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South Pacific Underwater Medicine Society

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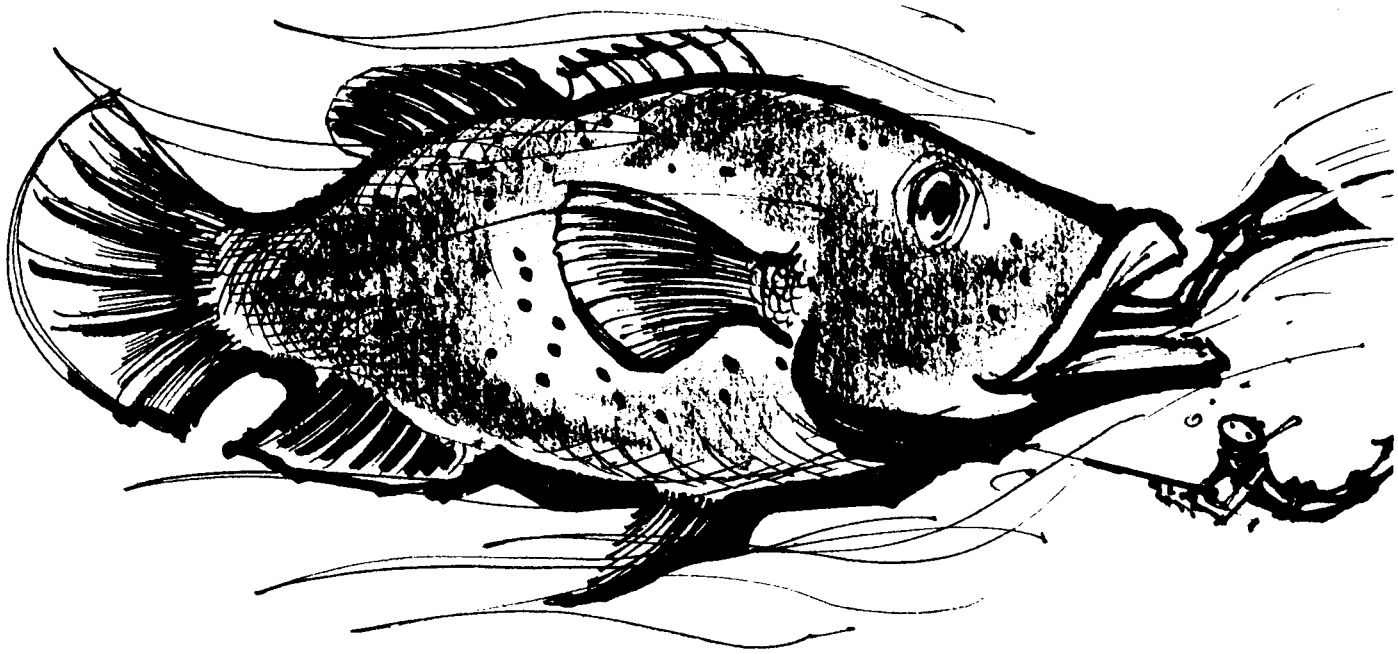

"THE TROUBLE WITH THESE BIG FELLERS IS YOU'RE LIABLE TO PICK UP CIGUATERA

CONTENTS

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EDITORIAL

Readers of this issue may well be forgiven for harbouring suspicions concerning the motives of any fisherman who offers them the biggest fish from his catch, especially if the fishing has been on the reefs off northern Queensland. Suspicion will harden into near paranoia if the kind donor grudgingly admits that his fish-loving cat has died recently! The occurrence of ciguatoxin in the fish of any area is a valid cause for alarm, not only because of the ill health which can result but also because of the potentially serious economic effects on the Commercial fishing industry and the tourist trade. The discouraging effect on sales of marine products due to valid fears concerning the risks of resultant illness are well known by oyster farmers in New South Wales, where costly purification schemes have needed to be introduced to reassure careful consumers. The interest in this problem of ciguatera by the Queensland Government is therefore very timely, and the discovery of some simple test for the presence of ciguatoxin in fish would be of immense value from the standpoints of both health and commerce.

Medical Journals, like newspapers, of necessity deal largely with life in terms of the things which have gone wrong, or are expected soon to do so. Our Journal, however, tries to use such events as a springboard from which to achieve increased safety. With such a reassuring thought in mind one can with greater equanimity approach papers which deal with PANIC and serious diving related accidents. The geographical diversity of the origins of these papers underlines the seeming universality of the problems which confront divers, and possibly adds weight to the message that both suitable training and a pre-dive anticipation of the possible risks and problems, with a view to their minimisation or avoidance, will favour survival despite possible misadventures.

Our Society's recent successful Scientific Meeting in Singapore will be reported more fully in a later publication, in line with our belief that good meetings achieve far less than their full potential if they remain unpublished. Our fellow society, UMS, has recently published reports on two of its "workshop" meetings. While regretting the delay in their publication, they have been discussed because of the information they contain and the matters they fail to discuss. The "workshop" which concerned itself with the possibly special problems of mixing pregnancy with diving, defined the presently available information, its limitations and its hard facts, and proposed lines for useful future research effort. The "workshop" which concerned itself with the teaching of emergency ascent, however, missed opportunity presented. There was no discussion of the options to avoid or reduce the out-of-air crisis incidence or the justification for accepting the present mortality rate for diving instruction. Only by careful pre-workshop planning to define the problem under discussion, whether <u>avoidance</u> or <u>management</u> of some danger or nuisance is the aim, will it be possible to avoid a "workshop" from becoming a mere forum for statements, a "meeting" such as is only to commonly experienced when items in contention are raised.

The opinions of readers are welcome, whether to dispute or maintain the viewpoints of contributors. Medicine is such a heady mixture of Science and Art, with a strong element of the Shaman in most practitioners and all experts, that even The Editor may sometimes get the message wrong and need compassionate correction from his readers. But, on the other hand, he may just possibly be right!

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SUBSCRIPTIONS

Members pay $20.00 yearly and Associate Members $15.00. Associate membership is available to those neither medically qualified nor engaged in hyperbaric or underwater related research. Membership entitiles attendance at meetings and the Annual Scientific Conference and receipt of the Journal/Newsletter. Anyone interested in joining SPUMS should write to the Secretary of SPUMS, Dr Christopher J Lourey, 43 Canadian Bay Road, Mount Eliza, Victoria 3930.

THE ANNUAL SCIENTIFIC MEETING OF SPUMS 1980

The Annual Scientific Meeting was held at the Merlin Samudra Hotel, Pulau Tioman, Malaysia, from Saturday June 28th. The guest speaker was Dr John Miller, the secretary of the Undersea Medical Society, who is the Medical Director of the Hyperbaric Programme of the FG Hall Environmental Laboratory at Duke University, North Carolina, USA. Dr Miller is an Australian and has served in the RANR. Other than drowning his 15 year old diving watch he had a very successful week. His contributions to the meetings made it a very successful week for the society.

Dr Miller's Keynote speech was devoted to the FG Hall Environmental Laboratory's hyperbaric programme at Duke University.

Other topics covered during the week included Diving Illnesses and Injuries when Drs David Cossar (sinuses), Bill Hurst (ears), Peter Cohen (eyes) and John Miller (Problems as seen at Duke University) contributed. The next session was on the First Aid, Treatment and Transport of Diving Casualties, when Drs John Miller (USA), Tony Slark (New Zealand), Chris Lourey (Australia) and Mike Davis (New Zealand) spoke about the problems in their areas. There were two sessions on Decompression Sickness. In the first Drs John Miller (Experiences at Duke University), Jimmy How (Experiences in Singapore), and John Knight (Treatment without a chamber) spoke. In the second Drs Chris Acott (The place of Barbiturates in Decompression Sickness), Mike Davis (The Christchurch Experience), Dr John Miller (Duke University) and Jimmy How (Singapore) spoke. The final session was devoted to Development of a National Plan when Drs Chris Lourey (Australia), Tony Slark (New Zealand), John Miller (USA), and Jimmy How (Singapore) outlined progress in their respective countries.

Edited transcripts of the presentations at the Scientific Meeting will appear in the next issue of the Journal.

The AGM was held on Wednesday 25th June 1980. The minutes of this meeting will be published in a later edition of the Journal. The committee elections saw Dr John Knight re-elected President, Dr Chris Lourey re-elected Secretary, Dr Bill Hurst re-elected Treasurer, Dr Douglas Walker re-elected Editor and Drs Victor Brand and Darrell Wallner re-elected to the Committee. Dr Beryl Turner, the Officer in Charge, RAN School of Underwater Medicine, was elected to the vacant position on the committee. This is the first time that a female has been elected to the committee. This is an excellent break from tradition and augurs well for the future. Everyone in the society can and should contribute to its activities and health.

The meeting accepted with regret Dr Bill Rehfisch's resignation from the Committee.

The AGM was followed by an excellent illustrated talk on dive sites in Australia by Mr Peter Stone, Editor of Skindiving in Australia and the South Pacific and Convenor of the Oceans Conference in Melbourne.

This year Oceans 80 will be held on October 17th, 18th and 19th at the Robert Blackwood Hall, Monash University, Clayton, Victoria. For tickets either write to the Convenor, Oceans 80 Conference, Box 4604, GPO Melbourne 3001, or at the door.

Following the meeting at Pulau Tioman the conference transferred to Singapore where an Underwater Conference was held on June 30th, July 1st and 2nd at the Hyatt Hotel hosted jointly by SPUMS and the Diving Medical Centre, Republic of Singapore Navy. This well attended conference was excellent. These were papers from Australia, New Zealand, USA and Singapore. The proceedings were recorded and will be published as a special souvenir issue of the Journal in due course. Sessions were devoted to the Challenge of Depth, Some Problems of Man in the Water, Decompression Sickness, Diving Illnesses, and Free Papers. Outstanding were the paper by Dr John Miller on the recent Chamber dive at Duke University to 2132 feet, and the excellent papers from the Singapore speakers on Decompression Sickness, covering its treatment, delayed presentation, the rehabilitation in spinal cord injury and of joints damaged by dysbaric osteonecrosis. It is impossible to do justice to the presentations in this short report. Our readers will have to wait for the full proceedings to be published before they can share the excitement and interest felt by those who attended.

This first International co-sponsored conference puts SPUMS right onto the diving medicine map. Let us hope that in further years we can continue the excellent work. The Society owes a great debt to Dr Jimmy How, the Senior Medical Officer of the Republic of Singapore Navy and a long standing member of SPUMS and to Dr Chris Lourey, the Secretary, for the tremendous amount of work they put into organising this combined conference which was such a resounding success.

In all the 1980 trip to Malaysia and Singapore was the best SPUMS conference yet and shows how wise the Society was to choose Chris Lourey as its Secretary last year in Vila. Next year's conference is being arranged to allow members to attend both SPUMS and UMS conferences. The latter is being held in California.

The Society's thanks must go to Anthony Newly of Allways Travel for travel, accommodation and diving arrangements. Large groups travelling together seem to stir Murphy's Law into action. Travel was not always to time but these occasions were beyond Australian Control. Anthony found out about Mr Murphy when he developed toothache on Pulau Tioman. Luckily Adrian Gardiner, our diving dentist, had brought his forceps and local anaesthetic with him and was able to relieve his pain. How many doctors take their working kit with them on holiday ? See you at the next AGM.

John Knight
President SPUMS

IDLE TALK: WHAT DO YOU *REALLY* NEED TO KNOW?

DG Walker

There is a trick known and practised by every successful politician, and by those who organise any meeting which is intended to produce conclusions, by which the desired answer can be made likely and the difficult questions ruled out of order. This is through the careful wording of the Terms of Reference, a document or statement which hypnotises the average participant like a bright light can a fish at night. The same effect is self induced whenever we seek to answer an immediate problem without giving any thought to the totality of the circumstances within whose frame the problem has arisen. Several instances of this blinkering of thought occur in the diving world, a prime example being a fixation on making it possible for a man to work acclimatised to great ambient pressures when the requirement may be to enable man to work where the job is itself subject to a high ambient but the operator need not be so exposed. A more divisive problem has been the long running saga of the Emergency Ascent Training controversy. Wittingly or otherwise, the Big Five American Diving Instructor groups (NSTC) seem to have orchestrated such a misdirection ploy at the "Workshop" called to discuss this matter under the patronage of UMS and NOAA. Thereby they lost a golden opportunity to make a radical examination of the important matter which should have occupied their thoughts, the basic skills needed by every scuba diver. The chance was ignored.

The meeting was attended by many astute, experienced, highly respected members of the "diving medicine" fraternity of the USA, the majority of whom allowed the discussion to centre about one particular solution to a problem (being out of air) whose frequency, cause, avoidability and true morbidity were not treated as being relevant. There was no attempt made to show that the desired skill (to make a safe emergency ascent in a real need situation) would result from the inclusion of a practice emergency ascent during an initial diving course or that people had either suffered from the omission of such practice or benefited from its inclusion. While it was admitted that emergency ascent practice carried a risk, its proponents readily accepted that accidents were a small price to pay. In their introductory statement to the meeting the Instructors made it clear that they took it to be self evident that the practice of emergency ascent(s) was an essential part of the basic training, without which the diver could not be considered to be equipped to dive safely. What they wanted, it appeared, was to be told that such practice was safe, or could be made safe. It is salutary to remember that what one generation considers to be "self evident" is frequently either disproved or markedly modified by those which succeed it. Unfortunately the belief that Emergency Ascent Practice is A GOOD THING is as deeply ingrained in the subconscious of many divers (Instructors and Doctors included) as was the belief in Original Sin in the Medieval Church. And as difficult to question.

