SOUTH PACIFIC UNDERWATER MEDICINE SOCIETY
NEWSLETTER

"ARE YOU REPORTING FOR THE SPUMS MEETING?"

Vol. 1 No. 2

November, 1971

SOUTH PACIFIC UNDERWATER MEDICINE SOCIETY
NEWSLETTER 2/71.

CONTENTS

1. Editorial
2. Article from Skin Diver - How Far is Alone?
3. Case report - Orbital Barotrauma.
4. Hypoxia in Breathhold Diving.
5. Correspondence.
6. Bubbles.
7. Diving Doctor’s Diary.

1. Editorial

Since our last Newsletter there has been an encouraging number of replies and acknowledgments from those scientists and physicians interested in Underwater Medicine. Our membership totals 40 fully paid up members and a dozen or so who state that they will become members. It is now our responsibility to ensure that these members receive advantages and benefits from the Society. The imparting of academic information and the interchange of ideas are readily performed by this Newsletter, and we are anticipating some help from correspondents. Also of importance are associated social and financial factors. Our Secretary corresponded with the Department of Taxation regarding the possibility of deduction of finances for travel and meetings for those members of SPUMS interested in this. The result appears favourable, and is reported more fully in the correspondence section. Acting as President of the Society, the Editor approached the Postgraduate Federation of Medicine in an attempt to obtain affiliation with the Federation. This was also successful and the reply is to be found in the correspondence section.

The annual meeting for 1972 is to be held on the second Monday of June, for a period of five days. It is to consist of brief presentations from those members currently engaged in underwater research, or from members who are able to review the current world literature on some related topic. It is anticipated that a considerable portion of the day will be spent in practical activities and informal groups. As we all have an interest in diving and marine biology, it is anticipated that the site of the annual meeting will be suited for such activities. The sites proposed have included, in order of popularity, Heron Island, Norfolk Island, Fiji, Green Island and a Barrier Reef cruise. It is presumed that block bookings would be financially advantageous to all. It is also presumed that some members will desire to bring fiancees, wives and/or families. The final decision as to which venue is chosen will be made of Monday 29th November, when it is anticipated a meeting will be held at HMAS Penguin. As the final decision will be made by the number of votes, it is strongly recommended that any member of the Society who wishes to cast a vote, send this to either the Secretary or myself, prior to the meeting.

One change in this Newsletter format is the reproduction of an article from “Skin Diver”. In performing this act I have clearly shown my own prejudices, as the article so accurately expresses by

own beliefs.

This Newsletter, the last of the gratis issues, will be followed by a quarterly Newsletter, available only to the fully paid up members of SPUMS. A two dollar subscription, payable to Mr F Ashmore, Treasurer, C/- School of Underwater Medicine, HMAS Penguin, is all that is required to ensure this status. The subscription is valid for this financial year.

(CARL EDMONDS)
School of Underwater Medicine
HMAS PENGUIN
Naval PO Balmoral
NSW 2091

2. How far is alone?

by Paul J Tzimoulis

NEVER DIVE ALONE has long been regarded as the first and foremost safety rule of sports diving. You'll find this phrase etched into the pages of every scuba training manual and loudly preached at every new diving class. To quote from the text of 'New Science of Skin and Scuba Diving', training bible among YMCA instructors, the buddy system is defined as:

> "No individual scuba diver, regardless of proficiency or experience, should ever undertake a scuba dive alone but must in the interest of self-preservation be accompanied by at least one other similarly qualified scuba diver who has acknowledged and accepted the responsibility for the safety of his partner."

The seriousness of these words and the sobering consequences of disobeying them would seen self-evident.

And yet, when we look back over the underwater statistics for 1970, we find that an incredible percentage of divers DIED ALONE. Tom Ebro of the LA County Underwater Unit reports a total of eighteen people died in underwater mishaps within the Los Angeles County area during last year. Of that number, twelve (two-thirds) were alone at the time of their accidents. Statistics spell a powerful message.

