entering the water, methods of reading decompression tables, the use of pressure gauges that can be read while diving, depth gauges, ditching rules, etc. They may even teach techniques such as buddy breathing, free ascent training etc. which I would prefer not to go into tonight. After they have taught the novice to dive with some capability, the instructional standard plummets to zero. They gloss over the teaching of first aid measures to be instituted at the time of a diving accident. It is very rare that instructors will actually advise on what steps would be taken once the accident actually has occurred. I hope that you understand the difference between prevention of accidents, and the first aid treatment of the accident, which must sometimes occur despite adequate training. It is the latter aspect

which I would like to discuss.

Some of the facts on diving deaths should be comprehended. Too often one hears the statement that we have no factual data on which to base safety recommendations. This is a nonsensical statement as there has been as vast amount of information available, but people don't seem to both reading it.

The UK information is as follows: Surgeon Captain Stanley Miles of the RN produced his paper on the cause of 165 diving accidents approximately 8 years ago. Heading the list of the major predisposing factors for fatal accidents was Inadequate Safety Precautions. I will quote exactly what Captain Miles has stated:

> 'Inadequate safety precautions. This applies solely in this context to the ability to remove a diver from the water should he become in difficulties and implies primarily adequate supervision and attendants and the use of a lifeline or buddy line.'

The British Sub-Aqua Club requires its members to remain within touching distance ie. 6 feet of each other. The Royal Navy Diving Manual states that when diving or underwater swimming ... a diver is always to have a lifeline securely attached to him except ... when operating in pairs, when swimmers are always to be attached to each other by a buddy line.

There also seems to be adequate information coming from the States. On the civilian scene Paul Tzimoulis, writing in 'Skin Diver', has kept many people up to date with the diving death statistics. I thoroughly recommend his editorial on January 1971 and his article of March 1971. If you do nothing else after this meeting than peruse the March 1971 article, you will have gained enormously. Instead of quoting from the 'Skin Diver' as so many of you do, please read it. The US Navy are equally clear in the Diving Manual of March 1970, they state that the buddy system is the biggest single safety factor in scuba diving. It makes two divers responsible for each other's safety, over and above all other safety precautions which the diving supervisor may take. It recommends the use of the buddy system wherever possible in any diving operation, even for surface attended scuba divers. It stresses that buddies are a pair of scuba divers working as a unit, each of the pair is responsible for his buddy's safety throughout the diver. It also states that the buddies must maintain a continuous contact.

From New Zealand comes the information in 'Dive South Pacific', by Wade Doak. His article entitled 'Six Divers Die Alone' is worthy of careful thought. In Australia we seem to be roughly where the

Brits were twenty years ago. I bring to your attention the last 10 diving deaths along the eastern coastline. Of these, two were due to decompression sickness, and the other eight decided against obeying the normal safety rules. In some cases they were innocents under training, and the negligence must be attributed directly to their instructors.

In each of the eight cases the person in difficulty was unable to be rescued because his ‘buddies’, when he had them, were unable to find him and surface him in time. That type of ‘buddy diving’ we can well do without. As you know, in some cases they are still looking for the bodies. In one case it was the instructor who died, and he presumably felt, in common with most of the rest of you, that the safety rules did not apply to him. On these diving fatalities that have occurred in the twelve months, over half were in very experienced divers - not sensible or safety conscious divers, just experienced.

I would now like to briefly explain what buddy diving is. It requires that you are personally responsible for the welfare and safety of your companion diver. This means that whether he has warning of his difficulty or not, you should still bring him to safety and commence resuscitation. This requires three things. Firstly, that you have an excellent communication system between. It does not imply mental telepathy.

- if you don’t know where your buddy is, then you haven’t got one;
- if you have to search for your buddy, then you haven’t got one;
- if you can see your buddy, but can’t reach him, or if you can reach your buddy in time, but cannot get to the surface you may as well not have a buddy.

The only method of reliable communication with which I am familiar is that of a buddy line between the two divers. Occasionally this may be avoided by having a surface attendant-to-diver line with a standby diver in readiness, but this is a second rate alternative.

That brings us to the second point. It follows that not only must there be excellent and immediate communication but then the two buddies, there must also be a method of ensuring that both divers reach safety. As those of you who have read the diving death statistics will realise, most divers who die do not ditch their weights, and less than half will inflate their life jackets. The reason is pretty obvious - they have greater priorities, eg. breathing. First aid therefore requires that the buddy is able to bring his disabled companion to the surface and maintain him on the surface with relative ease. There are, now, two obvious requirements: a buddy line which ensures that the injured diver is able to be reached, and an inflatable buoyancy vest which will ensure

that both divers reach the surface and remain on the surface.

The third aspect of first aid in a diving accident is resuscitation. Once the injured diver has got to safety, or sometimes even before, resuscitation must be commenced. Thus is the buddy who is doing the rescuing is not capable of performing mouth to mouth respiration or external cardiac massage correctly, then his companion can still die, despite prompt rescue.

Allow me to reiterate the three factors that are almost always essential for first aid treatment of serious diving accidents, and almost always absent in the fatal cases. There are:

- a buddy line for communication and assistance with rescue;
- an inflatable life jacket;
- training in resuscitation.

These refer to first aid given by divers, not to first aid from ambulance staff and medical officers. These latter groups give secondary aid and definitive treatment.

Mark Terrell, 'The Principles of Diving': *No diver shall be beyond the reach of immediate effective assistance....If diving is to be done in dark or tidal water a lifeline would be worn, and the divers should operate independently. But in good visibility the divers can often work more efficiently in pairs, being linked with a buddy line so that they maintain contact.*

## 5. HALOTHANE AND HYPERBARIA *

(General Instruction to all Hospitals No. 1842 from the Hospitals Commission of New South Wales H18326 of 11 August 1972)

Recently information was sought from this Commission regarding the inflammability of Halothane with various mixtures of other anaesthetic gases.

Advice from several anaesthetists indicated some thoughts on this subject, and the manufacturer's assistance was sought. The following extract from the manufacturer's booklet on Halothane indicates the limits of flammability of various mixtures of Halothane with oxygen and nitrous oxide, as well as precautions to be observed under hyperbaric conditions:

### INFLAMMABILITY

Mixtures of 'Fluothane' and oxygen, and 'Fluothane' nitrous oxide and oxygen are non-inflammable and non-explosive in the proportions used in anaesthetic practice.

In the following table compositions of mixtures of 'Fluothane' nitrous oxide and oxygen at lower flammability limits are indicated; the figures in the left-hand column indicate the lowest concentration of 'Fluothane' which will ignite (Brown and Morris, 1966).

| **'Fluothane'** | **Oxygen** | **Nitrous Oxide** |
|---|---|---|
| **% v/v** | **% v/v** | **% v/v** |
| 1 | 0 | 99 |
| 4 | 24 | 72 |
| 4 | 32 | 64 |
| 17.5 | 82.5 | 0 |

The values shown in the table should only be regarded as absolute limits with reference to the experimental conditions described by the authors.

Mixtures of 'Fluothane' and air are non-explosive and non-inflammable in all proportions.

### Hyperbaric Conditions

The inflammability of 'Fluothane' under hyperbaric oxygen conditions has been investigated by Gottlieb et al. (1966). They found that 'Fluothane' in the range of 1 to 6.5% at pressures of up to 4 atmospheres, did not explode and did not show evidence of being inflammable. It was therefore concluded that 'Fluothane' can be used safely in conjunction with hyperbaric oxygen.

Brown and Morris (1966) have recommended that certain precautions be taken when ‘Fluothane’ is used at increased pressure.

i. Nitrous oxide should not be used as a vehicle for ‘Fluothane’ in pressure chambers;
ii. cautery and coal gas flame should be excluded from the pressure chamber;
iii. the increase in atmospheric pressure should not exceed 2.5 atmospheres.

The attention of all medical officers, anaesthetists and theatre staff should be directed to this information.

* *The above script was supplied by Dr John Clift, with the post-script that cautery and coal gas flame seem a little on the dangerous side, whether fluothane is used or not, under hyperbaric condition. It seems a reasonable comment.*

## 6. ANNUAL MEETING OF SPUMS

It is understood that the sub-committee investigating the different locations for South Pacific Underwater Medicine Society annual meeting have decided that Fiji for 1973 is the thing. It appears as if prices will be much lower than previously, due to the changed airline policy, and that the meeting will still be held on the second Monday of June, in accordance with the established procedure. Full details will be sent to SPUMS member early in 1973, together with application forms. A full report on the meeting will be supplied by Drs. Hazel and Thomas, at their earliest convenience.