What is the possible origin of this tenet? Probably it arose in the early days of the popularisation of SCUBA, for the equipment was often home made from war surplus materials, there was no instruction available (or thought to be necessary), and cheap imported demand valves were likely to "pack up" unexpectedly. Naturally there were no contents gauges (submersible) because the naval technique with open circuit units was based on decanting between twin bottles. Most of the early divers were graduates from breath-hold spearfishers, at least in the UK, real he-men who welcomed the spice of danger. Twin "tadpole" tanks limited diving somewhat and free ascent practice occurred naturally in the regular course of diving activities. When information filtered down that the USN and Royal Navy put their submariners through supervised Ascent Practice a certain degree of resentment and a feeling of being considered as second class citizens may have been natural when they, the sport divers, were told that they should desist from including this type of ascent in their training programs. This hankering to return to the good old days seems to have been successful in the USA lately, and many European countries never abandoned the practice. But as the latter keep no valid records of their diving casualties, and these are believed to be high, their decision may represent a mistaken priority in training matters. Some faint echoes of the days when divers had a need to be heroes lingers yet, one example being the NAUI "bail out" drill and another the desire to retain or resume practice emergency ascents. While it is instructive for those interested in medicine and biology to watch the foetus recapitulate some of the evolutionary history of its species, such as the appearance of gill slits in the human, it is hardly necessary to suggest the same holds true for diver training. All training courses should be based on the requirements identified from the most recent available information, not on what used to be thought necessary.

Perhaps you remember the story of the traveller who wished to confirm that he was on the right road, so approached a group of the locals for advice. He was soon in receipt of a mass of conflicting directions and began to despair of discovering the truth of the situation. At last one man drew him aside and said "If I were you, I wouldn't start from here". Would that such advice had been tendered loud and clear early in the "workshop", for the advice would have served them better than it did the traveller.

Where therefore should discussion of this or any other significant problem commence? As the King of Hearts told the White Rabbit, one should start at the beginning and go on till you reach the end; then stop. As there have been at least 80 deaths during training of sport divers in the USA 1970-1976, of which 20% were in association with Emergency Ascent training of some sort, it is obvious that present training methods require some improvement. Mr John McAniff, director of the University of Rhode Island National Underwater Accident Data Centre stated his view bluntly; he

believed that NO death from such training was the only acceptable record. However others, while regretting the individual tragedies, considered the incidence statistically insignificant. This viewpoint seems to miss the reasons for obtaining instruction, which do not include Russian Roulette.

The basic reason for making an emergency ascent of the type under discussion is actual, imminent, or supposed interruption of air supply. The most common reason for this in a Scuba diver is that he has used up his air, equipment and malfunction being rare (it is said). Such an out-of-air situation should be largely avoidable if the diver monitors his remaining air. There is no reliable information available as to the frequency of such situations, only a fairly complete roll of those who die as a result. Cases where the ascent is either completely or partially non-traumatic are poorly documented, far a number of reasons. Fatality reports seem to indicate that it is the untrained and the inexperienced who die, careful divers following accepted safe diving rules rarely paying this price for their mistakes. This seems to indicate the value of training in the basic skills and attitudes to diving, which will keep the diver from creating danger situations for himself. This view receives support from the excellent safety record of the BS-AC, which for many years has not allowed Emergency Ascent to be practised by its members, but has concentrated rather on strict training and dive discipline. Well trained divers are likely to resist panic and are more likely to make successful out-of-air ascents based on their knowledge of what to do (as contrasted with having previous practical experience of the procedure). Naturally some BS-AC members hanker to be allowed to “Free Ascend”, but remain restrained by Royal Navy advice.

Both Art and Science have their fashions, trends which overwhelm the critical faculties of the majority of those currently active in moulding opinion. Medicine’s fads and fancies have been legion but have usually yielded in time to the force of facts. Such evidence is rarely accepted immediately, however compelling it may appear to those who come later, because current beliefs effectively censor out unwelcome input. It is, however, possible to side step this obstacle by rephrasing the problem such that it is accepted not as an attack on accepted beliefs but rather as a fresh challenge. The brain, like a computer, will use only the program you set it. It answers the question you set, not the one you thought you were asking. If you ask how to make it safe to make an Emergency Ascent, or reduce HPNS, or withstand cold/oxygen/nitrogen/decompression risks, etc., it will work on the problem without asking whether exposure to such risks is worthwhile .... unless you program yourself or the computer to seek such information. The first stage in any discussion should be a defining of the basic problem (safe achievement of some underwater program) and the collection of all possible relevant information. Diving Medicine has been seduced by a belief that all was understood about basic safety and has wandered off into the interesting borderlands of knowledge. Diving exposes an individual, with an unique, complex and ever changing physiology, to a series of constantly changing thermal, barometric, chemical and psychological Stresses. The problem is made more complicated by failure to recognise, till recently, that such factors were operative. The only measurement used till recently has been the scale dead/ill/minor or nil complaints, without regard to finer degrees of morbidity. Morbidity, of course, is very difficult to measure and has a large subjective element: it is also something most people don’t want to find! It is this very unwillingness to seek the basic problems and to prefer to concentrate on the peripheral ones that leads to expensive and spectacular progress towards what may turn out to be dead ends. Is it truly our intent to have every sport diver “overtrained” in emergency ascent through multiple repeated practice ascents, or is there a better approach to safety? Is the answer to exploring the depths to be liquid filled lungs, or artificial gills, or a machine-dependent man breathing exotic gas mixture, or would a 1 ATA suit be simpler and safer. Unless we start to consider what we are trying to achieve, we will continue to risk a misdirection of effort. As such misdirected effort may expose those concerned to risk, serious thought must be given to both current and proposed practices. How about holding a “workshop”?

HOW TO AVOID FISH HANDLER’S DISEASE

A common occupational disease among people in the fishing industry has been called “fish handler’s disease”, and is known medically as erysipeloid. Symptoms include an inflammation of the skin on the hands and arms, ranging from small red spots to large red swollen areas.

The disease is actually an infection of the skin caused by the bacteria Erysipelothrix insidiosa. These bacteria are present on marine fish and cause the infection by entering the skin through tiny cuts and scratches.

“Fish handler’s disease” can usually be prevented by washing your hands and arms thoroughly with a strong soap or detergent after handling fish. For further protection you can rinse your hands and arms in a sanitising solution. There are a variety of commercial sanitising solutions available, or you can make your own by mixing two teaspoons of household bleach in a gallon of fresh water.

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PHYSIOLOGICAL ASPECTS OF PANIC IN WATER-RELATED ACCIDENTS

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INTRODUCTION

Close inspection of fatal water-related accidents indicate that a problem other than equipment failure, absence of floatation gear, inordinate distances from safety, or diving problems such as the bends or air embolism leads to the victim's demise. This problem is panic. Since panic has a definite constellation of symptoms and effects on the body, but not always a clearly identified cause, it might appropriately be labelled THE PANIC SYNDROME. This paper discusses the subject of panic in water-related activities and proposes a mechanism to account for its presence. Suggestions for prevention, emergency care and definitive treatment of this condition are given.

"Panic, by definition, implies a loss of control ..."; a fear that the individual "... is not in control of the situation in which he finds himself.[1] The common denominators are the loss of control (ie. loses one's 'cool') and the irrational actions that follow. The psychological effects of losing control in water, an unnatural environment for the individual, accelerate the panic action.

Panic is not an unfamiliar subject. Components of panic are observed in the biological stress/ general adaptation syndrome.[2] It is seen in the acute asthmatic attack, the hysteric hyperventilating to the point of collapse, the frightened apprehensive child, and in a variety of other conditions. Voodoo deaths are believed to be another manifestation of panic.

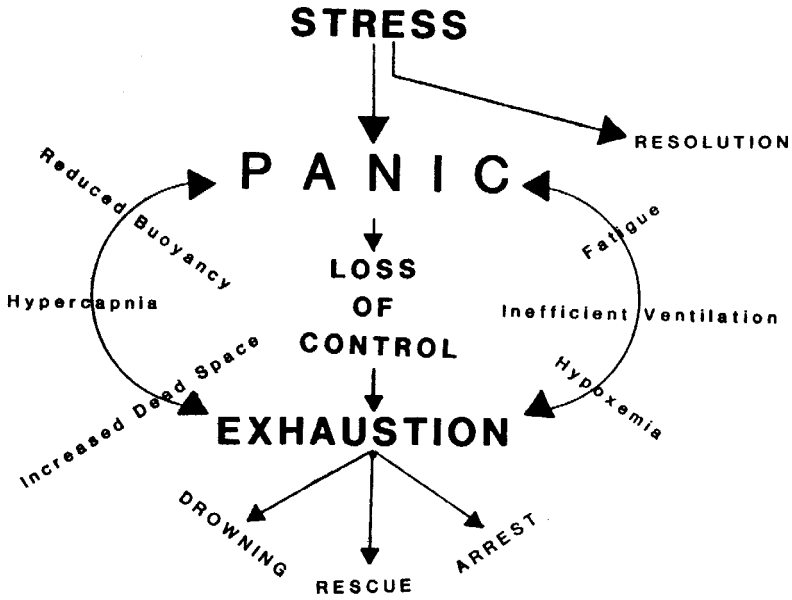
In the laboratory, studies disclose that rats drown much faster if their whiskers are shaved than if they remain intact. The whiskers do not aid in swimming. They act as tactile receptors. Apparently, the constant sensory input via the whiskers keep the rats from panicking.[3]

The unifying factor in all these situations is that once the stress reaction is initiated, the victim will continue to decompensate even if the cause is removed. This is due to a positive feedback mechanism commonly referred to as a "vicious circle".

In water-related accidents the mechanism is analogous. However, two important differences exist. First, the three components of the stress reaction (alarm, resistance, and exhaustion) occur so rapidly that the victim is often unable to make suitable adaptations during the state of resistance. Second, the consequence of exhaustion in the water is drowning whereas on land the consequences may merely be collapse and unwillingness to continue the resistance stage.

TABLE 1 PROBLEMS ASSOCIATED WITH PANIC IN WATER-RELATED ACCIDENTS

PROBLEMS	UNDERLYING STRESSES
HYPOXIA, ANOXIA	Difficulty with breathing equipment; insufficient air supply through snorkel or regulator; gulping of water; forced submersion.
FATIGUE AND EXHAUSTION	Inability to cope with surf, tides, or currents; markedly negative buoyancy from equipment; prolonged swimming.
HYPOTHERMIA	Prolonged exposure (even in relatively warm waters); diving or immersion in frigid waters.
INJURIES	Encounters with marine animals; trauma from boats, surf, etc.
FRIGHT/FEAR	Sighting sharks, etc.; flooding of mask; aspiration of water; loss of vision due to water turbidity; separation from swimming or diving buddy.
MISCELLANEOUS	Entanglement in kelp; loss of equilibrium sense due to ruptured tympanic membrane, etc.



THE PANIC SYNDROME

FIGURE 1

AETIOLOGY

There is no specific cause of the panic syndrome. Virtually any situation that requires extra effort or is strange to the individual can lead to panic. In essence, panic results from the addition of a stress, be it physical or psychological, to the victim's status-quo condition. Failure to resolve the stress adequately during the stage of resistance can result in panic. Table 1 summarizes commonly observed problems and their underlying stresses associated with panic in water-related activities. It is likely that several of these factors, not always clearly defined, interact in the genesis of THE PANIC SYNDROME.

PHYSIOLOGICAL ASPECTS

Panic leads to a series of predictable responses. Fatigue rapidly develops because of the increased energy demands associated with struggling during the resistance stage of the biological stress reaction. Ventilation may become inefficient because of the increased respiratory rate and decreased tidal volume associated with the victims "loss of control".

A rapid, shallow breathing pattern develops. The result is a relative increase in the respiratory tree dead space. Hypoxemia, hypercapnia, and dyspnoea, occur. These contribute to the victim's fatigue state and intensifies the state of panic. A secondary consequence is a reduction in buoyancy because the lungs are no longer maximally inflated with each inspiration. Swimming movements become inefficient due to fatigue and loss of control. When working at maximum energy levels, exhaustion occurs in only a few seconds, even in the well conditioned individual.

In summary, an unresolved stress leads to panic. The resistance stage of the biological stress reaction rapidly leads to exhaustion especially in the water. Indirectly, an inefficient ventilatory pattern develops with several secondary consequences. This leads to the positive feed back mechanism, ie. the vicious circle depicted in Figure 1.

CONSEQUENCES OF PANIC

If the process continues, one of three alternatives occur. The victim may become so exhausted that he can no longer maintain his head above water in order to breathe air or, if diving, keep the regulator or snorkel mouth piece in place. Aspiration of one mouthful of water at this stage may lead to unconsciousness since the brain's oxygen supply is already marginal due to hypoxaemia. One need only recall the Strokes-Adam Syndrome or vasovagal syncope episode to appreciate how significant a moment's interruption, in the brain's oxygen supply can be. Once the diver loses consciousness, aspiration of water and drowning occur unless the brain's oxygen supply is restored.

Second, the extreme energy output during the resistance stage of the stress reaction may lead to cardiac arrest. This is especially true in the poorly conditioned individual and/or the person with underlying cardiovascular disease.

Third, should the victim be resuscitated or the vicious circle interrupted, survival ensues.

SYMPTOMS

The symptoms associated with panic are those of sympathetic nervous system activation - ie. a "fight or flight" response. They usually appear precipitously since exhaustion can occur in a matter of seconds in the individual forced to exert himself at a maximal effort. Symptoms include a rapid, shallow breathing pattern, dilated pupils, facial pallor, and terror stricken faces. Swim movements are feeble as the victim often struggles to climb out of the water as a drowning man grasps at a straw. At this point the victim has lost all control. Actions are irrational. Such simple corrective procedures as floating, utilizing buoyancy control devices, or even slowing the breathing rate are overlooked.

CASE REPORTS

The following case reports exemplify the variety of situations in which panic can occur in water-related activities:

Case 1

A novice diver experienced difficulty making her first surf passage with SCUBA gear. She panicked when a wave crested over her head. Immediately, she pulled off her mouthpiece and struggled hysterically to keep her head above water. When the instructor reached her, the victim was exhausted and unable to talk. Her pupils were widely dilated, and she looked terror stricken. The instructor inflated her vest and towed her out of the surf zone without incident.