How does one explain this sudden rash of rule-breaking? Why do ordinarily sane, qualified divers suffer from spells of unaccountable stupidity? Is not the NEVER DIVE ALONE rule spelled out?

Aside from those unfortunate divers who perished alone, there are hundreds more who still dive alone and happen to be lucky enough to survive. I say lucky because diving alone is a lot like Russian roulette .. play it for long enough and you are bound to lose. The growing disregard for the buddy system has reached frightening proportions and the 'house odds' are beginning to take their toll. Maybe it's time we try to discover why this basic rule is being ignored.

The first question which comes to mind is one of definition. Exactly how far is alone? If divers must pair up, what is the maximum distance between partners for safe diving?

To some people I know, the NEVER DIVE ALONE rule is satisfied by having two divers in the same ocean. But in most cases, divers feel they are conscientiously following the buddy system principle by simply staying within sight of each other. This is a fallacy, and quite often a prelude to disaster. Underwater visibility is not the determining factor for distance between buddies ... time is. For example, if you are diving off Cozumel and the visibility is 150 feet, it does not mean you're diving safely when your partner is 150 feet away. Should something go wrong, neither one of you could swim fast enough to reach the other in time. Effective buddy support and aid depends on quick recognition of the problem and fast action. Chances are you would never even notice if your buddy was in trouble from a distance of 150 feet.

What, then, is a safe distance between buddies? The British Sub-Aqua Club requires its members remain with 'touching distance' (six feet) of each other, while many American distributors unofficially recommend 10 to 12 feet as a safe distance. To compound the question even further, should that distance (if and when it's established) be decreased at greater depths? The deeper one dives, the greater the chances of an emergency and the greater the need for a buddy's prompt action.

Still another point which seems to have been overlooked is the purpose and responsibility of the buddy. Many divers operate under the misconception that a buddy's primary function is to supply emergency air when his partner runs out. Although running out is definitely on the list of underwater emergencies, the most dangerous threat is unconsciousness. A free ascent might solve the air problem, but only a buddy can bring you back alive if you should pass out. For this reason alone it would seem inconceivable that any diver would ever go into the water without a reliable partner.

And while we're on the subject of partners, it might do well to mention the importance of buddy selection. When you agree to go underwater with someone, you are literally placing your life in that person's hands, should an emergency arise. You should therefore be highly selective in your choice.

Another point not covered in most manuals is the procedure for 'taking the lead'. Buddy diving is a little bit like dancing .. one partner has to take the lead while the other follows. Obviously, if both divers attempted to lead, neither would be watching the other and they would eventually end up separated. Conversely, if neither took the lead, they would probably end up milling around the bottom and going nowhere. The matter of who is

going to be lead diver should be settled before entering the water. It becomes the responsibility of the following diver to track his partner, but the lead diver must not fail to look back periodically to make sure his buddy is still following.

One of the most crucial points in the NEVER DIVE ALONE code is the avoidance of shortcuts. Impatience can turn an innocent shortcut into a needless tragedy. Its those little things ... like popping over the side for a quickie dive to free a snagged anchor. We've lost a few divers this way. Another is that moment of frustration you feel upon discovering your partner cannot clear his ears, particularly after a long boat ride and an arduous task of suiting up. Don't abandon your buddy and barrel down to the bottom - go back to the boat and get another partner.

By now you should begin to get the picture. There's a lot more that goes into the buddy system than you'll find in most books. And we think it's about time the diving instructors of America considered rewriting those ancient scriptures. If the words NEVER DIVE ALONE are ever going to mean anything, if they are going to receive total commitment and respect, they must be full qualified, justified, and outlined in detail.

If we are to survive as a sport and as individuals, then NEVER DIVE ALONE must become an ironclad rule. Those three little words can save your life.

Reprinted from Skin Diver (March 1971)
by permission.