## 7. CORRESPONDENCE

### Letter from Dr Douglas Walker

WATER SAFETY COUNCIL OF NEW SOUTH WALES

The Society has been represented in the formation of this council. Other member organisation include Maritime Services Board, RLSS, the Amateur Swimming Association, RLSA, NSW Police Department, NFC, and the numerous organisations concerned with yachting. It is believed that the medical viewpoint can be helpful in this council beyond purely diving matters.

### Letter from Dr Vic Brand

Back from Fiji and enjoyed it tremendously, although the weather was not as good as it should have been. I made enquiries re the possibility of it being the venue of the SPUMS annual meeting.

The best proposition is the following - the Salmar Diving Co. is operated by two partners, Ian Lockley and Neville Garrick, both from Queensland, who have been operating all around the Pacific for about 8 years - both very good blokes, quiet and responsible. I met them last year and spent a lot of time with them this year. They own a boat - the ‘Salmar’, beautifully equipped, sleep six - has sonar, radar, compressor, many cylinders, regulators, flippers, etc. This is available for charter and if there are 16 divers all told they also take a big well appointed trimaran. If more than 16 - they can

charter a bigger vessel - Sagandra. They run a 4 day cruise to the Astrolobe Lagoon 3 hours sailing from Suva, where they tell me the diving is the best in the whole Pacific - of which they have had much experience. I was there on a 3 day cruise last year and its a marvellous area. Non divers would also have a wonderful time.

The charge is $27 per person per day, which includes everything and diving gear.

The Salmar is based at the Tradewinds Hotel which is where I always stay in Suva. I include literature and tariff. Vessels from all over tie up here and this year I met there the man who directed 'Blue Water, White Death' and his cameraman - a top underwater photographer whose work I have been seeing for years in various magazines. Return air fares from Melbourne to Suva are about $246 and look as if they will get cheaper.

Further, don't forget Duty Free stuff - cameras, diving gear, etc. Half the price or less than Australia.

The other proposition. 'Scuba hire' - also based at the Tradewinds has 2 boats for charter at $7/hour. He usually goes to Bequa Island about 14 miles away, which he says is excellent diving but I believe not a patch on Astrolobe Lagoon. I enclose a list of his hire charges.

I may sound over-enthusiastic about Fiji but you will find that I have understated its qualities. I send you a photo of the Salmar which I request you to return please.

I'm enclosing cheque for annual sub for SPUMS which I hope you won't mind delivering for me.

Well I think that's all and I hope you can read it. You can get further information by writing to the address on the back of the photo (Salmar P/L, PO Box 3055, Nami, Fiji).

## Letter from Dr Tony Slark

I have read the latest copy of the SPUMS Newsletter with great interest. I must say I have considerable reservations about his idea of having a Diploma of Hyperbaric Medicine, possessing something of a surfeit of rather valueless diplomas myself I have a cynical attitude towards their merit. Personally I like to feel that a Diploma of Industrial Health is, in fact, the qualification which endows some academic basis for the expertise in the medical side of the diving occupation. Were there to be Specialist Diplomas in the medical aspects of every single occupational activity, the cope would

be truly enormous. I am sure the existence of a Diploma in Aeronautical Medicine is likewise unnecessary and again, I like to think that my innermost in this field also comes within the scope of Occupational Medicine. Surely the proper way of dealing with this is to accept the existence of such a qualification as the Diploma of Industrial Health providing within it some means of orientating the course of any particular sub-specialist interest towards that particular activity in exactly the same way as it is possible to qualify in the College of Surgeons or in the College of Physicians in a particular sub-specialist orientation.

Letter from Dr Jay Morton 19 September 1972

Please excuse the lateness of this letter, however, I put into operation both TAA and Ansett to see what price they could give us on a charter to the Triobriands. Both assured that they could not give a competitive figure against the charter to Norfolk Islands. However, whilst enquiries were under way we received the sad news that the Trobriands Hotel had burnt down!

The only other alternative would be the Arovo Hotel on an island off Kieta. I can assure you that this is truly magnificent, however the cheapest accommodation available is $21.00 bed and breakfast per head per day. At this figure I doubt if many members would be interested when air fares are added to this.

Whilst I have you captive, I would also like to discuss with you the sad story of Miss JB, F/10.

The above stood upon a stone fish whilst swimming at Salamaua. We saw her when she arrived at the hospital approximately one hour later. She had five puncture wounds in the sole of her foot and naturally was in considerable pain. A tourniquet had been applied immediately she was bitten and the wound kept as warm as possible. Our problem came after this when her mother stated that she had had an anaphalactoid reaction to her second triple antigen. This being so I was rather loath to use stonefish antiveneme and merely injected the sites of the puncture would with local anaesthetic and gave her pethidine for pain relief. An IV drip was inserted, second-hourly obs taken and she was placed on crystalline penicillin. Luckily no further problems occurred and she was discharged fit and well from hospital three days later.

Naturally we would be interested in your comments on the use of antivenene with her past history. The other interesting point is that the people at the local Yacht Club, who have been here for many

years, dividing stone fish into types 1 and types 2, the first type being extremely dangerous and people do not survive whilst the second type, though causing pain, has not been credited with any deaths. Personally I have never heard or read any text book of any differentiation between stone fish, however, the people who handle these a lot assure me that this is so and are quite adamant that they can produce two entirely different specimens. If I can obtain these would you be interested in having them sent to you at HMAS Penguin? If so, could you tell me (a) how to preserve them, and (b) any other information eg. location, etc. you would require. If you do wish to have them could you also arrange for yourself an import quarantine certificate and send us the number so that we can enclose it if and when we send you the fish ...

Letter from Dr K Shepherd. Ken sentus a letter recommending that we get our correspondence system in order, increase our efficiency and ensure that all officials of SPUMS have their names and addresses clearly recorded. One cannot help but agree with Ken's criticism, especially as I have managed to lose his letter. For safety's sake, and because we are a rather pelagic group, it would be much more sensible to send letters, annual subscriptions, etc. (you do get the message, I hope) to the relevant office bearer, and not only by name.

eg. Secretary, South Pacific Underwater Medicine Society
Dr I Unsworth
Prince Henry Hospital
LITTLE BAY NSW 2036

Treasurer, South Pacific Underwater Medicine Society
Mr FR Ashmore
School of Underwater Medicine
HMAS Penguin
BALMORAL NSW 2091

Editor, South Pacific Underwater Medicine Society
Dr R Thomas/Dr C Lowry
School of Underwater Medicine
HMAS Penguin
BALMORAL NSW 2091

I am loath to give my own address during 1973, as it would be a breach of security, and the Navy may find out where I am.

Editor

8. CASE REPORT

Diving Details

Monday. Compressed air diving to 60 feet, until the tank ran out of air (a 72 cu foot tank), without incident. Ascent and descent were uneventful, with the diver making many short ascents to the surface, to deposit the speared tuna into his boat. Diving completed at 11 am.

Tuesday, 3 pm. Snorkel diving to depths of 60 feet, for no more than 15 minutes total.

History

The diving holiday commenced on Monday. The diver involved, together with his mates, decided to 'rough it', and spend most of their time snorkelling or diving. This was disrupted by a heavy alcoholic intake following the successful fish catch on Monday; no breakfast on Tuesday morning (although a slight headache), and a light tuna meal on Tuesday at 2pm. The diver presented to the local hospital at 4pm on Tuesday with complaints of severe headache, dyspnoea, a skin rash - red with some swelling, and abdominal pains. On examination he was found to be pyrexic with bilateral respiratory rhonchi, a very rapid pulse rate (140/minute) and the previously mentioned skin lesion. The differential diagnosis of decompression sickness was considered, and a diving medico was informed at 6 pm.

CORRECT DIAGNOSIS - Full Marks

MEDIC: My worries are that he has decompression sickness involving the skin, gastrointestinal tract and lungs. I think you call it 'the chokes'.

DIVING MEDIC: No go. These generalised manifestations appear usually much earlier than 28 hours after the bends producing dive. Nor could one postulate Taravana disease with so few breathhold dives as could be carried out during 15 minutes. Decompression sickness must be most unlikely.

MEDIC: How about the salt water aspiration that we now hear so much about? It seemed to come on within an hour of his breathhold diving.

DIVING MEDIC: The skin lesions would refute that diagnosis. Also one rarely hears the respiratory rhonchi with salt water aspiration, which one can detect in this case. Also the drop in the $FEV_{1.0}$ percentage suggests obstructive airways disease, not at all like the parallel drop in VC and $FEV_{1.0}$ seen with salt water aspiration.