Case 2

A strong swimmer, but relatively inexperienced SCUBA diver was making his first deep dive. Buoyancy was adjusted so that he was neutral on the surface. After an uneventful descent to the bottom (100 feet) the diver found himself "very heavy". His attempts to swim directly upward were futile and he began to struggle. He inflated his life vest without any noticeable lifting effect. He panicked. His partner recognized the impending disaster, released the diver's weight belt and initiated a gradual swimming ascent.

Case 3

An experienced Navy diver made a bounce dive to investigate the bottom in 30 feet of water. After his findings were reported, the boat was moved to another area. Rather than climb aboard the small craft, the diver held onto a bowline while the craft moved at slow speeds to another site. To conserve air, he replaced the regulator with his snorkel. The manifold of the SCUBA tank became entangled in kelp and the diver was pulled downward. Before he could signal for help or replace the regulator, the diver was so entangled in kelp that he could not free himself. He was exhausted in a matter of seconds from struggling and so entangled that he was barely able to hold the bowline and raise his head to breathe. A dive partner aboard the boat recognized the difficulty, freed the regulator mouthpiece and repositioned it in the diver's mouth. With his self-contained air supply now operational he let go of the bowline. The tension of the kelp pulled the diver ten feet under water. Instead of struggling he relaxed since he now had an air supply and floated uneventfully to the surface as the tensions on the kelp were eliminated.

Analyses of reports disclose that a full blown panic syndrome can manifest itself in a matter of seconds. In these examples, had the interception of the vicious circle by the divers' partners not occurred, the outcomes could have been tragic.

PREVENTION

THE PANIC SYNDROME does not lend itself well to emergency treatment, for it may only be a matter of a few seconds before the victim loses consciousness and drowns or suffers a cardiac arrest. This disorder must be prevented. There are no substitutes for safety, conditioning, and co-operation in water-related activities.

However, there is always that event which is unforeseen. When this occurs the vicious circle of THE PANIC SYNDROME must be interrupted before the victim's life is jeopardized. Merely thinking that something is wrong is sufficient reason to curtail activities, rest, and re-evaluate the situation. The following suggestions are offered:

1. HYPERVENTILATE - Breathe deeply in a controlled and deliberate pattern.

2. IMPROVE BUOYANCY - Release the weight belt, drop the catch bag, inflate the buoyancy compensator.

3. REST - Float on your back with your head out of the water; breathe the surface air directly.

4. RE-EVALUATE THE SITUATION - Determine why panic occurred, how it can be prevented, and a plan for completing the remainder of the water activity safely.

5. REASSURE YOUR PARTNER - The calming and confidence instilling effects of this cannot be over-emphasized.

TREATMENT

Appropriate emergency medical treatment for the panic syndrome victim who presents as a near drowning includes careful monitoring of vital signs. If hypoxaemia is present, administration of 100% oxygen and positive end expiratory pressure is indicated. Blood gas and central venous pressure monitoring are important. Serial electrocardiograms and chest x-rays are required.

Follow-up observations to rule out late complications such as aspiration pneumonitis and atelectasis must not be overlooked.

Finally, one should attempt to identify the events leading to the vicious circle and discuss them with the patient. Providing the patient with an understanding of THE PANIC SYNDROME and how it can be avoided in future water-related activities may be the physician's most important contribution.

SIGNIFICANCE

Water-related problems are significant to any physician dealing with emergency care of patients.[4] Virtually any person in the United States can be associated with a water-related accident by virtue of recreation interests, competition, swimming or diving. The following list of disorders associated with water activities can lead to unconsciousness in the water and may result in near drowning, drowning, and/or cardiac arrest.

TABLE 2

WATER-RELATED DISORDERS THAT CAN LEAD TO UNCONSCIOUSNESS

1. THE PANIC SYNDROME
2. SHALLOW WATER BLACKOUT
3. HYPOTHERMIA
4. INJURIES FROM MARINE ANIMALS
5. THORACIC SQUEEZE
6. NITROGEN NARCOSIS
7. OXYGEN TOXICITY
8. ANOXIA
9. CARBON DIOXIDE TOXICITY
10. CARBON MONOXIDE POISONING
11. AIR EMBOLISM
12. DECOMPRESSION SICKNESS

Drowning and near drowning are complications of one or more of these underlying problems:

THE PANIC SYNDROME is gradually obtaining the attention it deserves. It is probably the underlying cause of more deaths in water-related activities than all others combined. For example, panic was implicated as the significant factor in over 80% of the SCUBA diving fatalities surveyed in Los Angeles County in 1970.[1] In the Rhode Island reports panic appeared to be a factor associated with approximately half the SCUBA diving fatalities.[5]

The actual incidence of THE PANIC SYNDROME is not known for several reasons. First, there are no requirements to report non-fatal water-related problems. Since the victim usually recovers without residual medical problems or does not even seek medical attention, there is no way of knowing the frequency of non-fatal panic episodes. Second, fatalities associated with water-related activities are usually signed out as drowning, rather than as the underlying problem which led to drowning. As sophistication in reporting water-related accidents improves, the true significance of panic will be forthcoming.

CONCLUSIONS

Panic as a problem associated with water-related activities is becoming increasingly well recognised.

The panic syndrome conforms well to the biological stress reaction.

The consequences of panic in the aquatic environment are drowning, near drowning, and/or cardiac arrest.

Emergency medical treatment for panic is directed at controlling its complications.

Hence, the only real method of dealing with panic is to prevent its appearance or interrupt its vicious circle before the stage of exhaustion leads to irreversible damage.

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PROXMIRE'S GOLDEN FLEECE FOR "POT" DIVERS

US Senator William Proxmire awarded his "Golden Fleece" monthly citation late last year to the US Department of Commerce because they had spent about US$ 5,250 on a study to find out if smoking cannabis had a particular effect on divers.

It had been concluded that such smoking was "not good" for divers.

Presumably somebody in the Department of Commerce believed that those who smoke "pot" were open to reasoned discussion concerning risks; or it may be that so many US divers are taking "pot" that its effects need to be scientifically established.

Uninfluenced by such possibilities the Senator has again demonstrated his skill for drawing attention to more-in-it-than-meets-the-eye projects.

PROVISIONAL REPORT ON AUSTRALIAN DIVING-RELATED DEATHS, 1979

Dr Douglas Walker

Overview

Ten diving related fatalities have been identified as having occurred during 1979 in Australian waters.

There were two breathhold divers, six using Scuba and two with hookah air supply systems. Adverse water conditions were significant in four cases, narcosis and excessive weighting in one, and some degree of inexperience in all except two. These two suffered from misadventure, one being drowned by a crocodile and the other poisoned by carbon monoxide fumes.

Mention is made of the omission of Inquest Proceedings in two cases where the bodies were not recovered, though legal powers appear to exist to cover such events.

In one investigated incident the buddy was so little present that the police omitted to question him about the dive, while in another incident the buddy was at the same risk as was the victim whom he was attempting to aid.

Two Autopsy examinations were outstanding in that the pathologist involved paid special attention to the possibilities of barotrauma and air embolism, conducting the examinations with particular care, in one case obtaining an X-Ray before opening the body.

In two of the incidents hired tanks were being used.

The use of effective buoyancy vests would have improved the chances of survival in all of the Scuba diver fatalities : only one wore a vest and as this was of the CO type it was ineffective at the depth of the incident.

One victim remarkably took off his new Fenzy vest before starting his dive.

The general conclusion is that trained and experienced divers avoid dying in diving incidents which claim the lives of the inexperienced, including those newly certificated. This indicates that many diving fatalities are potentially preventable.

Brief Case Reports Case

BH 79/1

Four friends were on their annual fishing holiday at the opening of the crayfish season, a ritual followed for eight or more years, at their usual area of rocky coast. Three were line fishermen, the fourth was said to be “a good swimmer for his age, experienced in breath-hold diving”. He was aged 51.

On the critical day they decided to move some pots which had washed too close to the cliffs but realised that the sea conditions made it too risky to take the boat close enough in, so the diver member swam and retrieved one. He then returned with a rope to reach the remaining “ring” but was overwhelmed by the second of four large waves “that seemed to rise out of a calm sea”. The boat turned bow into the waves only just in time to survive.

The victim failed to surface, so the alarm was raised. By the time the police diving squad arrived the surge and waves had become too dangerous to allow recovery of the body although its position was known, and the two police divers placed themselves at considerable risk in freeing it from entangling kelp and towing it seaward to the waiting launch the next day. It was found in one of the numerous gullies in about twelve feet of water. The rescue divers deserve commendation for their efforts. Witnesses stated that the dangerous sea conditions should have been apparent to any experienced diver. Unfortunately this swimmer realised too late the overwhelming power of waves and surge over rocks, especially at the base of the cliffs; entanglement made his fate more certain.

Case BH 79/2

This unfortunate man was on holiday and was diving for crayfish with a friend, while his wife waited on the bank of the creek. The peaceful scene was shattered when he surfaced and screamed out, at the same time seeming to be hitting at something with his hand. He then seemed to be physically pulled under the water and was seen to be towed out and away from the bank. His companion started towards him initially but realised the danger of involvement with a predator of unknown size. An intensive police search was carried out and the body discovered in a creek approximately one and a half kilometres away, a little over six hours later. A large (3 metre) estuarine crocodile was seen nearby. It was later captured and destroyed. As crocodiles are territorial in habit it seems highly probable that the responsible animal was indeed caught. Autopsy showed that the victim’s left elbow had been dislocated as he fought to escape being dragged underwater. He had been wearing a wet suit and using snorkel and mask, about 30 m from the shore, when attacked at about 5.00 pm. Although local radio warnings about crocodiles had been broadcast these only advised caution, not avoidance of all swimming. This is the first recorded case, as far as is known, of a crocodile attacking a diver in Australian waters.

Case SC 79/1

The victim of this incident was certificated for scuba diving a year previously but had confined himself to snorkel diving subsequently. This is believed to have been his first scuba dive since his course. He was aged 60.

On this day he first made a short snorkel dive with his buddy, then both returned to the shore to kit up with the scuba tanks. He seems to have removed his wet suit top and his new Fenzy ABLJ, and possibly also left off his fins, for this dive. His buddy advised him to wear his Fenzy but apparently he declined, giving as reason that it was too uncomfortable.

The sea was choppy, the water only 10 to 15 feet deep and visibility poor. The two divers seem to have proceeded independently of each other, and

as a result the buddy (also certificated for one year) concluded his dive and returned to the beach unaware of his friend's fate.

The police obtained no statement from him, possibly in the realistic belief that he had no awareness of the actions of his "buddy". It is thought that the victim was swimming to a nearby wreck, in shallow water close to the shore.

He was seen by a witness on the beach to surface several times and then to float on his back quietly. After observing this non movement for 5-10 minutes the witness felt alarmed and started to swim out to him, but found that he was "out of condition" and in danger of getting into difficulties himself.

He therefore raised the alarm and lifesavers recovered the body, which no longer had any weight belt, tank or snorkel. The missing equipment was never recovered for examination being (probably) stolen before a search was made to recover it. It is thought that he would not have run out of air so soon after starting his dive.

The Autopsy did not show evidence of any heart attack, though "marked sclerosis of coronary blood vessels" was noted. The sea condition was described by the lifesavers as "good" but may have been too much for a person inexperienced with scuba equipment and used to the greater freedom of snorkel diving. It cannot be known whether he suffered anginal pain or whether some other problem induced him to ditch his equipment. His Fenzy could have been lifesaving.

Case SC 79/2

Few details are available concerning this incident. It is said that the victim was separated from other divers to swim after a turtle and was never seen again.

The dive base was a reef island and it is said that adverse weather conditions for both boats and divers had been declared, but as the body was not recovered there was no Inquest held into the proven disappearance and presumed drowning.

Though police inquiries will have been made into the matter, their reports are not available. In a newspaper report, the mother of the victim stated that her daughter had been advised against diving deeper than 3m because of her Asthma. It is hoped that an Inquest will be held at some later date. Diving experience - 3 years.

Case SC 79/3

In this incident the three divers had completed their dive on the seaward side of a reef which was connected by a jetty to the shore. The two less experienced divers were low on air when they climbed onto the reef, which was being washed by 3 foot waves.

The most experienced member, the only one wearing a buoyancy vest, decided to make his way along the reef to the ladder at the end of the jetty, the other two choosing to snorkel back to steps part way along the jetty.

While one was preparing himself to re-enter the water, his companion started his swim. By this time the "dive leader" had got onto the jetty and looked back. He saw the victim making his way on the surface and did not immediately realise that he was in any difficulty in the choppy water, taking his equipment off before noticing that the victim had lost his mask.

He shouted to the third diver, still on the reef, and dived back into the water.

The victim had ditched his back-pack and had his hands firmly about the quick release of his weight belt when reached. The belt could not be released (later check established that it was a wire type release, difficult to operate with cold hands). He appeared to be semi-conscious, and in-water mouth to mouth resuscitation was made impossible by the waves continually breaking over them, so the rescuer towed him back to the reef and, with assistance, got him back to and onto the jetty. Resuscitation attempts (EAR and closed chest cardiac compression), both on the reef and after 'raising onto the jetty, were unavailing.

The victim was aged 19 and this is thought to have been his fourth dive since taking a course a year previously. While one of the other divers, the one with the buoyancy vest, had several years' experience (and still had 1,000 psi air remaining), the remaining diver had only just completed a course (and was on reserve air when he reached the reef). It was found that the victim's tank still contained 650 psi air, the equipment was new and functioning correctly, and the weight belt carried 15 lb of lead.