I will go further. Being able to view your partner up to the time of an emergency, is not enough. You must be able to reach him and assist him. And if you cannot reach him, you must be able to help him to reach you. You must also be able to stop him doing idiotic things such as ascending into boat propellers or other dangers. Communication is vital to his and your safe diving. Speaking underwater posses a problem, especially in times of emergency. Hand signals rely on an attentive audience and good visibility. How do you circumvent these difficulties? Simple, use a buddy line, length 3 metres, nylon, attached to arm band by an easy release shackle. Visibility is no longer a threat to the buddy concept. You won't have to spend half an hour looking for your buddy, or diving for his body.

- Editor.

3. CASE REPORT - ORBITAL BAROTRAUMA

Presenting Symptoms

A New Zealand diver descended to a depth of 20 feet, using a compressed air demand supply. At this depth he noted that his right eye was becoming swollen. He requested permission to ascend and this was given. By the time he reached the surface the right eye was completely closed, and was grossly swollen. Duration of illness - 3 hours prior to presentation.

Past History

This diver had received a 'black eye' during a minor altercation some days previously. He decided to dive with this, assuming that it could not in any way influence his performance in the water.

Clinical Features

The right palpebral fissure was completely occluded by the puffed up and slightly bruised eyelids. It was impossible to open these due to the swelling, and thus the cornea could not be observed. Palpation of the superficial tissues of the orbit revealed a surgical emphysema. These was no evidence of any pathology of the ears, nose or throat.

Treatment

The books on diving medicine didn't help very much for this one. We decided to administer 100% oxygen via a mask and bag, with a high O_2 flow (15 L/min). Within an hour the swelling had decreased greatly in size, the eye was able to be opened by the patient and there was no evidence of any ocular pathology involving the cornea or sclera. The patient himself stated that discolouration was no worse than when he had commenced his dive. O_2 was then administered for a further hour, with again further improvement in his clinical state, as shown by a further decrease in the swelling and a widening of the palpebral fissure. No diving for 2 weeks.

Follow Up Treatment

The patient was observed for a couple of hours and then dispatched back to his ship. He was advised that under no circumstances should he do any flying, and that if a recurrence of the swelling is noted, that he immediately start breathing 100% oxygen, as previously described.

Provisional Diagnosis

Facial barotrauma, involving the orbital tissues, with the probably source of entry of air through the integument damage ('black

eye'). It is presumed that during the dive there were some periods in which the pressure within the face mask exceeded ambient pressure by a slight degree, but sufficient to cause a passage of gas into tissues. The ascent produced an aggravation of the condition, in accordance with Boyle's Law.

Comments

1. There seems to be no limit to the variety of barotrauma.

2. Diving should not occur following any injury which produces a break in the integument. This is specially applicable where the integument is related to higher than ambient pressures, eg. following dental extractions and breathing with a positive pressure demand system.

3. 100% O_2, given through an efficient mask and without positive pressure, is invaluable for the removal of bubbles within tissues.

4. Recompression therapy is not required in barotrauma producing surgical emphysema, no matter where it may be, as long as there is no likelihood of mortality or serious morbidity.

4. HYPOXIA IN BREATHHOLD DIVING

- Bob Thomas

Any decrease in arterial oxygen concentration to 35mm Hg or less will induce some impairment of consciousness in a diver, and this may lead to fatal sequelae. The hypoxia which occurs in breathhold diving can become a real hazard under certain conditions, and these will be elaborated in detail.

Normally, the breaking point of a breathhold dive occurs when the P_aCO_2 reaches approximately 50mm Hg. If for some reason this threshold is increased, then the breathhold dive may be prolonged for a sufficient degree to result in a fall in P_aO_2 to a level which would then be unacceptable for consciousness. There are several ways in which the breaking point threshold may be increased, ie. the desire to breathe may be temporarily overcome by the use of these diversionary tactics. These include:

- swallowing
- diaphragmatic movements
- exhalation
- adaption
- volition (eg. spearing a fish)

The following sequence of events illustrates how hypoxia may develop:

1. Initial surface breathing, normal alveolar oxygen pressure (P_AO_2), P_aO_2, P_ACO_2, P_aCO_2.

2. With descent there is a decrease in lung volumes and a subsequent increase in the partial pressures of the contained gases (Boyle's Law). These higher partial pressures of O_2 then allow O_2 uptake by the blood to continue for a longer period than if breathhold had occurred at the surface. There is often an early mild desire to breathe during descent but this soon wanes. Transfer to CO_2 from the blood to the lungs is reversed across the alveolar membrane due to the increased P_ACO_2.