MEDIC: What then do you advise? Should we consider the possibility

of a recompression trial?

DIVING MEDIC: No. I don't think that's necessary. The man appears reasonably distressed, so I would suggest the use of intravenous hydrocortisone, about 100mgm and repeat each few hours, as needed. Failing that, perhaps you would give him some intramuscular antihistamine, and I am sure the symptoms will abate rapidly.

MEDIC: (Half hour later). Yes, you are perfectly right. He is feeling much better now, and we have sent word out to other members of the diving party to prevent them also developing this illness.

CORRECT DIAGNOSIS: Half marks.

Histidine is a chemical found in many fish, especially of the tuna type. If the fish is not adequately stored and refrigerated, then it is able to be converted by bacterial action into saurine. In this case the divers did not avail themselves of adequate storage facilities, and anyone who ate this fish a day after it had been exposed to non-refrigerated conditions is very likely to encounter this disease, called Scombroid poisoning.

## 9. DR TONY SLARK - VISIT TO AUSTRALIA

Following the Aerospace Medicine meeting, we were delighted to receive a visit from Dr Tony Slark, who has obtained a lot of valuable experience in the treatment of decompression sickness in New Zealand. Of interest to SPUMS members is his suggestion that one annual meeting should be held in New Zealand, but not at the usual time. If this is considered of value by SPUMS members, then it would be reasonable to have two meetings during one year, a summer meeting in New Zealand and a winter one elsewhere. This concept received some support from the previous annual general meeting, and probably warrants further consideration.

## 10. THE BULGING MAIL BAG

The Editor wishes to thank the numerous correspondents who have recently contributed to the Newsletter. Some of the letters are included now, but many others would not be considered appropriate. This is especially so in regard to the question raised in the first Newsletter viz the possibility of sexual intercourse underwater. It has now been confirmed and verified many times that the answer is 'yes, yes, yes'. No further research needed be carried out in the pursuit of this knowledge. It is regretted that the same enthusiasm was not engendered regarding the discussion on locations of recompression chambers around Australia. If our large numbers of presumably uninhibited members could possible sublimate their activities into obtaining this latter information we will be most appreciative.

## 11. DIVING MEDICAL CENTRE

As most of the readers of ‘Fathom’ are now aware, the Navy is not prepared yet to treat civilian divers who cannot be classified as medical emergencies. This has resulted in a small group of diving medicos forming their own clinic, where divers can get medical examinations, and where diving injuries can be assessed and treated. As it is not intended to run this as a profit making organisation - and with the number of destitute and non-MBF divers around, it is just as well - the facilities will be made available to any medico who wishes it, eg. if you feel that one of your divers needs assessment or investigation, then please let us know. For this service, either no charge will be made, or an MBF refund will be fully acceptable, whichever is appropriate to the particular case. In this way it is hoped that his medically under-privileged group will obtain a little more attention than they are now receiving.

## 12. EASTER DIVE-IN ’73

The first Northland Scuba Convention will be held on the Tutukaka coast next Easter. The organisers are the same group that ran Underwater World ’72, with the leadership of Peter Fields and the team work of the Auckland Underwater Club.

The aim of DIVE-IN ’73 is to continue the growth towards underwater education initiated at Underwater World to open up new horizons for the scuba diver; to introduce him to the opportunities of skindiving in clear offshore waters; to develop a true love for the sea and to encourage his interest in underwater exploration, marine biology and underwater photography. At the same time every effort will be made to ensure a fun weekend for the whole family on the Tutukaka coast.

The program: Good Friday to Easter Monday.

Daytime: Organised daily charter trips to the Poor Knights Islands will be the main feature of the Convention. Up to six charter boats are planned.

- Runabout rallies in coastal waters
- Sightseeing bus trips along the coast
- Beach picnics and horse riding
- Scenic amphibian flights
- Surfboard riding at Sandy Bay

Evenings

- Good Friday - a pictorial introduction to the Poor Knights, followed by an underwater film screening of New Zealand footage.
- Easter Saturday - beach barbecue and party
- Easter Sunday - divers' discotheque party

While the official program will end on Sunday, on demand the pattern of organised scuba diving trips will be continued on the Monday, Tuesday and Wednesday (Anzac Day).

Since Anzac Day and Easter Weekend are only a day apart in 1973, most people will seize the opportunity for a monster six day holiday.

Special Features

A photography workshop will be run on Good Friday and Easter Saturday during which time expeditions to the Poor Knights will be hosted by leading underwater photographers. New equipment will be displayed and special techniques discussed.

Each evening the trips will be coupled with evening resumes of results.

A Marine Biology Workshop in the same manner will be hosted by experts. A perfect opportunity to expand one's knowledge of the unique underwater flora and fauna of our offshore islands.

DIVE-IN '73 is focussed on education and competitive elements have been deliberately excluded. If sufficient interest is shown among experienced divers a night dive will be organised in Rikoriko Cave.

DIVE-IN '73 is not for the beginner nor the spearo. Stringent safety rules will be applied to all participants on all charter boat expeditions.

They are as follows:

1. All divers to carry an NZUA scuba proficiency certificate; each descent to be made with an acknowledged buddy.

2. Buoyancy compensator absolutely compulsory for everyone operating from charter boat whether using snorkel or scuba.

3. No descent beyond 120 feet.

4. Most diving in good areas with no need to go below 100 feet.

5. Divers below 100 feet must have contents gauge - DC *[illegible]*. Such dives will be properly supervised and controlled.

6. All divers making repetitive dives must use DCP.

7. No spearfishing while using scuba.

Accommodation

Motels, a hotel and camping grounds. Write for bookings through Peter Fields, PO Box 22152, Otahuhu, Auckland.

Compressed air available and equipment can be hired.

*Editor's Note: SPUMS members who wish to attend this convention should contact Dr A Slark, 6 Victoria Road, Devonport 9, New Zealand, to arrange an official medical invitation.*

## 13. **BUBBLES**

- SPUMS T-shirts are available from Marine World, 532 Military Road, MOSMAN 2088. These cost $3 to buy, and have the SPUMS initials together with a diagram similar to the motif on the front of this Newsletter. It is not known whether this can be claimed as a tax deduction or not.

- Off Beat Books

  'Medical Aspects of Sport Diving' by Christopher W Dueker has just been received, published by AS Barnes and Company, 1970. This book was reviewed by Bob Thomas and Carl Edmonds. The opinions are entirely divergent, one believing it to be a most valuable book for sport diving, the other believing that it is even more out of date than Stanley Niles' 'Underwater Medicine' first edition. The point on which they are in agreement is that it is an excellently written book, easily read and adhering strictly to the diving manuals. Surprisingly it has no section on safety aspects of diving.

  'Go to the Widowmaker' by James Jones. $1.90 Fontana Paperback Publications. An interesting fictional work, showing considerable insight into trainee/instructor relationships. Thoroughly recommended. C.E.

## A Sick ‘Bubbly’

Sister Pam Peterson
(Part time SUM)

I have tried to do a project on the accidents of diving,
All are serious NOT requiring recompression
And all that I have managed, in all my earnest striving
Is that diving is now giving me depression.

I’ve pondered over drowning. The treatment, I thought easy,
But now I know there’s more to this and really feel quite queasy.

The thing I know is mouth to mouth, and use of oxy-viva
There are differences when in the sea or diving in a river.

When intravenous should be given, Saline or Dextrose drip
Or when a chap by some mishap has fallen off a ship
And bumped his head, is nearly dead -
This makes for some confusion
Cos resus first then for his head, another thing, perhaps a blood transfusion

Apart from drowning, ‘wet’ or ‘dry’
There is intoxication. No, not from drink
I really think, I almost want to cry.
There’s $O_2$ poisoning which makes one shake
And here are partial pressures
For $CO_2$ what would one do?
Resus with oxygen are the measures.

The raptures of the deep are caused, by nitrogen is true.
Just change your depth you’re down too deep,
The treatment? Nothing new’.

Some other things a diver fears when going down in water.
The pressure felt upon his ears, causes pain, to say a quarter.
Aural Barotrauma, this is called, and damage can be serious,
Can burst the drum, not hear a hum, for deafness is deterious.

A chap who’s welding underwater can stand to have a blast -
The noise can wake King Neptune’s daughter
And throw him up the mast.
Oh boy, this guy, sure will feel sick,
The trauma to his tissues,
Both large and small, it’s gut and gall,
And from his lung blood issues.