It is probably that the victim felt overweighted for the water conditions which he experienced but was unable to drop his weights due to cold hands, design of the release and involuntary submergence. The use of the air remaining in his set, especially had he been wearing a buoyancy aid, could well have allowed him to complete his return to the jetty without experiencing any problems. This dive area has claimed a number of previous victims and misjudgement of ability in relation to sea conditions appears to be a major problem with such incidents.

Case SC 79/4

This club dive ended in disaster. It was a boat dive on a newly popular dive site, a spectacular series of drop-offs from an initial 10 m to a maximum of over 65 m but subject to strong currents and only short times of slack water. The buddy pair involved wore "twin 88's" and had a buddy line connecting them.

They completed their planned dive to 50m for 5 minutes and had begun to ascend when the buddy saw the victim having some problem with his demand valve. He tried to assist, pulling the cord on the victim's vest to activate the CO_2 cylinder. Either the unit failed to fire or the depth rendered the gas volume ludicrously inadequate, for the vest failed to provide needed buoyancy and the victim started to descend instead of making the desired ascent.

The buddy felt that he would blackout and that his own life was at great risk, so left the

victim (now unconscious?) on a ledge at 60 m and made a rapid no-stop ascent ignoring planned "stops" advisable for such dive profiles in order to raise the alarm. Several other divers made an immediate but unsuccessful search for the victim and later a surface search was made in hope that he had surfaced and been washed away unseen by those in the boat.

Because the body was not recovered no Inquest into the incident has been held to this date, a year later. Other sources of information have been used for the above report. It is thought that the dive was made without appreciating the dangers inherent in open water deep dives in the presence of strong currents. Cold, poor visibility, nitrogen narcosis and decompression sickness, are additional factors in such dives. There was no provision for in-water decompression stops other than the air remaining to each individual diver, and it is said that the initial surface concern was regarding DCS rather than the victim's out of air/ drowning risk.

An experienced diver familiar with this site suggests that "cave dive" techniques be employed and that careful dive planning is mandatory. The ascent "stops" can only be made on a weighted line so a line from this, or the anchor, to the diver is necessary if he is to find it for his ascent at the conclusion of his dive.

The victim is said to have used a throat spray before the dive because of headaches after and during previous dives. It is not known what type of buoyancy aid, if any, the survivor wore.

It is obvious that correct weighting, a submersible air pressure gauge and an ABLJ are basic requirements for safe deep diving, and the experience to recognise and plan for all likely risks.

Case SC 79/5

This fatality unfolds with some of the inevitable logic of a Greek Tragedy. The victim had almost completed his course, one lecture still remaining, but dive requirements completed. The group of five was led by one of the assistant instructors, though this was not part of the course, and he hired the tank for the victim. The dive shop owner was under the belief that a pool dive was planned, but the group intended to swim to a reef about 25 m from shore, a relatively shallow area.

The group entered the sea and were checked for air on, etc., when about chest deep. Shortly after starting the swim three of the group decided to abort their expedition because they found the water conditions too adverse. In fact the "dive leader" continued to the reef in the belief that all the others had returned to the beach, and he returned to the beach only after he completed his solo dive, unaware of the tragedy occurring in his absence.

The victim was seen to signal that he was in difficulties but the waves prevented his friends from reaching him from the beach. The calls for help attracted a board rider, who had initially thought that the victim was merely calling to his friends. He found it impossible to get the distressed diver onto his board, or to help himself greatly, and was unable to remove the diving equipment. The current washed them out over the reef and separated them for a while. However, with the aid of another board rider he eventually brought the victim back to the beach. Resuscitation was unsuccessful. The board riders deserve praise.

The plan was to snorkel out to the reef and it is thought he did not use his scuba. He had no buoyancy vest. It is reasonable to suppose that he would have survived had he worn a buoyancy aid and used his scuba air rather than persisting with his snorkel. He was aged 44.

The subject of the next lecture was to be the management of the many dangerous currents at this dive site.

Case SC 79/6

The exact sequence of events during this dive is unknown, for the victim was alone when death occurred. He was aged 28, an experienced freediver but untrained and inexperienced with scuba. This was probably his third dive, though a claim was advanced that he had received training and was experienced. His buddy had 20 dives experience.

The victim borrowed one tank and hired two more, the buddy supplying his own tank. They made a brief dive and then moved to another site to dive again. The victim mentioned some ear discomfort after this first dive but showed no reported difficulty in descending with his buddy to 30 feet at the second site. After about 10 - 15 minutes the buddy noticed that he was alone, so surfaced, took off his equipment and got into their boat.

As he saw no sign of his companion, he made a boat search of the area, but without success. He therefore went ashore and gave the alarm, then resumed his search. About half an hour later he located his friend lying on the rocky sea bed in all his gear. The body was brought into the boat, obviously lifeless.

The Autopsy showed no signs of pulmonary barotrauma (a chest X - ray was performed before the opening of the body), but there were a few air bubbles in the ascending aorta suggesting that some PBT did occur. There was a fresh haemorrhage noted in both middle ears and mastoid cells, an event likely to incapacitate a diver by the pain and vertigo produced. It is possible that otic barotrauma on the first dive might have predisposed to this problem but it is not known which was worn by the victim, which by his buddy. They contained 790 psi and 2,500 psi so it is reasonable to think that the fatality occurred very soon after descent and that buddy contact had been brief. It is unfortunate that he was so easily able to borrow and to hire tanks, given that he was untrained and inexperienced with scuba.

Case H 79/1

Assistants on abalone boats naturally aspire to the better paid and more status satisfying position of Diver. On this occasion the diver acceded to the requests of his tender/sheller to

be allowed to dive after he had finished diving, for he was aged 21, claimed experience in New Zealand, and had seemed competent on several previous trial dives. After all, he said later, the water was only 25-30 feet deep. While the victim was underwater the water trap valve of the compressed air reserve tank vibrated loose and fell out with a loud noise and the air escaped.

This was such a common type of mishap that the Diver unconcernedly awaited the surfacing of the victim. When this did not occur ha replaced the valve and pulled on the hose, as no bubbles were seen ascending when the air supply was restored. The victim was not breathing and could not be resuscitated. He was still wearing the weight belt, with the hose attached. The compressor was said to be virtually new, though the hose was in poor condition. Apparently cut-offs and gear failure are an accepted occupational hazard and free ascents are commonly made when such occur, sometimes from 80 ft. The victim was insufficiently experienced to accommodate to such diving conditions and failed to appreciate the need to ascend when deprived of air.

Examination of the compressor unit revealed that sanitary napkins were used to dry the air, and were wet, so ineffective. The air was said to have a “bad taste” but was not apparently, tested for purity.

Case H 79/2

Abalone divers have a reputation for tolerating poor working conditions and the acceptance of “dirty air” by this diver contributed to his demise, though unique additional factors were the immediate critical inputs into the diving situation. The victim was a professional diver aged 25, working from a small boat which contained the compressor and his tender/sheller. The divers and assistants lived on a larger boat, which carried several such dinghies.

His routine was to send up his net full of abalone by parachute, indicating by line whether he wished to remain down or to move to another site. This morning the bag came up after about 15 minutes. To the surprise of the dinghy boy it only contained 20 instead of the usual 140 abalone, so he line signalled to establish whether the diver wished to try another place. As he appeared to get a reply meaning the diver wished to remain down, he returned the bag and waited a further 10 minutes in a certain degree of uncertainty. He took the occasion to contact divers in another boat and they noted bubbles ascending but got no line call reply. The air line was used to pull him to the surface.

His equipment was on but the regulator was out of his mouth. The immediate belief was that he had been attacked by a shark and had stayed down for fear of one, but no such attack had occurred.

Investigation established that he was experienced (he had survived compressor pieces blowing out) and tolerant of “dirty air”, for several months previously another diver had used his compressor and refused to use it again because of the impurity of the air it supplied. He had mentioned headaches after diving on recent days, suggestive of carbon monoxide contamination. Test running the compressor on land showed excessive presence of Carbon Monoxide, but not sufficient to explain the observed blood saturation of Carbon Monoxide of 68%, a lethal level, following a short exposure at 30-40 feet depth. More detailed consideration of the events of the dive provided an explanation. The sea was calm and there was probably little wind (witnesses differed on this). The little aluminium dinghy was anchored in a current and kept stern into this current by running the outboard motor. There was a piece of loosely fitting tube over the inlet of the compressor and this could easily have been pointed towards the exhaust of the outboard, sucking up the fumes. The regulator was found to contain foreign matter sufficient to impair its function, another indicator of the maintenance standards for this hookah unit.

Discussion

There is nothing to suggest that those who died were in any significant way different from the majority of their fellow divers, save in the outcome of their dives. The critical factors operating in their dives were probably present in many other dives which did not exact such drastic penalty. It is hoped by detailing the circumstances and identifying the most probable adverse factors it will make it possible for others to recognise disadvantageous aspects of their personal diving techniques, which they can then eliminate or at least modify. It is noteworthy that trained divers who have acquired some experience do not figure in this role of victims, as far as present information goes, unless they put themselves at special risk. No person wearing an ABLJ died, while absence of any effective buoyancy aid proved a critical disadvantage to several. Water power is clearly a force of importance capable of leading to the death of surface divers without buoyancy aids. Two divers had air at the surface but failed to use it, a lethal error in rough conditions.

Dive planning is always important, particularly for any club diving a deep area subject to currents. Consideration must be given to the adequacy of the training and experience relative to the planned dive. Keeping in mind Murphy’s Law, consider water conditions (cold, visibility, waves, currents the problems of safe exiting/retrieval of divers, dive discipline, correct equipment buoyancy vests, contents gauges, lines, etc.), correct weighting of divers for depth, and preparedness for emergency situations. It is not possible to institute underwater stops unless adequate air is available and a fixed line is used. Narcosis, cold and decompression sickness must be expected possibilities with deep dives. Divers need to have knowledge of emergency procedures, the ditching of the backpack not being advisable or appropriate in most circumstances as a priority action in a panic situation. Buoyancy aids give a surface diver time for calm consideration of his problem. Naturally an entangled tank requires removal ... if the buddy is not there to give assistance. To use a “crook” hookah denotes careless diving habits which are indefensible.

The fact that two fatalities occurred while using borrowed or hired tanks highlights the anti-social effects of allowing the inexperienced to use scuba other than under carefully controlled circumstances.

Solo diving, and separation from one’s

buddy, appears to adversely effect safety by reducing the changes of assistance in the vital early moments of some crisis.

Medical factors may incapacitate a diver unexpectedly, immediate assistance being vital for survival. The medical conditions noted in this series (coronary artery disease, middle ear haemorrhage) might not be fatal if the victim receives immediate assistance. The history of asthma in one victim raises ethical and legal considerations which will not be discussed here.

In brief, those at greatest risk are the inexperienced, diving alone without buoyancy vests or contents gauges in environmental conditions beyond their ability to manage.

Acknowledgments

This report would not have been possible without the interest and assistance of many persons and groups, and in particular the generous and continued assistance of the Attorney-General's and Justice Departments in every State, and the Coroner in the Northern Territory. The valued assistance of the Water Safety Councils, in NSW and South Australia in particular, and the National Safety Council is gratefully recorded. Detailed reports by individual divers has been of decisive importance in several cases. The AUF and FAUI are thanked for their continued interest and assistance.

Project Stickybeak

Readers are requested to support this research and thereby assist further raising the safety record of diving. Any type of diving-related incident however minor may hold clues to safer diving. No problem can be remedied until it has been recognised, no improvement occurs unless the information is shared. All information supplied is treated as confidential concerning the actual persons involved. Please write to:

Dr. Douglas Walker,
PO Box 120,
NARRABEEN NSW 2101

THE CORONIAL INVESTIGATION OF "SKIN-DIVING" FATALITIES IN NEW ZEALAND

Dr PRJ Lewis

I have recently reviewed the New Zealand skin-diving fatalities for the period 1961-1973 (*NZ Medical Journal* 89:472-475) and found major deficiencies in the information made available to the coroners, on which they reached their conclusions. In only one case had an overall assessment of the facts been made by a skin-diving expert. The Coroner's Act states "The principle functions of a coroner shall be to enquire in accordance with the provision of this act, into the manner of death of any person in any case where this act requires that the death be reported to the coroner". It seems reasonable to interpret this as requiring the coroner to investigate why the incident occurred rather than merely how the death occurred. To state only that someone "drowned by skin-diving" leaves too many questions unanswered. Why should these fatalities be investigated in such a way? I see two main reasons. First, to establish the factors that contributed to the fatality, and second that we may learn from the mistakes of others. These lessons can be incorporated into instruction programmes leading, hopefully, to safer diving practices.

The following 21 case histories illustrate the varied critical factors that have been identified in this series.

Case 1

This 50 year old had been a scuba diver for 2 and a half years and was thought to be competent. He was crayfishing with a buddy in 12m of water from a boat in calm conditions. All was well until he indicated that he was going to surface with a sack of crays. The buddy watched him ascend and then as he started to follow he saw the sack of crays come down. He recovered the sack and on reaching the surface saw the deceased face down in the water just below the surface. Frothy blood dribbled from the mouth. The rescuer dropped the deceased's weight belt and mouth to mouth resuscitation was given whilst towing the deceased to the boat, but to no avail. No buoyancy compensator was worn by the deceased. The equipment does not appear to have been checked following the incident. The postmortem showed signs of drowning and patchy atheroma of the coronary arteries with almost complete occlusion of the anterior descending coronary artery. It was concluded that death was a consequence of the coronary artery disease.

Cardiac arrhythmia or myocardial infarction are especially hazardous when they occur in the water. If buddy contact had not been broken at the time of ascent, it would have been theoretically possible to prevent drowning. The outcome would then be dependent on the severity of the cardiac arrhythmia or infarction.

Case 2

This 51 year old was a newly qualified diver and a member of an New Zealand Underwater Association club. He was diving with a buddy at an off-shore island from a boat. They had a shallow dive for 15 minutes, after which they surfaced and had lunch in the boat. One hour later they dived again for 25 minutes in water 10m deep. The deceased gave a signal to surface which they did together, and they found that they were 30 metres from the boat. The sea was quite choppy and the deceased was having difficulty in breathing.

The buddy had lost his own snorkel and both

divers were swallowing a lot of water. The buddy told the deceased to hang on to his tank and then started towing him back to the boat. After 10 metres he noticed the deceased had disappeared. Several other divers in a nearby boat were asked to assist. The deceased was found half an hour later in 5-6m of water with his weight belt still on. Artificial resuscitation was attempted but to no avail. No comment is made whether a buoyancy compensator was worn. The cylinder and regulator were borrowed and later testing revealed 1.95 litres of sea water in the cylinder and no air was present. There was considerable corrosion.

Sea conditions were not really appropriate for a newcomer to the sport. He was ill-equipped without buoyancy compensator, snorkel or contents gauge. He ran out of air and so could not use his regulator on the surface. The weight belt was not ditched.

Case 3

This 18 year old was an experienced snorkeller but had only two previous scuba dives. He was diving with two companions (T and W) at the Poor Knights Islands. After snorkelling a while they descended with aqua-lungs and spearguns to 45 metres, spending 5-10 minutes at that depth with a total time in the water of 20-25 minutes. "W" felt nitrogen narcosis coming on and signalled that he was going back to the surface. He moved up 10 feet and then the victim swam to him indicating that he was low on air and also wanted to surface. The victim grabbed "W"'s arm. Thinking the victim needed air, "W" handed his mouthpiece to him. A rush of bubbles obscured "W"'s vision and he then blacked out, dropping his speargun. He recovered on the surface without his mouthpiece in his mouth. In the meantime, the victim had diver deeper to get the dropped speargun. During this time "T" was also not feeling too good and had started to surface with "W". On seeing the victim dive deeper for the speargun, "T" went after him. The victim at this stage was attempting to turn on his tank valve (which was already on) and did not have his regulator in his mouth. "T" offered his regulator to the victim but this was refused. "T" then released the victim's weight belt and aqualung and then had to surface himself. In the meantime, "W" had changed to a new tank and when "T" told him the victim was still on the bottom, "W" descended and searched for him in vain. "T" then went down again and found him after a total lapsed time of 10 minutes. The postmortem showed signs of drowning and frothy blood in the right heart and pulmonary arteries. The cerebral and mesenteric arteries also contained air bubbles.

The deceased and far too inexperienced for such a dive and ill-equipped, not having a buoyancy compensator or contents gauge. The loss of buoyancy, nitrogen narcosis and exhaustion of air supply meant death was almost inevitable. The intra-vascular gas found at autopsy reflected the length of time the body was under pressure and did not indicate decompression sickness. It was indeed fortuitous that his companions did not suffer from decompression sickness in their search for the deceased.

Case 4

This 27 year old was a weak swimmer and it was noted at a club training session one week prior to death that he was not happy with some of the tests. Over the few days prior to the dive, he was not feeling well. He went diving from a boat with two buddies. Gear was checked before entering the water but it was noted that the deceased's fins were not being worn. Buddy "A" and the victim went in and a strong current carried both of them away from the boat. Although they knew there was a current present, they did not appreciate that it would be as strong as it was. The buddy was able to make it back to the boat and he then swam a line to the victim who was then pulled back to the boat by buddy "B". He was left hanging on the back of the boat. Buddy "B" then swam the line to buddy "A" and they both returned to the boat. They then noticed the deceased on the bottom in 6m of water with his weight belt off and the waist strap of the tank harness undone. The tank was dangling from the neck by the regulator neck strap. A buoyancy compensator was worn but the cartridge had previously been removed. On recovering the body, it was seen that the face mask was half full of blood. The postmortem showed signs of drowning and the blood in the mask was a consequence of pulmonary congestion.

In view of his previous lack of competence, the deceased should not have been diving in a current. The pre-dive gear check was inadequate and drowning was directly attributable to the absence of fins and consequent difficulty in staying on the surface. The reason the deceased let go of the back of the boat is not known. Possibly he attempted to take off his belt prior to getting into the boat and on letting go of the back of the boat he sank. Another possibility is that he was so weakened from the previous ordeal that he did not have the strength to hang onto the boat. His buoyancy compensator should have been inflated by himself or his buddies.

Case 5

This 47 year old had no previous diving experience at all. He purchased new equipment five days prior to his death. The only instruction he had was given by a salesman who knew very little about the sport himself.

He went to search for a sunken mooring in a harbour at 7.00 pm in darkness. He was wearing a wetsuit and weight belt but no fins. An assistant was present in a 2 metre row boat. An 8m length of rope was attached from the diver's arm to the bow of the boat. The depth of the water was not recorded and water conditions were calm. After one minute, the diver surfaced and floundered around. His assistant pulled him half into the dinghy which then became swamped. He was unable to support the

diver who was at this stage limp and unconscious. When the body was recovered a short time later, the rope was seen to be tangled around his leg and the weight belt had not been released. No postmortem was performed

The sale of diving equipment by ignorant salesmen to ignorant people is to be deplored. Presumably death was due to drowning as a consequence of lack of buoyancy although pulmonary barotrauma cannot be excluded.

Case 6

This 29 year old had been a snorkeller for four years and had used scuba for 4 months, having taught himself. He and a buddy went crayfishing from a boat leaving the skipper topside. His first dive was to 9m for 10 minutes after which he surfaced and fiddled with his regulator as it was giving trouble. They then moved to another dive spot and 30 minutes after the last dive they descended again. After 10 minutes at 12m, the deceased surfaced with a large cray and swam to the boat. He seemed OK but did not take an oar that was offered to him by the skipper. He sank beneath the surface and bubbles were seen coming up from where he sank. The buddy dived but he immediately ran out of air.
After changing tanks he dived again but due to a leaking regulator took in water and surfaced in a distressed condition. Once he had regained his composure and fixed his gear up, he wanted to dive again, but the skipper thought it unsafe and left the site to get help. When the body was recovered a short while later, it was noted that the 6 kg weight belt was separate and the dry suit was torn. The diver recovering the body could not bring it to the surface until after he had removed the scuba. A post mortem showed signs of drowning. The navy tested the regulator and found it to be functioning satisfactorily. 990 ml of sea water was present within the tank.

Death appears to have been a consequence of loss of buoyancy after the dry suit was torn, presumably from the crayfish or a rock. Water would have entered the tank only after exhaustion of the air supply. A buoyancy compensator could have averted death. If the buddy had not exhausted his own air supply and had his own equipment in good condition he may have been of more use to the victim.

Case 7

This 29 year old was able to snorkel to 21m but his scuba training and experience were not known. Although he had eight hours sleep the previous night, he had been drinking and was described as “full as a bull”. He dived with a buddy to 30m, both taking spearguns with them. The buddy experienced shortage of air and thought that his reserve was jammed. Consequently, the deceased commenced buddy breathing although the initiation of this was delayed due to a neck strap around the regulator. About half way back to the surface, the deceased seemed to hold on to the regulator longer than normal. The buddy therefore tried his own regulator and finding it to be working, signalled all was OK. The deceased however persisted in holding out his regulator to the buddy who then moved rapidly to the surface in panic without purging his compensator. At that time they had been down 10 minutes. The deceased never reached the surface and fifteen minutes after the incident, another diver found the body in 30-40m of water. The postmortem showed signs of drowning with haemorrhagic fluid within the lungs.

The exact reason for drowning is not known although the possibility of air embolism occurring was high. It is indeed tragic when a would-be rescuer loses his life and the potential consequences of improper buddy breathing technique are obvious.

Case 8

This 24 year old was inexperienced and dived with an inexperienced buddy in search of mussels 20m from shore in 6m of water. Both surfaced after 5 minutes and then dived again. While underwater, the buddy touched the deceased, pointed up and surfaced. He returned to shore where he had trouble getting back on the rocks. The deceased then surfaced, shouted for help and appeared in difficulty. Help was summoned and the victim was found half an hour later lying on his back on the sand 40 metres out. Two weight belts and an empty sugar bag were found 3m away. Mouth to mouth resuscitation was unsuccessful. The postmortem showed signs of drowning. When the equipment was tested, 1200 psi of pure air remained in the tank. At an equivalent depth of 6m, no air could be sucked through the demand valve and operation of the purge caused a continuous air flow that could not be stopped. Disassembly revealed the rubber of the tilt valve seat protruding through the hole that the spindle of the tilt valve went through. The first stage was severely corroded.

Death seems directly attributable to an inexperienced person using equipment that had not been adequately maintained. Since the buddy was also inexperienced (his first ever dive), it is doubtful that a rescue could have been effected even if buddy contact had not been broken.

Case 9

This 30 year old was on a club dive trip. He entered the water and stayed on the surface for 10 minutes before descending with his buddy. The buddy had to surface because of difficulty clearing his ears but the depth when this occurred was not recorded. A few minutes later the buddy saw the victim floating in white water with his compensator fully inflated. Rescue attempts were hampered because the weight belt could not be released during the rescue procedure and the charter boat could not move closer to the victim as a result of nearby rocks and no dinghy was available. A resuscitator was used for 2 1/2 hours

without success. It was commented that "oodles of blood were coming out of his mouth". The postmortem showed signs of drowning and a very slight tracheal stenosis, a consequence of a previous automobile accident. An excellent airway was still present however.

Rescuers described "oodles of blood", but no mention was made by the Pathologist as to its possible source. Although drowning in the white water may have been the only problem, it is more likely that air embolism occurred either following a normal ascent, a panic ascent or accidental inflation of the buoyancy compensator.

Case 10

This 23 year old had no previous scuba experience and borrowed equipment from a person who himself had limited experience. The lender warned the deceased to have an experienced person with him. He ignored the advice and dived alone in a murky river dressed in corduroy trousers, football jersey and a 7kg weight belt. A non-diving companion was with him. After three minutes he surfaced struggling. His companion attempted to rescue him but was nearly pulled under and so the victim had to be left. The body was recovered 1 hour later in 4m of water at which time the weight belt was not attached. A post mortem showed signs of drowning.

Amurky snag-ridden river and an ignorant overweighted novice seem the perfect combination for death.

Case 11

This 37 year old was a heavy smoker and thought to be a safe diver, who usually dived in less than 6m of water. He had been diving for two years. He went diving with two buddies in a boat for the purpose of crayfishing.

He remained in the boat while the other two dived. When they had finished he put on gear and went down by himself. The tank and regulator had been used earlier in the day for 10 minutes by one of the others who commented that the mouthpiece was leaking. The deceased passed a remark about showing the others how to do it. Water conditions at the time were choppy. When he did not surface, a search was attempted for 10-15 minutes, but then abandoned since there was too much tide movement for safety. The body was found the next day with all gear on at a depth of 33m. He was not using a buoyancy compensator, depth gauge, reserve system or contents gauge. The autopsy showed signs of drowning. Testing of the equipment revealed a defect in the regulator's second stage non-return valve which allowed water to enter. The air was at 0 psi and analysis revealed a carbon dioxide concentration of 0.7%.

It seems likely that the victim ran out of air at 33m with his mental facilities impaired as a consequence of nitrogen narcosis and excessive inspired carbon dioxide. The lack of a buoyancy compensator would have meant increased effort to maintain a neutral position and consequently increased carbon dioxide production. A deep dive when alone, inexperienced and inadequately equipped is courting disaster.

Case 12

This 33 year old was thought to be a strong swimmer who was used to mask, flippers and snorkel. He had used scuba only twice before. Although healthy, it was reported that he was a heavy drinker and suffered from migraine and high blood pressure. The night before the fatality he was drinking until 2 am and on the morning of the fatality, he had only a cup of coffee for breakfast. He was suffering from a headache, shaking badly and admitted to feeling weary. He was diving alone for mussels from a boat in which companions were present. His equipment was borrowed and he used a 3 kg weight belt without a wetsuit. No buoyancy compensator was worn. He was diving in 1m of water initially. He then moved into 5m of water before surfacing and indicating that he was in trouble. A companion from the boat told the deceased to drop his sack of mussels and he then swam over to him. In the meantime, the deceased had removed his mask and regulator and sank. He surfaced again and the rescuer tried to undo the weight belt but both of them began to sink. At this stage the victim was limp. The rescuer had to let go of the victim who then sank. Help was summoned and the body recovered 1 1/2 hours later in 9-12 m of water. Resuscitation was attempted for one hour. It was noted that the waist strap of the tank harness was over the top of the weight belt and no air was left within the aqualung. The equipment was later inspected and found to be functioning properly. Water conditions at the time were calm although a current was present which pulled the victim and rescuer away from the boat. The victim had consumed two beers with his lunch. A postmortem showed signs of drowning and a blood alcohol level of 105mg%.

An inexperienced, intoxicated, overweighted diver who ran out of air while diving alone.

Case 13

This 28 year old had been scuba diving for two years. He was diving from a boat near rocks with a buddy in 12m of water. The purpose of the dive was spear fishing, but it was not specified whether the victim had a gun. The buddy surfaced and climbed onto rocks after completing his dive which he had classed as easy. He saw the victim on the surface 75m away and he appeared to be carried seawards by a strong current, although he did not appear to be in difficulties. The buddy signalled the boat to come around to give assistance, but on looking back the victim had disappeared. The body was never found.

The circumstances leading to death are not known, but certainly the lack of buddy contact and probable failure of the victim to drop his weight belt were factors.