It’s treat for shock and resus first
Perhaps we’ll say a prayer,
And rush him to the nearest hosp we durst
Leave him until he’s there.

May be perhaps, these ‘blasted’ chaps will not be knocked unconscious
But will be bruised, organs contused, with some paralysis
For treatment here, we need to know
The symptoms of the victim
Perhaps X-ray a part must play
To tell what did affect him.

Oh, accidents come hard and fast when underwater swimming
To act like fish, problems are vast
And sharks don’t think of slimming.

So when a diver finds that he is minus foot or member
It’s treat for shock, stop blood, revive
A day he’ll well remember!

This project has been difficult
There’s so much field to cover,
And with their treatments I have felt
That resus is first mover.

I’ll leave the rest and to the test
We’ll find out when it happens,
Let’s hope it won’t, my fingers crossed,
I’ll call for Doctor Edmonds!!!

## 14. DIVING ACCIDENTS AND DEATH

### THE ROAD TO SAMARRA

by Dr Douglas Walker

> "Any worthwhile activity where injury or loss of life are accepted as outside possibilities should be so planned to ensure that these are kept to a minimum level. What are the accepted death and injury rates for any activity must vary considerably with the enthusiasm or profit in that particular field. Always there must be a striving to reduce it and always it must be very small or the participants will be discouraged and its progress lapse.
>
> Much can be learnt from the study of accidents that can increase the safety of diving as a whole. One single lesson that is apparent is that however tedious, time-consuming cumbersome may be the rules and regulations in the best diving manuals there is no doubt whatever that strict adherence to them will reduce the accident rate by at least 75%. The provision of adequate communication and contact with the diver at all times is essential."

The above quotation is the conclusion drawn by Stanley Miles in his 1964 paper '165 Diving Accidents'* and is reinforced by the findings of all other investigations into diving accidents. It is the justification, if such be necessary, for the investigations of diving accidents. As diving is advanced to greater and more sophisticated equipment and gas mixtures are employed so new problems and dangers become apparent. A continuous monitoring of incidents and morbidity is required as a balance to the erroneous belief that 'they' know all about bends an gas mixtures, etc. The present interest in hearing defects and aseptic necrosis of bone in divers and caisson workers demonstrates the re-discovery of problems documented in the 19th century and then forgotten because they became less gross. The rate of progress converts yesterday's experimental dive into today's work diver and tomorrow's diver for the moneyed amateur. The rate of advance in the engineering is in excess of the advance in understanding of the problems, as witness the occurrence rate for bends in experimental dives. Diving, like medicine in general, is an art as well as science and will so remain as long as man is a 'one off' product.

The purpose of any accident investigation should be to discover how to prevent any repetition. To this end it is first necessary to discover the sequence of events which occurred and thence to identify the points of critical decision at which the response to the problem then present influenced the outcome for better or worse. Should a common factor be found on several occasions where injury has occurred, it is likely that a significant fault in selection, training, dive procedure or equipment requires urgent attention. The

* *For all Tables, see Appendix A*

safety margin underwater is small; the environment being terribly unforgiving of any incapacity, carelessness or neglect. It is found that the most important factor is the diver himself: it is rare for equipment failure or sudden acute illness to be inevitably fatal if the trained diver has an alert and trained buddy and surface support. In an incident in America, the element of panic decided the different fates of three helmet divers trapped in mud under a wreck in the same incident.

The investigation of accidents is not simple, as most authors remark. There is a natural reluctance to report foolishness, which may not even be recognised as such, if nothing serious eventuates. Even greater is the desire to minimise or deny stupidity or gross carelessness should death result. 'Nihil nisi bonum' limits one's own responsibility: but without open recognition of faults they will continue to be repeated. It is well known that those who suffer the bends lie concerning the dive depth-time when first seen. For such reasons the notification schemes of diving clubs and organisations give an incomplete picture of the true frequency of incidents. Nevertheless, progress has been made by the University of Rhode Island in America and the British Sub-Aqua Club in the UK in the collection of details of fatal and non-fatal incidents. These reports show value for effort despite the admitted limitations.

The welcome paucity of diving deaths has the troublesome effect of giving no cause for the inclusion of a code for such deaths in the international classification of deaths. They can only be identified by direct knowledge or from newspaper reports, and not every death is newsworthy. In the Los Angeles and Florida areas there are local notification schemes instituted by interested coroners, but published reports still note that no details can be obtained regarding many known deaths. In this respect then all assistance offered by the Attorney-General's and Justice Departments of all the Australian states, to make copies of the investigations by coroners into such deaths available for study, is in advance of the position anywhere else in the world. This article is in part, a plea for reporting of incidents both fatal and non-fatal by all who hear of them (Project Stickybeak): only thus can the maximum benefit be obtained from this proffered assistance.

Initially medical interest was in the mode of death, articles describing Pulmonary Barotrauma, Air Embolism and Decompression Sickness. The intent was to warn against the too simple findings of 'drowning asphyxia' and also to indicate the special problems to be considered by pathologists at such autopsies. It is still apparent that the differentiation of air embolism from post-mortem decompression tissue gas is not always appreciated, with resultant misdirection of the coroner. The Medical Research Council in the UK is circularising pathologists there concerning the examination

of deaths associated with work in compressed air or diving. It is hoped that the same approach be introduced into Australia: a copy of the notice is given in Appendix B. The passage of time between the accident and death may allow resolution of air bubbles in Coronary or Cerebral blood vessels, but the clinical course may suggest such a cause. The findings of subarachnoid haemorrhage or evidence or a coronary occlusion may explain why some divers have died, though even such cases might survive in the presence of immediate rescue facilities.

The next phase in published reports was the noting of the incident to see what had gone wrong and why the result was death. Here different reports found a variety of significant factors, the most important single one being the isolation of the victim at the critical time. Some reports are summarised shortly, but many questions remain unanswerable as too rarely is any note made of the equipment. It is suggested that a note always be made concerning weight belt, life jacket, knife, depth gauge, watch, contents gauge, harness and cylinder, demand valve system, air reserve and air remaining. Check of the cylinder for water or contamination is necessary; though rarely implicated as cause of trouble, cases have been reported. A check of 25 tanks by the University of Washington, reported by FR Smith, showed two had nil contamination, 18 had 10-25 ppm CO and 5 had over 25 ppm CO (one being over 75 ppm CO). It is not stated how these tanks were chosen. A BS-AC survey of air purity suggested that minor impairment of alertness may occur more often than is suspected and carbon monoxide contamination should be suspected if post-dive headaches occur without obvious other cause.

Investigation of the deaths of breathhold divers revealed a preponderance of good swimmers, many of Spearfishing Championship Standard. In fact deaths occurred, and still occur, at such competitions. Apart from the occasional entanglement in kelp, speargun line or anchor line, such deaths were long a mystery. However, the work by Craig has led to the general acceptance of prior hyperventilation as the critical factor in such drownings. This valuable finding would be more helpful if divers acted on it: in the recent spearfishing championships in Chile divers were noted to hyperventilate while lying on the deck before diving, taking up to 50 very long deep breaths while completely relaxed.

The logical next phase of reports should be to consider the reasons why divers fail to follow ‘the accepted safe diving procedures’ and so fail to survive unscathed the inevitable mishaps that occur. It may be that they are unaware of the dangers, inexperience, diving beyond their capability to cope or just do not accept that their practices are potentially dangerous. The current interest in better instruction and the limiting of the hire of equipment to those with evidence of basic skills is a welcome advance.

The British Sub-Aqua Club reports are given at their Diving Officers' Conference each year. They reveal the need to have a buddy, to consider the power of moving water and the dangers of poor seamanship.

The power of currents is a frequently underestimated factor, Weirs, water intakes, currents and wave surge over rocks or as surf have all caused drowning. Especially at risk are those who leave their boat unattended and possibly poorly anchored and surface down current. Should they lack brightly coloured lifejackets they may never survive to learn better.

That seamanship is neglected is apparent from the numerous reports of failure to be able to restart the dive boat outboard engine when the divers surface and require picking up. There are also incidents of boats endangering divers in the water and of insufficient safety cover. This aspect of training is now receiving attention in the UK as a result of these findings.

So diving, or separation from one's buddy, are frequent findings in fatal incidents. Of the 39 deaths in the BS-AC reports, 17 were diving alone and 12 were separated from their buddies at the critical time. There were 3 failed reported attempts due to inability to drop the victim's weight belt. One pair of cave divers relied on sticking tape to join lengths of their lifeline, so died.