Case 14

This 48 year old was said to be experienced. He scuba dived alone while his four boat companions line fished. After a bottom time of 20 minutes, he surfaced over 100m from the boat and waved. The anchor was pulled up and the boat headed towards him. When 30m away, the deceased went under the water for a few seconds and then came up and gasped before going under again. One of the boat members grabbed the anchor rope and dived down and found the victim head down close to the bottom in 5-6m of water. He grabbed the victim and then his companions pulled them to the surface by means of the anchor rope. The regulator mouthpiece was not in his mouth at this time. He was given external cardiac massage and EAR and after 15 minutes began breathing strongly. However breathing ceased two minutes later. The deceased was using twin cylinders which were completely empty. The postmortem showed signs of drowning.

Another death while diving alone and running out of air.

Case 15

This 37 year old and his female buddy were diving for paua from the shore. The depth and duration of the dive were not recorded. When the sack was full, the victim and buddy signalled to each other that they would go ashore. The buddy surfaced 20-30m from shore and the deceased surfaced 10m from shore and began using his snorkel. The buddy noted that he was near a rock and told him to move away but he said something about the bag and appeared to get caught up in the kelp. The buddy went over to him (which only took a few seconds), pulled him clear and noticed that he was limp and unconscious. She immediately removed his weight belt and tank, the latter being difficult. After a considerable struggle, he was brought ashore. Water was squeezed out of his chest and then EAR was applied for 20-30 minutes to no avail. The sack had been tied to his wrist and he had cut the string with his knife. The post-mortem showed signs of drowning.

Death was undoubtedly due to drowning due to entanglement as a result of tying the bag to his wrist. When he realised he was in trouble he should have reinserted his regulator mouthpiece. The short interval between entanglement and unconsciousness illustrates that drowning may indeed occur very rapidly, a fact not widely known.

Case 16

This 40 year old was a well known and very experienced diver who commonly dived deeply with disregard for proper decompression procedures. The fatality occurred during a diving convention. The victim was buddied with his brother and together they descended to 75m. The brother ascended because his decompression meter showed it was nearing time to go up. The duration under water was not specifically recorded but was probably at least 10 minutes. The victim ascended later and met up with his brother at 16m. At this time the victim's decompression metre was well into the red danger mark. The victim ran out of air and then used his brother's tank. By the time the victim reached the boat, he was unconscious. He was transported to the Naval Decompression Chamber arriving there five hours after the accident. Death occurred four hours later. The postmortem showed congestion of the organs with no evidence of intravascular gas.

Death appears to be due to either severe decompression sickness or air embolism subsequent to surfacing after running out of air. The decompression treatment may well have altered the postmortem findings and accounted for the lack of obvious intravascular gas.

Case 17

This 33 year old had one year of scuba experience and was diving with two others from two boats looking for crayfish. The maximum depth of water was 23m. He ran out of air at 8m after a bottom time of 30-35 minutes. The two other divers remained underwater two minutes longer and when they ran out of air they ascended. The victim was seen to surface by companions in the boat who noted that he sank, came up again, raised his arm and then sank again. The boat anchor was unable to be raised and so the warp was cut to enable a search to begin. A surface search was unsuccessful. No below water search could be carried out since all scuba tanks were empty. The body was never recovered. Two weeks prior to the accident, the victim collapsed but did not see a doctor. The day prior to the fatal dive he said he thought he had sunstroke. However, he went out that evening returning home at 10.30 pm.

The cause of death cannot be ascertained. Air embolism as a result of a free ascent, inhalation of water due to choppy surface conditions, or medical illness are all possibilities. All three divers used their air up completely. Not only did this probably lead to the death of the victim, but it precluded underwater search by his companions. Buddy contact was broken. If it had been maintained tragedy may well have been averted. If a float had been attached to the anchor warp, then it could have been thrown overboard and so save time before initiating the search.

Case 18

This 37 year old was experienced and had dived all over the world. The victim was diving from a boat where water visibility was poor. Surface conditions were not recorded. The victim complained of headache prior to diving, which

cleared up after one hour of snorkelling. He then scuba dived with a buddy but buddy contact was lost in 9m of water due to the poor visibility. The buddy continued diving for a further 15 minutes and then surfaced. While the buddy was in the boat, he saw the victim 150m away on the surface for 30 seconds. When the buddy looked the other way, the victim disappeared and was never seen again. A search was made for air bubbles unsuccessfully. The water was 18-26m deep in the area the victim was last seen. The victim was wearing twin tanks and a buoyancy compensator and submersible pressure gauge. A spear gun was also carried. The body was washed up ashore 12 days later. The tanks were still attached with the left tank valve open and the right tank valve jammed closed. The weight belt was missing. There is no record of the equipment being tested following the tragedy. The body was decomposed too badly for postmortem to be of any use.

The significance of the headache prior to diving was not known. It is a pity the equipment was not checked following the tragedy. The right tank valve was jammed closed but it is not recorded whether air still remained within this tank and it is not known whether this jamming occurred prior to death or following death, as a result of contact with the bottom. Although the contents gauge registered zero, there may have been air left at the time of death with free flow occurring following death. Buddy contact was broken.

Case 19

This 19 year old was regarded as fairly experienced. He was diving for crayfish with a buddy from a boat in rough water with 1m visibility. The divers went initially to 27m and then ascended to 23m. While searching for crayfish at this depth they became separated. After completion of the dive and when the victim had not surfaced, an extensive search was carried out. A third party in the boat had noted previously that the victim's bubbles had not been moving from near a rock. The rough surface conditions and poor visibility hampered attempts at finding the victim. A large number of crevices were present in the area which raised the possibility of entrapment in a cave. The buddy made an adequate search without success and resulted in his DCP entering the red zone. The body was finally found 11 days later. The body was badly decomposed and only one glove and one flipper were present. Another flipper was nearby. The victim was not wearing a DCP or contents gauge or depth gauge. The Body was badly decomposed and determination of the cause of death was impossible. There was no evidence to suggest a cause other than drowning.

The factors leading to death are unknown, although entrapment is possible. Continuation of buddy contact may have resulted in a happier outcome.

Case 20

This 30 year old was thought of as an "experienced diver" by his buddy who had dived with him five times before. A party consisting of the victim, his diving buddy and two girls went to a bay on a deep fresh water lake by boat. The two men dived and at 38m the victim signalled to his buddy that he wanted to surface. He appeared alright. The duration of the dive was not recorded. Both divers surfaced but did not keep in sight of each other. When the buddy surfaced the victim was not to be seen. The two girls in the boat reported that the victim had called for help on reaching the surface and after floundering he sank. The buddy then searched for the victim going down to 38m until his air was exhausted. The boat then returned to shore and picked up another diver and tank. They then returned to the dive area and the third diver searched to no avail. The buddy then put on a tank and searched to 60m until air was exhausted. The body was recovered the next day at a depth of 53m. No comment was made as to whether the victim was wearing a knife or buoyancy compensator or depth gauge or contents gauge. At the time the body was recovered, the weight belt was still present. 1200 psi of air remained in his tank. The postmortem showed air within the venae cavae and right heart. The lungs were voluminously inflated and microscopy showed alveolar rupture.

The reason for the rapid ascent and probable pulmonary barotrauma with air embolism is not known. The buddy certainly put himself at risk of getting decompression sickness in his attempts to find the body.

Case 21

This 42 year old was using scuba gear in order to inspect a boat mooring. He was diving alone but had his wife in a row boat accompanying him. He had a piece of chain around his body for a weight but it is not known how much this weighed, nor whether a wetsuit was worn. No details are available as to other articles of dive gear that he was wearing, if any. On the day of the fatality, water conditions were calm but the depth is not known. He dived for an unknown period of time and then surfaced beside the row boat. According to his wife he then let go and swam underwater. He then appeared to surface and shoot backwards at speed for about 30m and shout out "Jesus, Sweet Jesus". He then lay face upwards with one arm out of his diving harness. His wife then dived into the water and pushed him to shore where he was noted to be groaning. The rocky shore made attempts at resuscitation difficult. Examination of his equipment showed no remaining air and leaks from both first and second stages of the regulator. Rust was present within the tank. The postmortem showed signs of drowning.

The wife's description of the victim shooting backwards at speed for about 30m defies analysis. The victim undoubtedly ran out of air. Whether he then inhaled water or whether he suffered air embolism on surfacing cannot be ascertained. Although postmortem revealed changes of drowning, this may have occurred when being taken to shore. Since the mechanism of the fatality is not known, it cannot be ascertained whether EAR in the water would have altered the outcome. The cause of death

was certified as drowning from using faulty diving equipment which is probably incorrect, since he was able to continue diving until his air ran out.

The following factors contributed to the 21 fatalities:

1. Running out of air: 9 divers. In addition attempts at rescue were thwarted in three cases because the buddy had also run out of air.
2. No Contents Gauge: Only 3 divers were recorded as having a contents gauge. 10 were known not to have one. Presence or absence was unknown in 8.
3. No Buoyancy compensator: 6 divers were recorded as having a buoyancy compensator. 9 were known not to have used one. The situation was unknown in 6.
4. No Fins: 2 divers did not wear fins.
5. Faulty Equipment: In 6 cases, the tank or regulator were defective although in only one case did this lead to death.
6. Lack of Experience: 2 had nil, 8 had 0 - 1 year, 8 had 1 - 5 years and 1 had over 5 years. In two cases, experience was not known.
7. Lack of Fitness: This factor was inseparable from adverse weather conditions which contributed to 3 deaths.
8. Nitrogen Narcosis: contributed to 3 deaths.
9. Training: previous training was not recorded in 16 cases.
10. No Buddy: 7 had no diving buddy, 12 of the remaining 14 were separated from their buddy by at least 6 metres at the time of the mishap.
11. Air Embolism: only 1 confirmed case, although in 7 others there was a strong possibility.
12. Alcohol: 2 divers had blood alcohol levels of 25 mg/100 ml and 105 mg/100 ml respectively.

It is of interest that 14 deaths were in less than 15 metres and only one was greater than 45 metres.

DISCUSSION

It is apparent that greater information would have been available concerning the critical factors had the Coronial Investigation sought to obtain the following basic details.

1. Pre-Dive Data

   a. Diving experience and whether the victim was suitably experienced for the type of dive that proved fatal.
   b. The type of training and whether the diver was taught by a recognised diving school.
   c. The events of the previous 24 hours, with specific reference to the amount of sleep, whether alcohol was consumed and any evidence of medical illness.

2. Diving Equipment

   a. A complete inventory of the equipment worn.
   b. Testing of the first and second stage regulators and of the tank with comment made as to whether any fault detected could have been contributory. Too often equipment has been described as faulty but its relationship, if any, to the fatality ignored.
   c. Gas analysis in every case. Even an “empty” tank contains air at ambient pressure that can be sampled and analysed.

3. Environment

Weather and sea conditions, visibility, water temperature, currents, all contributed to the fatalities recorded in this paper.

4. Dive Profile

A complete description is required with particular attention paid to the time at which various events happened. This is the most important piece of information that can be given to the coroner and the events of the dive must be described in detail. It is this information that needs critical appraisal by a skin-diving expert and preferably such an expert should have the opportunity to question appropriate witnesses to insure all the relevant facts are brought out.

OBITUARY

Ian Plant, UK Cave Diver

The tragic death of Ian Plant has been reported from the UK. This occurred in late March while he was attempting to plot the link between Bull Pot and Aygill Cavern, Cumbria, dye tests having shown the continuity of water filled passages.

He was a very experienced cave diver and had helped to save the lives of dozens of trapped potholers during his career. He was closely connected with Oliver Statham and Geoff Yeadon, who last year made the world record cave-dive at Keld Head.

Cave diving is a speciality of extreme risk, requiring the highest qualities of skill and self control.

Readers may like to re-read past articles on this subject. (*SPUMS Journal July-Dec 1977, Jan-Mar 1978)*.

FISH POISONING CAUSES CONCERN IN QUEENSLAND

NC Gillespie

Reports of fish poisoning in south-east Queensland recently have focussed attention on the fact that the State has a ciguatera problem.

Since August 1976 more than 200 cases of ciguatera - the name originated in the Caribbean but the illness has been recorded throughout tropical seas - have been reported to the Queensland Health Department, almost all of them in south-east Queensland.

Most of these cases involved fish caught in coral reef areas near Fraser Island or a little further north. In May last year at least 32 people on the Gold Coast became ill after eating fish sold to a wholesaler by an angler who had been fishing near Fraser Island.

Even though ciguatera has long been known to be endemic in northern Queensland, this type of fish poisoning was virtually unheard of in the south of the State. Not surprisingly there has been extensive media coverage of these surprise outbreaks.

Consequently the fish-buying public has become aware of a certain danger associated with eating fish, and ciguatera has thus become a problem for both the health authorities and the fishing industry in Queensland.

It would be reassuring to be able to give some guarantee of safety when selling reef fish. However, ciguatera toxin is odourless, tasteless and impossible to detect using any simple test, other than feeding suspect fish to sensitive laboratory animals such as cats.

Furthermore the incidence of ciguatera in fish in Queensland is low enough that random sampling of catches would not be really effective.

Another possible solution would be to outlaw certain species commonly involved in ciguatera poisoning. The red bass *(Lutjanus bohar),* chinaman fish *(Symphorus nematophorus)* and paddle-tail *(Lutjanus gibbus)* are already widely recognised as poisonous and cannot legally be sold in Queensland.

However the South Pacific Commission recognises a wide range of other fish also caught in Great Barrier Reef waters as high risk species, including: spotted trevally *(Caranx melampygus),* one-spot sea perch *(Lutjanus monostigma),* coronation trout *(Variola louti)* and a wide range of cods, parrot fishes, surgeonfish, barracuda, moray eels and trigger fishes.

Add to this the fact that most common reef species have been linked with ciguatera at some time or other and it can be seen that decision-makers would have quite a problem isolating ‘risk species’.

And many of the fish causing ciguatera in south-east Queensland have been narrow-barred mackerel, which has been implicated in only a handful of the ciguatera cases in northern Queensland. Any steps to outlaw the sale of this fish would destroy one of Queensland’s major fisheries.