The value of an alert buddy has been demonstrated in the BS-AC reports and also in Australia. Poor training can result in death of a rescued diver through inability to give EAB in the water. The reported deaths of a snorkel diver and a scuba diver. He was waiting to re-enter the dive boat, by entanglement in kelp, causing drowning remind one that it can be fatal to forget safety at any stage of the dive.

In America the two areas most reported are Los Angeles and Florida. In Los Angeles the Department of Parks and Recreation not only regulates diving areas but also arranges training facilities. This represents an intelligent response to diving incidents. Dr Glen Egstrom, University of California, has informed me that of 17 deaths in 1970, 10 were solo and 2 were separated by waves at the surf line at the time of death. There were 5 unsuccessful attempts at rescue by buddies.

Taylor et al. have reported on the Florida area, where cave deaths have been a cause of major concern. Information could not be obtained regarding all cases, in only 18 of the 24 cave deaths being made available. Of these, 10 had no safety line and 6 went beyond their lines. Sixteen had buddies, but 2 were alone. Such are the conditions in caves that multiple deaths are to be expected, and occur, as both divers are probably taking the same risks. It seems that ignoring of rules rather than lack of training were responsible. Concerning

open water cases, in the 11 in which facts were available, 7 were separated from their buddies at the critical time, 4 were inexperienced and one died after a shark attack. The need for co-operation by the authorities involved is well illustrated by the paucity of hard facts in this survey, though the information often neglecting to answer questionnaires. The report by Desautels gives an age-season-site breakdown of fatalities, but nothing concerning diving experience or the dives themselves, once again being an incomplete picture of the events that occurred.

Hassel has noted that 'lung' failure was not conclusively demonstrated and should not cause death if safe diving procedures are followed. He stressed the need for thorough, competent instruction in diving, this to include buddy-diving techniques. At not time does the buddy seem to have been near at the onset of the fatal series of events in his series. Most victims were apparently novices and some couldn't quick release their equipment. One experienced diver died from the probable combination of Nitrogen Narcosis at 180ft + poor sleep the night before + cold water. Another expert, Conrad Limbough, dived into a cave alone + no lifeline + current + poor visibility: somewhat naturally, he died. The conclusion drawn by Miles was that non-fatal cases depend for the most part on good planning, efficient safety organisation and alert comrades. Okalyi also commented on the fact that in the Torres Strait the divers rarely drowned (except during attempted recompression in the water) as they watched each other carefully. However a lack of understanding of decompression, with reliance on the experience of the lugger captain, and lack of recompression facilities combine to give a high morbidity rate.

The first report to note the dangers occurring during the period of instruction in scuba was that of the University of Rhode Island. This noted that 11 persons died on their very first attempt at scuba diving, raising a serious question about the current standards of diving instruction and sporting retail store policies.

Neither the manufacturer nor the retailer stands to gain from a system with these casualties. In at least four of these cases the water was less than 10 feet deep: sometimes the victim barely got underwater. There were 17 cases of death during training activities. Only two deaths occurred in pool training, and one of these was due to a heart attack. One death occurred on the first ocean dive made by the victim and his brother after 'C' card certification by a nationally advertised organisation's pool-only scuba course. The authors of the report say they would award damages if on a jury judging such as case. The novice scuba diver, and his parents, cannot be expected to judge the relative risk differential between pool and ocean diving. When anyone is 'qualified' by a school they have every reason to expect that they have been trained to deal with the normal environmental problems associated with ocean or lake dives. These include poor visibility, waves, surges, currents, surf, cold,

greater depth, kelp, and weed, inshore rocks and (Appendix B) suggests that the present teaching of progressive ocean skills is deficient: even schools including some ocean dives may be advancing some trainees too rapidly into deep rough water.

In at least 19 separate cases, one buddy attempted to save the other. It would appear that the buddy system is employed but that there is a lack of knowledge as to what to do in case of trouble. The authors wonder how many scuba courses include sessions on the management of emergencies in the water, and how many trainees have ever attempted to remove the weight belt and tanks of an unconscious man, let alone a fighting one. They suspect that over the years the 'buddy system' has been given a great deal of lip service but relatively little careful study.

In engineering terms, a pair of scuba divers should be considered a single integrated system. Such a system must stay together, a difficult job when twenty people in full, black wetsuits are involved in a multiple dive. Buddy identification is thus essential. The diving equipment must be readily removable by both the wearer and his buddy: similarly, the life vest should be inflatable by either. The buddy-breathing problem also requires further study as in practically every fatal case where buddy breathing was attempted, the survivor notes that he was running out of air. This is not unexpected, as both divers have usually about equally used their supply when the emergency occurs.

The possibility that Air Embolism had occurred was suggested by witness accounts in 28 cases, autopsy confirming in eight. Ditching failure, weight belt or lung, occurred in 17 cases but success was noted in 24 others. Of 4 cases with Coronary Thrombosis, 3 were aware of their heart condition.

Webster also noted the inexperience of victims and that in virtually all cases the victim had disregarded one or more of the recognised rules or procedures of safe diving. Twenty eight overestimated their abilities, 15 were solo, 24 were separated from their buddies at the critical time and some were diving in groups of three.

The US Navy reports stress the poor results they obtain when treating non-military 'bends', apparently due to the victims having markedly departed from recommended decompression schedules and then delayed seeking treatment. Some illustrative cases are described in which DC problems were influenced by poor sleep, discomfort, minor injury or minor activity during decompression staging. Two post-dive 'drunk and disorderly' cases are noted as possibly ascribable to DC sickness. The dangers of emergency raising of divers using Helium mixtures at depth are noted, avoidance of the need for this dangerous situation being advised in view of the extreme risk of death from

such procedures other than if the dive of a short duration and less than 150 feet depth. Oxygen partial pressure of max. 1.6 ATA is advised having regard to carbon dioxide dangers. Treatment facilities must be immediately available for all deep dives, and gentle handling is important, as witness one diver whose spine was damaged by rough, careless helpers. The US Navy, like other navies, has few diving deaths (average two per year) but these reports reveal the fact that 'bends' remain a serious problem as diving progress outstrips knowledge.

We in Australia cannot be complacent about diving accidents, cases being known that match almost every case reported overseas. For this reason a brief summary may be an aid to reducing accidents:

| | |
|---|---|
| BS-AC | Victim alone at time of most fatal accidents. Seamanship is important for safety. |
| Denney and Read | Of 21 deaths, 18 in water less than 25 feet deep. Air embolism suspected in 11 of these cases. |
| Desautels | Cave divers must take extra care; equip and train specially. |
| Uni. Rhode Island | High danger in learning period with scuba. |
| US Navy | Poor results civilian DC sickness treatment, so obey 'table'.<br>Dangers of 'blow up' when using $HeO_2$ except short duration dive and less than 150 feet. Need $HeO_2$ limit 300 feet and oxygen partial pressure 1.6 ATA. Use submersible Redepression Chamber Technique. Every dive plan must consider the possibility of sudden loss of air. |

Postscript

The Arabs tell of a merchant in the market plan of a far fair city, resting after the labours of his journey. He chanced to look up to find himself face to face with Death. Both showed surprise

at the unexpected meeting. Immediately abandoning his friends and possessions without a further word, the merchant fled to seek the safety of his house, for he had seen Death's ways with other men. Many dangers beset him, but he never rested till he reached his journey's end. There he was met by smiling Death, who said "Had you not hastened so, you would have missed our appointment here in 'Samarra'".

## APPENDIX A

### DIVING ACCIDENTS AND DEATH

**Dr Douglas Walker**
Heron Island
June 1972

Bayliss (Non Military Diving Deaths Australian waters 1957-67)

| Year | 1957 | '58 | '59 | '60 | '61 | '62 | '63 | '64 | '65 | '66 | '67 |
|---|---|---|---|---|---|---|---|---|---|---|---|
| Deaths | 4 | 48 | 2 | 4 | 10 | 13 | 10 | 3 | 7 | 4 | 9 |

| Causes of Death | | |
|---|---|---|
| | Drowning, no specific antecedent features | 30 |
| | Drowning, equipment or entanglement blamed | 12 |
| | Drowning, pre-existent disease noted | 6 |
| | Drowning, in skin diver known to hyper ventilate | 3 |
| | Pulmonary Barotrauma | 11 |
| | Decompression Sickness | 9 |
| | | 71 |

BS-AC Incident Reports

| Diving Officers Conference | 1966 | 1968 | 1969 | 1970 |
|---|---|---|---|---|
| Deaths | 13 | 8 | 10 | 8 |
| Bends | 2 | 5 | 4 | - |
| Suspect Air Embolism | 1 | 2 | 1 | 6 |
| Solo Divers | 5 | 7 | 5 | 4 |
| Separated from buddy | 5 | 6 | 4 | 4 |
| Dive boat engine failure | - | 9 | 3 | 4 |
| Inexperience | - | 5 | 1 | 2 |
| Power of water (river, weir) | 3 | 8 | 2 | 1 |
| Current (sea) | 1 | 6 | 1 | 5 |
| Lifejacket pack/failure | 2 | 2 | 2 | 4 |
| Weight belt trouble | 3 | 2 | - | 1 |
| Diver surfaces, unobserved | 1 | 5 | 4 | 1 |
| Unattended boat | 2 | - | - | 2 |
| Exhaustion | - | 1 | 1 | - |
| Trouble from other boats | - | 4 | 5 | 2 |
| Shared ascent | 1 | - | 1 | 1 |
| Probable FA or Breathholding | 1 | 4 | 2 | 6 |
| Rescue attempt by buddy or another diver | 5 | 6 | 8 | 6 |
| Contaminated air | - | - | 3 | 1 |
| Water in cylinder | - | - | 1 | 1 |

Desautels: Florida Diving Deaths

| Year | 1960 | '61 | '62 | '63 | '64 | '65 | '66 | '67 | '68 | '69 | TOTAL |
|---|---|---|---|---|---|---|---|---|---|---|---|
| Open Water | 6 | 4 | 4 | 2 | 3 | 7 | 7 | 7 | 5 | 13 | 58 |
| Scuba Caves | 4 | 8 | 8 | 3 | 4 | 6 | 4 | 12 | 8 | 9 | 66 |
| Free Diving | - | 2 | 5 | 2 | 3 | 3 | 4 | 3 | 2 | 3 | 27 |

Multiple Accidents: 1 x 4 deaths; 1 x 3 deaths



Miles: 165 Diving Accidents 1959-1964 (excludes hard hat)

| CAUSE | FATAL | NON-FATAL | |
|---|---|---|---|
| Asphyxia | 18 | 6 | Loss of air supply |
| Anoxia | 8 | 14 | Rebreathing sets |
| Illness in water | 5 | 10 | CT, virus, epilepsy |
| Oxygen poisoning | 5 | 5 | XS depth, sensitivity tests |
| Syncope, collapse | - | 40 | $O_2$ rebreath; hyperventilation |
| Pulmonary Barotrauma | 4 | 4 | FA training (excludes escape training) |
| D/C sickness | - | 27 | Failed use DS tables. XS exertion |
| Shark attack | 3 | - | |
| Ear injuries | - | 7 | |
| Others | 2 | 7 | U/W explosion,squeeze |
| **TOTAL** | **45** | **120** | |

| Predisposing Factor | FATAL | NON-FATAL | Examples of Factors |
|---|---|---|---|
| Inadequate safety precautions | 25 | - | No buddy, lifelines, supervision |
| Inadequate training | 21 | 95 | Failure to follow correct procedures |
| Hazardous diving | 14 | 18 | Repeat dives *[illegible]*; entanglement |
| Failure of apparatus | 8 | 22 | Lack of air, wrong gas mixture |
| Illness in water | 5 | 11 | Even minor respiratory infection |
| Personal factors | 2 | 31 | Anxiety; stress; *[illegible]* |

Okalyi: Native Divers in Torres Straits

| | FATAL | NON-FATAL |
|---|---|---|

| | | |
|---|---|---|
| Drowned | 3 | *[illegible]* |
| Pulmonary Barotrauma | 14 | *[illegible]* |
| DC Sickness | 5 | *[illegible]* |
| Illness | 2 | *[illegible]* |
| Cause uncertain | 2 | *[illegible]* |



University of Rhode Island: 1970 USA Diving Deaths

| | Skin Divers | Scuba |
|---|---|---|
| 1965 (Webster) | 27 | 67 |
| 1970 (URI) | 21 | 101 |

Diving Experience of Victims (Scuba)

| | |
|---|---|
| First dive ever with scuba | 11 |
| First open water dive | 7 |
| Early open water dive | 12 |
| Some experience with scuba | 24 |
| Considerable experience with scuba | 11 |
| Very experienced with scuba | 11 |
| **Total** | **76** |

17 of these deaths while under instruction

US Navy Research Reports

EDU RR 1-66

Average number of reported USN diving accidents 78 per year
Average fatalities 2 per year
Types of accidents: DC Sickness 50%
Lung over pressure 10% (50% with air embolism)

Comment 40% of diving accident in 'No Decompression' limits
8% cases actual decompression taken is less than required amount

USN EDU RR 10-68, 11-70, 12-70

| YEAR | 1967 | 1968 | 1969 |
|---|---|---|---|

| Civil - Military | C | M | C | M | C | M |
|---|---|---|---|---|---|---|
| DC Sickness | 21 | 46 | 25 | 55 | 28 | 37 |
| Lung over pressure | 3 | 9 | 6 | 9 | 3 | 4 |
| Other | - | 23 | 7 | 36 | 5 | 22 |
| TOTAL | 24 | 78 | 88 | 99 | 36 | 63 |

Page 4 of Appendix A

Results of Recompression Treatment

| **Results Treatment DC Sickness** | **1961-66** | | **1967** | | **1968** | | **1969** | | | | | | | |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| | **M** | **%** | **C** | **%** | **M** | **%** | **C** | **%** | **M** | **%** | **C** | **%** | **M** | **%** |
| Complete relief | 189 | 79 | 11 | 52 | 36 | 80 | 9 | 36 | 44 | 80 | 9 | 32.1 | 22 | 59.5 |
| Substantial relief | 20 | 8 | | | 1 | 2 | 8 | 32 | 7 | 12.7 | 10 | 35.7 | 7 | 18.9 |
| Substantial residual | 6 | 3 | | | 1 | 2 | 6 | 24 | 1 | 1.8 | 6 | 21.4 | ? | 3.5 |
| under pressure | 12 | 5 | | | 1 | 2 | | | | | 1 | 3.6 | ? | 2.7 |
| Recurrence at surface | 11 | 5 | 10 | 48 | 4 | 9 | 2 | 8 | 3 | 5.5 | 1 | 3.6 | ? | 2.7 |
| Deaths | - | | - | | 3 | 6 | - | | - | | - | | - | |
| No treatment | - | | - | | - | - | - | | - | | 1 | 3.6 | | 2.7 |
| TOTALS | 238 | | 21 | | 46 | | 25 | | 55 | | 28 | | 37 | |

Time of Onset of DC Sickness Symptoms (Military)

| Cumulative% | 1963 | 1961-66 | 1967 | 1968 | 1969 |
|---|---|---|---|---|---|
| During Dive | 9.1 | 12 | 11 | 45 | 51.6 |
| After surface 1 hr | 54.7 | 56 | 59 | 72 | 728 |
| After surface 2 hrs | 66.8 | 65 | 69 | 74 | 76.8 |
| After surface 6 hrs | 88.2 | 90 | 90 | 88 | 8?.9 |

Fatalities: Report of Solo Diving

| Source | Area | Year(s) | Total Deaths | Solo Diver | Separated from Buddy | Failed attempt Buddy Rescue |
|---|---|---|---|---|---|---|
| BS-AC | UK | 1966-70 | 39 | 17 | 12 | 8 |
| Egstrom | California | 1970 | 19 | 10 | 2 | 55 |
| Hassel | S Calif. | 1953-60 | 41 | 26 | 3 | - |
| Taylor et al. | Florida (open water) | 1960-62 | 11 | - | 7 | - |
| URI | USA | 1970 | 107 | 18 | - | 19 |

| | | | | | | |
|---|---|---|---|---|---|---|
| Webster | USA | 1965 | 86 | 15 | 24 | - |

Reported Depth of Fatal Incidents

| | | | |
|---|---|---|---|
| **Denney and Reed** | 1959-65 | Michigan | of 21 deaths, 18 at 25 depth |
| **University of Rhode Island** | 1970 | USA | 25% at 15 feet<br>50% at 30 feet<br>only 16% over 100 feet |