Even if there was legislation governing the sale of certain reef species, it is unlikely this would prevent their being marketed. Already a substantial proportion of all fish caught on the Reef, including spanish mackerel, are unloaded as blocks of frozen fillets, most of them skinned. Separation and individual identification of these blocks of white-fleshed fillets would be a mammoth task.

An additional problem is the so-called ‘back-door’ trade in reef fish. It is known that a large proportion of the total catch is marketed illegally through channels other than the Queensland Fish Board. Substantial quantities are also exported direct to interstate markets.

One of the advantages of living close to the Great Barrier Reef is the opportunity it offers private individuals to catch a feed of fish.

Following the May school holiday period last year there were 60 cases of fish poisoning stemming from ciguatoxic fish caught by anglers between Maryborough and Rockhampton.

Angler-caught fish seem to be more often involved in ciguatera presumably because is most cases larger portions are eaten and portions of the same fish may be eaten as a part of successive meals. There is little that can be done to control reef-fishing by private individuals or their fish-eating habits.

It is quite apparent then that there is little chance of the public being protected from ciguatera poisoning by regulation or controls in the catching or marketing of reef fish.

It must be accepted that connoisseurs of reef fish will always have to face the slight risk of ciguatera poisoning. The recent attention of the media in southern Queensland does not change that fact. Ciguatera has always been endemic in north Queensland.

The fish-eating public there accept the slight risk without question. Over-reaction to ciguatera and exaggerated publicity can cause necessary and irreparable harm to the fishing industry and mar the overall enjoyment of the Great Barrier Reef by the public.

Nevertheless, the severity of the symptoms (which often lead to hospitalization) mean that the public must be informed and warned about ciguatera and steps taken to discover more about it.

The embarrassing fact is that little information can be provided about ciguatera in Queensland, other than some advice on how to minimise the risk and a description of the symptoms.

Little knowledge of the level of incidence is available, other than the Health Department records (limited to southern Queensland), and information accumulated by the Queensland Ciguatera Fund (a private, non-profit organisation) and two interested doctors in Townsville and Cairns.

Nothing can be said about the distribution of toxicity with species or in various areas at present and in general scientific input into the ciguatera problem in Queensland has been minimal.

Consequently, part of this information gap needs to be closed by a short-term survey of doctors and public to at least establish the level of incidence of ciguatera, species involved and suspect areas.

A recent discovery by Japanese workers in collaboration with those in French Polynesia of the toxin elaborator, a dinoflagellate named *Gambierdiscus toxicus* and the subsequent culture of this organism have laid the groundwork for possible long term research programs in Queensland.

It is now possible to identify possible problem reefs by the presence of the dinoflagellate producing the ciguatoxin.

If the toxin can be produced by culturing the organisms, a host of biological and clinical studies are possible which could explain the function of the toxin, its accumulation in fish and the mode of action of the toxin in humans.

Work could also be started which could lead to a simple means of detection of the toxin.

There is considerable justification for such a study. There are a number of universities, and Government and private laboratories, capable of the basic investigations required to answer some of the questions on ciguatera.

However it will not happen without adequate funding. Salaries have to be paid and equipment purchased.

It is possible that because of the tourist and fishing potential of the Great Barrier Reef, a special fund for ciguatera research could attract donations from groups with some commercial interest in the region.

Certainly ciguatera research could produce considerable practical benefits, not only for the fishing industry in Australia but also for tropical island communities where the threat of fish poisoning hinders the harvesting of a valuable protein source.

Tips to avoid poisoning

Ciguatera, because it has no obvious effect on fish flesh, is virtually impossible to detect.

However for connoisseurs of reef fish:

* never eat large portions of large fish, and in fact try to avoid eating large fish at all;

* never eat repeated meals from the same fish, particularly if the ‘tingling’ warning signs are apparent after eating the first meal;

* never eat the viscera of reef dwelling fish (they are all slightly toxic);

* do not be lulled into thinking ciguatera only occurs at certain times of the year - there are seasonal variations but no guaranteed safe period; and

* never eat the flesh of red bass, chinaman fish, barracuda or moray eel.

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CIGUATOXIN TESTING WITH A MONGOOSE

Q. It was suggested recently (Sea Frontiers and Sea Secrets) that pieces of fish flesh be fed to a mongoose or a cat to test the fish for ciguatoxin.

Would it be advisable instead to feed the test animal a piece of the fish’s liver, which would be expected to concentrate the toxin?

Also, what quantity should be given to the test animal, without inducing needless illness?

A. While it is true that ciguatoxin will be concentrated in the liver of ciguatoxic fish, it is not a good test for ciguatera to feed a piece of liver to a test animal, for the following reasons.

First, the muscle of the fish is the site of the lowest concentration of ciguatoxin, and detection of a high level of toxin in the liver would not automatically signal a toxic level in the muscle. Thus, while a toxic liver might not be eaten without danger of illness, the flesh of the same fish could still be edible.

Second, fish livers filter out and store all kinds of toxic materials, including pesticides, heavy metals, industrial pollutants, and natural compounds: therefore, if the test animal becomes sick from eating the fish’s liver, it will be difficult to determine if the cause was ciguatoxin or some other toxic material.

Sensitivity to ciguatoxin varies among people, and the same may be true for cats and mongooses.

Therefore, in regard to the quantity of fish flesh that should be fed to the test animal, perhaps the best suggestion would be a piece that is the same proportion to the animal’s body weight as a dinner-sized portion would be to the body weight of the prospective diner.

If the test animal is given too small a piece, it may not show the symptoms that would affect a human who had eaten a large meal of the same fish.

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SURVEY OF CIGUATERA POISONING

What is Ciguatera?

Ciguatera is a form of food poisoning occasionally caused by eating certain fish species associated with coral reefs. The poison has been identified as coming from a microscopic organism called a dinoflagellate which is usually attached to algae growing in reef areas. The toxin is transferred to plant eating fish and thence to larger predatory fish, where it is accumulated.

What are the Symptoms?

The symptoms are noted within two to twelve hours after eating the fish. Severe cases may occur earlier and mild cases may be detected later when alcohol is consumed. The symptoms may include:

* tingling sensations and numbness often in fingers and toes but also around the lips, tongue, mouth and throat (89% of cases);
* burning or pain of the skin on contact with cold water (87% of cases);
* joint and muscle pains with weakness and/or cramps;
* nausea, vomiting, diarrhoea and/or abdominal cramps (50% of cases);
* muscular weakness, headache, fatigue, fainting;
* extreme itchiness, exaggerated when alcohol is consumed;
* in severe cases, difficulty in breathing may occur.

It is always best to seek medical attention at the first onset of symptoms to exclude other conditions such as botulism.

What Type of Fish Cause Poisoning?

Any large fish is a potential danger if it inhabits coral reefs, but there is no hard and fast rule.

Ciguatera poisoning occurs sporadically and unpredictably. However, at present certain fish caught on the Barrier Reef, eg. the chinaman, the red bass and the paddletail are recognized as particularly dangerous and are not accepted for sale by marketing authorities. Occasional problems are encountered with coral trout, spanish mackerel, reef cod, barracuda, emperor, groper and surgeonfish.

Ciguatera victims are often anglers and their families, feasting upon a particularly large “catch”. The toxic fish is often the largest of the batch caught and is usually of the predatory type.

The presence of toxin, even in high concentration, does not alter the appearance, smell or taste of the fish. The toxin is not destroyed by cooking or freezing and there is no known culinary method for removing it.

Prevention

There is no simple way of testing for ciguatera but one method that may be used is to feed a sample of the fish to a cat. These animals are extremely sensitive to the presence of the toxin and should be observed for six hours before the fish is eaten.

At present, the only other way to minimize the risk of poisoning is to observe the following points:

* do not eat red bass, chinaman fish or those species which are known to be poisonous in your area;
* never eat moray eels;
* under no circumstances should the roe, intestines, liver or other viscera or reef fish be eaten;
* treat all oversized reef fish (over 10 kg) with suspicion and avoid if possible;
* eat only small quantities of reef fish at each sitting.

Treatment

Persons suffering from ciguatera poisoning should consult their medical practitioner. Information on the management of this condition is contained in “Dangerous Marine Animals of the Indo-Pacific Region” by Dr Carl Edmonds (Publisher: Wedneil Publications, 54 Schutt Street, Newport, Vic, Australia).

What is Being Done About It

Very little is known about the distribution of ciguatera poisoning in Queensland. A survey is currently being undertaken by Health Department and the Queensland Fisheries Service to gather information on the types of reef fish involved, areas where toxic fish are caught and the numbers of people affected each year.

If you or any of your friends develop food poisoning after eating fish please contact

The Officer in Charge,
Ciguatera Survey,
Post Office Box 5
Deception Bay QLD 4508
Phone: (07) 203 1444

KILLER WHALE FILM

“Medsea Films” of New Zealand have recently released the world’s first underwater footage of wild Killer Whales.

The producer-Underwater Cameraman was Simon Cotton, a SPUMS member. It is hoped that members in all countries will get the opportunity to see this film, which has already appeared on the New Zealand television.

JOINT RESEARCH ON CIGUATERA

Martin Bowerman

French, United States and Japanese laboratories, working in co-operation, have achieved very real progress in research aimed at combating ciguatera among Pacific Islanders.

J Laigret of the Louis Malarde Medical Research Institute on Tahiti, writing in the South Pacific Commission's *Fisheries Newsletter* last November, said a major result of this co-operation had been the discovery that the dinoflagellate *Gambierdiscus toxicus*, first identified in the Gambier Islands, was the basic cause of ciguatera.

A separate study in the West Indies had indicated that the same marine organism was probably responsible in all areas where ciguatera occurred.

Scientists were beginning to understand the environmental factors which caused *Gambierdiscus toxicus* to multiply from time to time, he said. Evidence indicated that an increase in the dissolved phosphate content of the sea was a contributing factor.

The two major aims of research at the Louis Malarde Institute - conducted in association with the South Pacific Commission Project on Fish Poisoning - had been to:

* monitor and control ciguatera outbreaks more effectively; and

* develop methods, or apply methods developed elsewhere, to directly assay ciguatoxin in fish.

Dr Laigret said an understanding of the chemical structure of ciguatoxin was essential for developing effective test methods for fish intended for human consumption.

Gambierdiscus toxicus was now being grown successfully in the laboratory but only one of the two major components of the toxin complex had been recovered in relatively large quantities. This was the water-soluble maitotoxin (MTX). However production of the more important pathogenic substance, the non-soluble ciguatoxin (CTX) has proved very difficult.

Development of a practical test for poison in fish would require a comparatively large quantity (several mg) of CTX in its purest form. This presented a major obstacle, unlikely to be overcome quickly. The Louis Malarde Institute was collaborating with Professor Yasumoto of Japan - under South Pacific Commission auspices - in a study of mechanisms of large-scale production of CTX in nature and in the laboratory; and of production of toxic fish extracts in quantity.

Many Victims

In the *Fisheries Newsletter* report, South Pacific Commission epidemiologist T Kuberski said several thousand cases of fish poisoning among the islanders were reported to the SPC annually. Many others would be unrecorded.

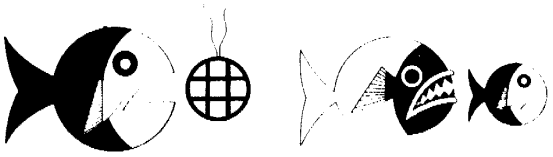
The incidence of ciguatera appeared to be rising and this might be related to changes in the environment. He said the micro organisms producing ciguatoxin appeared to increase rapidly in areas which experienced sudden, drastic changes, either natural or man-made. These could include unusually heavy rainfall, construction of a new wharf or a channel through a reef, wrecks, or dredging.

The process eventually increased the number of toxic fish, though recognised human fish poisoning might not be evident for months or years after the increase in the toxin-producing dinoflagellates.

TABLE 1 DISTRIBUTION OF 3009 CASES OF CIGUATERA FISH POISONING BY AGE AND SEX
(percentage shown in brackets)

Age - group (years)	Male		Female		Totals	
not recorded	107	(6.0)	59	(4.8)	166	(5.5)
0 - 9	77	(4.3)	68	(5.6)	145	(4.8)
10 - 19	131	(7.3)	140	(11.4)	271	(9.0)
20 - 29	398	(22.3)	297	(24.3)	695	(23.1)
30 - 39	478	(26.8)	311	(25.4)	789	(26.2)
40 - 49	338	(18.9)	178	(14.5)	516	(17.1)
50 - 59	172	(9.6)	111	(9.1)	283	(9.4)
60 - 69	72	(4.0)	49	(4.0)	121	(4.0)
70	12	(0.7)	11	(0.9)	23	(0.8)
	1,785	(59.3)	1,224	(40.7)	3,009	

He said: "The complicated manner in which the different varieties of fish became toxic has made recognition of the association between human fish poisoning and this small organism very difficult. Further studies are needed before all the facets of ciguatera poisoning can be understood."



3009 Tested

Between 1964 and 1977 T Kuberski, with R Bagnis of the Louis Malarde Institute and S Laugier of the SPC, collected clinical observations on 3009 people suffering from ciguatera on several South Pacific island groups.

TABLE 2 PERIOD OF TIME BETWEEN INGESTION OF FISH AND THE DEVELOPMENT OF SIGNS AND SYMPTOMS IN 3009 CASES OF CIGUATERA FISH POISONING

Period of Incubation (hours)	Number of Patients	Percentage of Patients
12	2,222	76.8
12 - 24	552	19.1
24	118	4.1
not recorded	117	

The study showed patients generally had neurologic symptoms such as numbness and tingling of the hands, cold objects feeling hot to touch, dizziness and difficulty in balance. Often they also had gastrointestinal symptoms - diarrhoea, abdominal pain, nausea and vomiting. Symptoms usually developed within less than 24 hours of eating the fish, and in most cases (76.8 per cent) within 12 hours.

The tables give details of the tests

TABLE 3 FREQUENCY OF CERTAIN SIGNS AND SYMPTOMS IN 3009 CASES OF CIGUATERA FISH POISONING

Sign or Symptom	Percentage of Patients with Findings
Numbness and tingling of hands	89.2
Numbness around the mouth	89.1
Burning or pain to skin on contact with cold water	87.6
Joint Pains	85.7
Muscle Pains	81.5
Diarrhoea	70.6
Weakness	60.0
Headache	59.2
Chills	59.0
Abdominal pain	46.5
Itchy skin	44.9
Nausea	42.9
Dizziness	42.3
Difficulty walking	37.7
Vomiting	37.5
Sweating	36.7
Shaking	26.8
Dental Pain	24.8
Neck Stiffness	24.2
Watery Eyes	22.4
Skin Rash	20.5
Pain on Urination	18.7
Salivation	18.7
Shortness of breath	16.1
Low Blood Pressure	12.2
Inability to move arms or legs	10.5

The study revealed significant differences in certain symptoms between Polynesian and Melanesian ethnic groups. This suggested either a difference in susceptibility or in the nature of the toxin in different Pacific areas. People who had been poisoned more than once in the past seemed to have more severe effects than those having their first case of ciguatera.

TABLE 4 DAYS IN BED FOR PATIENTS WITH CIGUATERA FISH POISONING. OUT OF 3009 CASES, 1013 (33.7%) WERE BEDRIDDEN

Days in Bed	Number of Patients	Percentage of Patients
1	161	27.2
2	218	36.9
3	91	15.4
4	40	6.8
5	30	5.1
6	13	2.2
17	6	1.0
8 or more	32	5.4
not recorded	422	

TABLE 5 BLOOD PRESSURE AND PULSE MEASUREMENTS IN 3009 PATIENTS WITH CIGUATERA FISH POISONING

A. Systolic blood pressure (mmHg)	Number of Patients	Percentage of Patients
Unobtainable	5	0.2
Less than 80	41	1.7
80 - 100	311	12.9
over 100	2,048	85.2
Not recorded	604	

B. Pulse (per minute)	Number of Patients	Percentage of Patients
Unobtainable	6	0.2
Less than 60	324	13.4
60 - 85	1,833	75.6
over 85	263	10.8
Not recorded	583	

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FOLK REMEDIES FOR CIGUATERA

Martin Bowerman

Pacific Islands folk medicine may be of help to modern science in finding a cure for ciguatera. But the research must be undertaken urgently because the encroachment of civilisation has meant the rapid loss of much traditional culture and lore.

This is the view of Phil S Lobel, a Hawaiian-based biologist with particular interest in coral reef fish. Recently he studied traditional medicine practised by the Gilbertese of Fanning Atoll in the Central Pacific Line Islands.

Writing in the July-August, 1979, edition of *Sea Frontiers,* published in Miami, Mr Lobel said that although folk remedies lacked scientific precision they were often developed through centuries of trial-and-error testing. Usually they had little value beyond reassuring the patient, but some did achieve genuine cures.

While on Fanning Atoll he had learned two basic local remedies for ciguatera and two for fish and jellyfish stings. Mr Lobel stressed that the effectiveness of the potions - normally kept secret and passed between generations of a single family - had not yet been medically proven.

In particular the ciguatera treatment might do no more than speed passage of contaminated food through the digestive system. On the other hand the potions might have valuable medicinal qualities - only thorough scientific testing could establish this.

Mr Lobel said the ciguatera remedies acted mainly to ease pain rather than to cure. A main ingredient of one was the stem of a young padina tree. The first part of the stem was cut and the section with the first set of leaves taken. The leaves were peeled from the stem yielding about a six-inch piece, from which the soft fleshy pulp was scraped into a bowl. The meat from half a green coconut was added to this, then the ingredients were mixed well and eaten to relieve minor ciguatera poisoning.

For more serious cases a concoction was made with the fresh buds of a breadfruit tree and coconut oil, Mr Lobel said. Five fresh terminal bud sprouts containing a white sap were plucked from a breadfruit tree. In a particularly severe case two buds could be eaten immediately to give some relief while the potion was prepared.

Three breadfruit buds were crushed and set aside in a bowl, he said. Coconut oil should be made by frying pure coconut milk squeezed from the meat of brown coconut. The meat was carefully scraped into a cheesecloth or a fine woven mat, and cloth and meat were twisted and pulled until all the milk was extracted.

Then the milk was fried in a shallow pan over a low fire. The frying milk must be stirred continually until after 15 to 20 minutes a clear oil appeared, mixed with a brown popcorn-like residue. The sweet brown residue was set aside for a treat.

For the medicine, a teaspoon of the oil was mixed with three crushed breadfruit buds. The patient ate this mixture at least once a day. The coconut oil could be prepared in advance and stored for several months but the breadfruit buds must always be fresh.

Rabbitfish (*Siganidae*), a good eating fish often caught in gill nets, can cause intense pain if its dorsal spines prick the skin. The people of Fanning Atoll treated this by removing the gut of a rabbit fish, squeezing it in a cloth, and applying the intestinal fluid directly onto the wound, Mr Lobel said.

Stings from stonefish *(Scorpaenidae),* fire corals and some jellyfish were more serious - stonefish had been known to kill people. The remedy was made from the root of the beach Naupaka *(Scaerola serica)* when in flower.

A juice squeezed from root scrapings was applied immediately and directly to the wound, which must first be slit open. The application would continue until the tissues were saturated. The pain, which normally remained intense for hours, was said to subside quickly after this treatment, Mr Lobel said.

He added: "Of the various folk medicines this one appears to have the most medical promise. It awaits for some researcher to examine its ingredients and test its effectiveness."

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PUBLICATIONS OF INTEREST

EMERGENCY ASCENT TRAINING
UMS Publication - No. 32 (EAT) 10-31-79

EFFECTS OF DIVING ON PREGNANCY
UMS Publication - No. 36 (EDP) 1-31-80

US UNDERWATER DIVING FATALITIES, 1976
Report to URI-SSR-78-12

The Emergency Ascent Training workshop started with the proposition, stated as fact by the five major diver training organisations, that such practice was recognised as being essential basic training. It was apparent that although some 'diving medicine' support existed for this proposal there were many who disagreed greatly.

The chief support appeared to come from those involved with University Diving, the contrary views being held by those likely to hear about the misadventures such as the URI group, the Legal advisers, and specialists involved with hyperbaric facilities. It was noted that there was uncertainty in the printed report as to whether some speakers were stressing the need for open water training or of open water emergency ascent training.

The Instructors, through Mr Hardy, seemed to wish to project a Crusading image, declaring "We have some very strong moral convictions about the people we are training. If we did not have these convictions, if it were only a legal issue, we would not be here; we would settle it with our attorneys and our insurance companies .... We are losing a certain number through ascent training and also losing others due to other problems in training. We could entirely eliminate our legal liabilities by getting out of open water training entirely. Morally, however, we cannot live with that, because we have lost a total of 80 people, 20 of them during ascent training (in 7 years)."

A more helpful introduction was made by Dr Lamphier when he said, "We will, among other things, be trying to decide whether or not it is all right to kill or injure a certain number of people to save a very uncertain number of others who might otherwise die or be injured in actual diving. In fact, I do not feel very confident that ascent training in open water adds a great deal to what we could accomplish with optimal classroom and pool training .... This training should not be required for certification by any group". During discussion suggestions were made concerning the type of pool training most safely applicable and a good case was made, it may seem, for the compromise method where the pupil swims the length of the pool while exhaling and thereby avoids the critical element of a rapid vertical ascent.

Dr Nemiroff summarised the dilemma thus:

"We are trying to train a skill for an emergency context that requires either a high degree of skill or overlearning or all three. In a true emergency, where the mind is not working and the body is not functioning the way it should, the emergency technique that would he best, would be one requiring absolutely zero skill, zero memory, and zero reinforcement. Therefore, I have no answer as to what the best emergency training technique is, but it seems to me we should strive for those that require minimum skill and minimum reinforcement and yet can still be considered valid exercises under the condition."

During the discussion Dr Harpur related his remarkable experiences with eight people "totally spaced out in panic because they had made a rapid ascent and were thoroughly expecting that they were going to drop dead despite the fact that some of these ascents were over an hour and a half prior to the time they arrived on our doorstep. They were terrified before they began and if there is any better way to get someone in a panic state, I do not know it. This is a big element we have to look at."

He also noted that there have been people in out-of-air situations who have chosen every possible action other than ascent, including swimming 25 feet deeper from the 50 foot mark (then finding the buddy couldn't give them air) or making a 50 yard horizontal swim to a buddy in 60 feet deep water.

Such instances really show the appalling standard of training some divers are given and in no way can be related to the argument concerning ascent practice, though seemingly reported as such.

Dr Lampbier disagreed with some who thought the possibility of lung damage should be played down, reminding those present that even a history, x-ray and clinical examination could not guarantee the total absence of lung dysfunction.

Lee Somers later reminded instructors that they were wrong to disbelieve in the possibility of lung barotrauma because they are unaware of any serious injuries in sport diving directly linked to emergency ascent training. He was aware of the limited number of cases reported in literature readily available to the sport diving community, but drew attention to cases documented by Nemiroff and Dircks, seen at a major midwestern medical centre.

He repeated with approval Dr Eric Kindwall's pool training method of the pupil ditching his gear and then swimming horizontally towards the shallow end while humming.

It was of significance that John McAniff, Director of the National Underwater Accident Data Centre, URI, stated bluntly "I submit that NO death from this type of training is the only acceptable record."

And John Wenzel warned of the legal risks should injury or death occur in association with training in emergency ascent, ending his warning thus: "Worse still, the jury is still out as to a scientifically reliable explanation for some of the injuries sustained due to free ascents. Legally, it is unwise to conduct such training activity when we don't really know what may happen and how to prevent it."

He suggested that a better answer for the future may be to re-examine the fundamental need for the skill in the first place.

One solution for an out-of-air emergency would be to have a 100% redundant breathing system as this would eliminate the need for free ascents: such a system is more easily defended legally, too.

"After all, sky divers have two parachutes, and most Judges think we are as crazy as sky divers."

Dr Charles Brown stated that the case for supervised air-venting ascents "seemed so obvious as to defy dissent." He seemed to blame incidents either on panic or over emptying the lungs and believed that discontinuance of training practice ascents would lead to increased fatal incidents. He quoted as support of the safety of such practice the BS-AC record.

Unfortunately he was incorrect because the figures for safe ascents were derived from the experiences of 36 members of the Kingston branch active 1956 -1961. These people made practice and urgent ascents because of their poor dive discipline (too interested in lobsters!) and poor quality equipment. The figures were averaged out for the club membership over these years, and extended to BS-AC membership numbers, and halved to make the probability of acceptability greater: they were then quoted in the BS-AC Diving Manual from year to year. Thus are myths born!

The BS-AC indeed has an enviable safety record, but for years Emergency Ascent Practice has been prohibited as a training course inclusion. In its place strict training and dive supervision was enforced. Commercial diving organisations, naturally, cannot be so generous with training time.

Notwithstanding all that was said, the Instructor Groups remain convinced of the moral correctness of their stance.

The Workshop on Pregnancy and Diving reviewed the conflicting evidence from animal experiments.

It was noted that it was important to use sheep as their placental circulation was a concurrent arrangement with the maternal flow, unlike that in the dog and rat.

The work by Bolton, Bangasser and others in seeking out information from the increasing numbers of women who dive was noted with approval, for in the human experience will be found the truth by those who seek. Luckily the problem is recognised now, before large numbers of risk situations have occurred.

The apparent increased risk of DCS by women as contrasted to men lends strength to the advice of the Workshop members that at present safety for both mother and baby cannot be predicted in the diving situation.

The URI report has the limitations inescapable from all investigations relying for the information input on a large number of uncontrollable sources. The better incident schemes become accepted, the better will be the chance that reports will contain all necessary critical details and therefore the greater the validity of conclusion which are drawn from the reports.

These three reports contain much information of interest, and incidentally illustrate significant differences in approach which reflect their management of the facts presented. The first report illustrates the apparent non-communication which occurs when people with fixed viewpoints meet, while the second shows that where fixed positions have not been taken there can be a useful reviewing of conflicting and inadequate data, with an implied commitment to further investigation of the subject.

The URI Report is the most recent available one of an ongoing investigation which is now gaining in sophistication, for the information is being progressively reworked, re-analyzed, and transcribed into punched-card format. Such data can now be examined by computer. There will always remain the problems of inadequacy of the reports themselves, which probably explains the continued equating of dive depth with incident depth: such a definition in Australian cases would have resulted in highly misleading conclusions so its use in the American series is regretted. Such factual reports are the necessary foundation for informed discussion of problems but suffer at present from the paucity of non-fatal reports available.

Now go and read these reports and decide for yourself whether you agree with what is written here.

COURSES IN UNDERWATER MEDICINE

The Diving Medical Centre will be running a course in Underwater Medicine in 1981 - Honolulu, June 2nd to 16th, 1981. First week in Honolulu, second week in the outer Islands.

For further details contact:
Diving Medical Centre,
6 Hale Road, Mosman, NSW 2088

PUBLICATIONS OF THE UNDERSEA MEDICAL SOCIETY

Emergency Ascent Training.
15th UMS Workshop, December 1977. RC Sampson and JW Miller.
Price $4.00 including postage.

The Effects of Diving on Pregnancy
19th UMS Workshop, November 1978. WP Fife.
Price $3.00 including postage.

Treatment of Serious Decompression Sickness and Arterial Gas Embolism.
20th UMS Workshop, January 1979. JC Davis.
Price $3.50 including postage.

These are available from:
The Undersea Medical Society,
9650 Rockville Pike,
Bethesda, Maryland, 20014,
USA

Prices are in US Dollars and a bank draft should be sent with the order.