**SOME INVESTIGATIONS INTO SKIN AND SCUBA DIVING DEATHS**

| AUTHOR OF REPORT | SOURCES OF INFORMATION | PERIOD COVERED | DEATHS |
|---|---|---|---|
| Bayliss | Forensic Pathologists, Departments of Health in Capital cities, Aust., Statisticians | 1957-67 | *[illegible]* |
| BS-AC | Reports from BS-AC Branches and individual diver | 1965 onwards | 9 |
| Denney & Read | Death Certificates, with co-operation Michigan State Vital Statistics Bureau; Coroners | 1959-1965 | *[illegible]* |
| Desautels | State Board of Health, Florida | 1960-1969 | *[illegible]* |
| Hassel | Los Angeles Fire Dept (?) | 1959-1965 | *[illegible]* |
| Miles | Chance reports to RN Medical College (excluded ‘hard hat’ divers from report) | 1959-1964 (5 years) | *[illegible]* |
| Noguchi | Department of Chief Medical Examiner, Coroner County of Los Angeles | 1961 onwards | *[illegible]* |
| Okalyi | Thursday Island Hospital records | | |
| Press, Walker | Illinois Dept of Health: enquiries to 4 other states also | 1965-1966 (12 months) | *[illegible]* |
| Smith FR | Seattle - King County Safety Council | 1959-1965 | *[illegible]* |
| Taylor, Williams & Chappell | Florida State Board of Health who gave diving deaths on ‘code’ in death certifications | 1960-1962 | *[illegible]* |
| USN | EDU Research Reports based on NAVMED 816 accident reports | 1961-19?? | *[illegible]* |
| URI | Newspaper reports; | 1970 | *[illegible]* |

| | | | |
|---|---|---|---|
| | Coroners | | |
| Webster | Facilities Accident Prevention Bureau of State Services, US Dept of Healths, Newspapers | 1965 | *[illegible]* |

Project Stickybeak Newspaper reports, private reports, reporting schemes of AUF and SDAA and full co-operation Attorney Generals' and Justice Departments of States

**APPENDIX B**

## DEATHS ASSOCIATED WITH WORK IN COMPRESSED AIR OR DIVING POST MORTEM EXAMINATIONS

In view of the many gaps in our knowledge of the causes and mechanism of death from decompression sickness the Medical Research Council Decompression Sickness Panel is most anxious to collect information from the post mortem examination of divers dying following exposure to compressed air and during or after diving. In order to obtain adequate information it is essential that special care should be taken when carrying out such examinations and it is hoped that Pathologists will kindly co-operate with the Panel so far as they are able.

1. External Examination

   Particular note should be taken of the presence of sub-cutaneous emphysema and also the appearance and distribution of abnormal blotching or marbling of the skin. (A colour photograph of any such markings would be extremely useful).

2. Radiological Examination

   Whenever possible radiography of the chest and major arteries should be carried out before any internal examination. The chest radiograph may show lung pathology, such as a cyst, and the presence of gas in the heart and blood vessels. Joint radiographs can indicate the choice of bones to be examined (see 3c).

3. Internal Examination

   a. Central Nervous System - the calvarium should be opened before any other incision is made in order to prevent the accidental introduction of air into the body. The presence or absence of bubbles in the vessels on the surface of the brain should be noted. The brain should be removed in its entirety and, where possible, fixed in formalin without dissection. If possible the whole spinal cord should be removed and similarly fixed.

   b. Chest and Abdomen - it is advised that the trachea should be tied and occluded through a neck incision before the chest is opened.

i. HEART - it is particularly important to note the presence and distribution of gas in the heart and thoracic blood vessels. The heart should be examined under water in the conventional manner for the presence of gas in the chambers and coronary arteries and it must also be carefully examined for evidence of valvular or non-valvular communication between the left and right compartments.

ii. LUNGS - particular interest centres around the presence or absence of localised or generalised air trapping in the lungs. The heart and lungs should be removed with care and any local distension or collapse or any evidence of

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sub-pleural spread of air, noted. The heart-lung preparation should, if possible, be preserved in its entirety for subsequent dissection. In any event the whole of both lungs should be retained for later examination.

iii. BLOOD VESSELS - arteries and veins should be examined for the presence of gas in such sites as the alimentary canal, the brain and the kidneys. The consistency of the blood should be noted, for haemoconcentration, and a sample kept for carbon monoxide estimation.

c. Skeletal System - There is a particular interest in caisson disease of bone; and, where possible, at least the head of a femur and the head of a humerus should be removed and fixed for subsequent examination. Where there is radiological evidence of bone disease, as many specimens as possible should be obtained from both affected and unaffected regions.

d. Other Systems - where possible, other organs should be preserved in entirety, or portions retained for examination. This particularly applies to the kidneys and the endocrine system. Specimens of voluntary muscle, and of skin at the site of any lesion, should be obtained.

It would be greatly appreciated if the Medical Research Council Decompression Sickness Panel could be informed, at the telephone number given below, of a forthcoming post mortem on a subject who died during or following diving, or after working in compressed air. A member of the Panel would be willing to attend a post mortem examination should the Pathologist think this desirable.

Medical Research Council Decompression Sickness Panel
University of Newcastle upon Tyne
21 Claremont Place
Newcastle upon Tyne, NE2 4AA
Telephone: 0632 - 24987

"STICKYBEAK"
Provisional Report on Diving Deaths in 1972
DG Walker

The eighteen (18) divers who died in 1972 were taking no more risks than many who had uneventful, or at least non fatal, dives. This report is based in part on evidence given at Coroners' inquests, but in greater part the source is newspaper reports. Despite the (present) incompleteness of the information, the facts available seem to justify publication in the hope that others may thereby avoid the same mistakes.

Failure to follow the accepted rules for safe diving appears to be the critical factor that enables a mishap to end fatally; one should always try to learn from the 'almost got into trouble that time' dive incident. Most divers have learnt to choose an exit before entering the water, or to choose the dive boat 'cover' with care, after an occasion on which they omitted such a precaution. Not everyone is granted a second chance. It is not sufficient to have survived, the good diver has learnt.

These eighteen divers cover the entire gamut of diving experience from first time in the sea to 'pro' abalone divers. All made the fatal mistake of overestimating their ability to manage the water conditions, though some were the victim of mistaken decisions made by those they trusted.

The only bright spot was the absence of hyperventilation deaths, there being no deaths reported in champion spearfishermen this year. It is hoped that this form of self-destruction, the result of a desire to excel coupled with a belief that 'it can't happen to me', will be controlled by education through clubs plus a realisation that a buddy can only save you if he is both nearby and looking at you when you pass out. Relatives seem to expect clubs to be safety-conscious nowadays.

As deaths were three times as frequent in 1972 as in 1971 there seems to be need for more effective diving instruction.

**Table 1**
(Diving Deaths (so far known))

| **Year** | 1965 | 1966 | 1967 | 1968 | 1969 | 1970 | 1971 | 1972 |
|---|---|---|---|---|---|---|---|---|
| **Deaths** | 6 | 5 | 10 | 7 | 7 | 8 | 6 | 18 |

**Table 2**
(1972 Deaths/States)

| **State** | QLD | NSW | ACT | Vic | SA | WA | Tas |
|---|---|---|---|---|---|---|---|
| **Snorkel Divers** | - | 2 | - | 1 | - | 1 | - |
| **Scuba/Hookah** | - | 2 | 1 | 5 | 4 | 1 | 1 |

| | | | | | | | |
|---|---|---|---|---|---|---|---|
| **TOTALS = 18** | - | 4 | 1 | 6 | 4 | 2 | 1 |

Too much regard should not be given to the ‘league table’ as small factors may, and do, decide whether the outcome is survival or multiple deaths. As the information gathering system is far from efficient I appeal to my readers to supply information of cases known to them: hence the project’s title! In reading the reports of incidents employ charity for those involved, to whom the events occurred unexpectedly and without apparent justice.

Breathhold divers, by which is meant swimmers using fins, mask and snorkel, appeared in four fatality reports. Two had been washed by surf or wave action under shallow water rock ledges, there to drown. Another, said to have been a good swimmer, suffered cramp and drowned despite the valiant attempts of companions to rescue him. The final death was of a sole swimmer who suffered a fatal heart attack. None apparently wore lifejackets. They were all examples of the ever present dangers common to all swimmers, though the rescue failure was especially distressing. The cramp may have been caused by the waring of too small size fins, plus cold water conditions at the time.

Scuba divers, in which group are included the abalone divers (as information is not yet available as to whether they were using Hookah air supply) demonstrate in death the necessity to carry out the rules for safe diving that are taught by all good instructors, written in all the diving books, and largely ignored by the majority of Australian divers. Their sins were venal but the penalty was death. The inescapable conclusion must be that all these deaths could have been avoided by forethought but had become highly likely by the time the index mishap occurred. Safety starts before you enter the water.

One pupil died during his first sea dive, his fourth ever time in water wearing scuba, in the presence of his fellow pupils and the instructor. The pupils seem to have made valiant but unavailing rescue attempts, managing to drop the victim’s weight belt and scuba pack. The basic fault appears to have been a failure to recognise the risks involved in teaching a group of pupils in open water and a failure to react adequately to events. The wearing of lifejackets could have prevented this death, while a recognition of the danger period associated with the changeover from scuba to snorkel on the surface in those new to the procedure would have made the trained divers present more alert and ensured, at the very least, that they kept the class close together at all times. The instructor is morally, and possibly, legally, responsible for his pupil at all times in training and is truly his buddy. This death occurred despite excellent efforts by some of those present, but the chain of safety is tested at the weakest link. One day a legal case will occur and thereafter the Insurance companies will regulate those they choose to insure.

To teach yourself to dive can be fatal. One death occurred in the

presence of the victim's equally inexperienced brother. They were returning towards shore with empty tanks, the buddy leading by 20 feet when the victim called for help. He had panicked and dropped his weight belt and tank harness. His buddy dropped his also and swam to give help. But help was unavailing as the victim has tied his weight belt to his hired harness and the whole mass was caught on his knife, on his leg. The weight dragged him underwater. The fact that the tank was hired to him without questions as to his diving fitness was only one factor. No lifejackets appear to have been worn. Once again, it is demonstrated that the diver is not 'home and dry' when he reaches the surface. It will be of interest in later stages of this investigation, 'Stickybeak', to see whether more divers die underwater or after surfacing. This report may alert some to the dangers of this period of any dive.

Few details are available at this time concerning three of the other deaths, though inexperience and lack of lifejackets were suggested as important factors. One surfaced short of air, with a similarly panicky buddy. They were tired and 'half-drowned'. The victim-to-be apparently took a snorkel from his buddy before they were separated. Only one survived. The other two divers were drowned after failing to exit safely onto rocks, being washed back into the sea. In one of these cases the victim's lifejacket is said not to have functioned, a not unknown failing of the $CO_2$ inflation type, and the weight belt was not dropped. The other incident occurred despite diving club organisation of the outing. The divers were paired, with an experienced diver in each pair. The dive was by four pairs from a boat. But none wore lifejackets and the weather conditions apparently worsened while events revealed than an insufficient surface watch was exercised. The divers found the area uninteresting and soon surfaced, finding themselves not only unable to regain the boat but also unable to attract the attention of the occupants of their boat, despite using a makeshift flag. The other divers were also requiring recovery from the water by the boat crew. Because of cold and exhaustion (yes, COLD) the distressed pair made for some rocks. The adverse conditions, waves and surge, made leaving the water difficult; the absence of lifejackets made it essential. In fact only the experienced diver was successful, the other being washed back off the rocks and drowned. Such at least is the newspaper report, and having myself once been washed also from a boat, and also experienced the sudden realisation of helplessness in the grip of white water over oystered rock, I find the story all too probable. It takes a very good diving officer to cancel a dive which is possibly dangerous for <u>some</u> of the group.

There is a strange human desire to achieve magic numbers, in our sport shown by the interest in depth achievements by inexperienced divers. They are often unappreciative of the significance of the depth in

terms of loss of buoyancy, cold, nitrogen narcosis, rate of use of air, and possible decompression problems. As few are equipped with air contents gauges or constant volume lifejackets, any mishap can turn to rapid tragedy. The following cautionary tale is of a diving outing to an offshore wreck in about 150 feet of water. The sea was rough enough to induce a degree of mal-de-mer in the victim on the trip out to the dive site. He was ‘an experienced diver’, though not for deep dives; neither he nor the diver organiser recognised the significance of this fact. The divers were paired and noted as they entered the water, each being responsible for his own safety checks as there was no Diving Officer in control. There was a strong current and surge, which caused the victim-to-be, the first to enter the water, difficulty in reaching the anchor chain from his point of entry near the stern. He was here subjected to the movements up and down as he held on, waiting. As he had no snorkel he was forced to use his air supply while he waited for his buddy to complete his preparations and enter the water. The initial descent was made hard by the sea conditions, effort and air being generously required. At the wreck, sea floor depth 160-170 feet, the buddies separated though remaining in sight of each other. The victim was seen to pick up and swim with two light anchors before suddenly signalling his air lack and to swim the 15 feet or so that separated them. The attempt to buddy breathe failed when the strap holding the demand valve mouthpiece twisted so that neither diver was able to obtain air. In the confusion and natural panic, with both now in danger of drowning, the buddy activated his ‘Fenzy’ type lifejacket and ascended in a cloud of bubbles. When he had recovered and cleared his mouthpiece and checked his ascent, he was alone. Having surfaced and given the alarm, he attempted to descend again but found himself short of air. There was no safety diver ready to enter the water immediately, though it was probably already too late for effective help. Search failed to locate the victim that day. From evidence later available it is known that the victim failed to activate his cylinder reserve, drop his weight belt or make and attempt to ‘free ascend’ by holding onto his buddy. Whether this was due to panic, narcosis or because he aspirated water can never be known. He was not helped by being some distance from his buddy at the critical time, having excess weight (21 lbs) not having a lifejacket or snorkel and having over-exerted himself both on the surface and on descent. This type of dive organisation here recorded is not unique to this dive, I fear. It is most unwise to ascribe this death solely to the twisted strap, a factor though it was. The entire dive pattern was an invitation to disaster.

In one incident a diver was seen to suddenly go rigid and die. This occurred in a sea cave, in the presence of his buddy. No explanation can be given as the equipment was not recovered and the body was lost at sea for several days.

Cave Divers continue to received unwelcome publicity, with further deaths in the Mount Gambier water-holes. It seems reasonable to suggest that notices be displayed warning that the visibility can rapidly fall to NIL when mud/sediment is disturbed; there are four graves to prove it. In one case the victim had a line but had thought it unnecessary to use it; his buddy escaped by luck. In the other incident four divers suffered a 'rats in a trap' dive, here again one diver finding the exit by luck as his air ended. Neither were organised club dives. Clear visibility lured them to dangers they never expected. One survivor said that his training in nil visibility diving enabled him to avoid fatal panic in his terrible predicament.

Abalone Divers are tough guys who think decompression tables are for amateurs, or such is the impression they like to give. They dive frequently so are 'adapted' to tolerate nitrogen absorption problems better than the 'tables' suggest; but they still pay the penalty for overtaxing their systems with nitrogen. It seems likely that many will suffer aseptic bone necrosis in years to come, their disablement being the price of their present financial success. The details of one death are unavailable at this time but the double fatality from decompression sickness received wide press coverage. Both these victims were said to have received recent treatment for 'bends'. It was reported that the divers' association in the area seeks safety facilities for more rapid treatment of decompression sickness, but better diving routines would give better results for life and health.

Summary

**Snorkel divers - 4**
- 2 drowned, waves washing under rock shelf
- 1 cramp; buddies failed to effect successful rescue
- 1 heart attack, alone

**Scuba divers - 14**
- 1 pupil under training, on surface
- 1 inexperienced, untrained, entangled in equipment when panicked on the surface
- 1 inexperienced, washed off rocks; lifejacket failed
- 1 inexperienced, washed off rocks despite buddy (who already managed to land). Had been unable to regain dive boat
- 1 drowned in sea cave, cause unknown
- 1 drowned, deep dive; panic when air supply low
- 4 drowned, lost in fresh water (Mount Gambier) when visibility suddenly to nil
- 2 decompression sickness
- 1 abalone diver. Cause of death at present unknown
- 1 drowned - in distress on surface; separated from buddy

Conclusions

**Scuba divers**

5 of these deaths occurred at the surface, wearing scuba
4 deaths were due to lack of lifeline in freshwater hole;
2 were due to severe decompression routine failure;
2 were deaths in learning stage of scuba diving.

Lifejackets would have saved some of the victims.

**Mask and snorkel divers**

Two of these divers underestimated the sea conditions. Another, though said to be a good swimmer was unable to survive the seas conditions when affected by cramp; he would have survived had he or his companions worn lifejackets. The fate of the fourth diver who died might have been different had he had a companion with him when he was taken ill.

Acknowledgements

The assistance of the Attorney-General's Department in all States is gratefully acknowledged. All those who have supplied information are thanked, particularly helpful being the AUF, FAUI and the Water Safety Council of Western Australia.

All those who can assist with this ongoing investigation are invited to write to:

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NARRABEEN NSW 2101