3. During the course of the dive (at depth) there is a continued removal of O_2 from the lungs, and its subsequent utilisation by the body. This may be increased by excessive demand as with strenuous exercise. Exercise also results in an increased production of CO_2 and lactic acid, and the P_aCO_2 equilibrates with the P_ACO_2.

4. As the P_aCO_2 and P_ACO_2 continue to increase during the dive, an increased awareness of nearing the breaking point of the

breathhold occurs, ie. there is an increasing urge to breathe. This sensation may be diminished by using such diversionary tactics as mentioned previously.

5. Relief from this sensation may also be obtained by ascent. This in effect will increase the lung volume, causing a concomitant fall in the P_ACO_2 and thence P_aCO_2, unless the ascent is very slow. However, the P_AO_2 and P_aO_2 also fall, and although the P_AO_2 may have been sufficient at depth to maintain adequate oxygenation, a fall to a lesser concentration may precipitate hypoxic loss of consciousness. This, in fact, does occur, and the loss of consciousness almost always has occurred during the ascent phase of the breathhold dive. If no loss of consciousness should occur during the ascent, then it may still become apparent immediately following surfacing, because the circulatory delay in correcting the hypoxia of ascent may be sufficient to allow further reduction of the P_aO_2 to an unacceptable level.

Hyperventilation prior to breathhold diving is a common manoeuvre used to reduce the P_aCO_2, and thence a longer time will elapse following the commencement of the dive until the threshold P_aCO_2 of the breaking point is reached. This increased interval, although allowing a longer submergence time, may also permit a dangerous degree of hypoxia to develop, such that either:

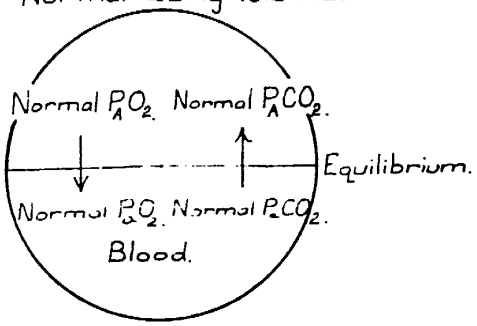
- loss of consciousness may occur well before the P_aCO_2 has increased to reach the breaking point threshold, or

- loss of consciousness may occur with ascent as discussed before, or

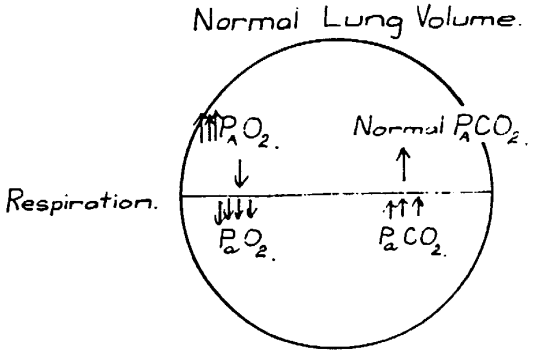
- ventilation may be stimulated by hypoxia whilst still ascending.

Consequently, the use of hyperventilation techniques should be avoided by all breathhold divers. Unfortunately a lack of significant statistical information does little to assist in warning both the trained and the novice diver of the inherent dangers.

The following diagram illustrates the development of hypoxia with and without prior hyperventilation.



(With prior hyperventilation P_ACO_2 and P_aCO_2 are greatly diminished. P_AO_2 is slightly increased)

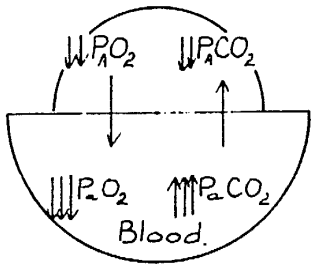


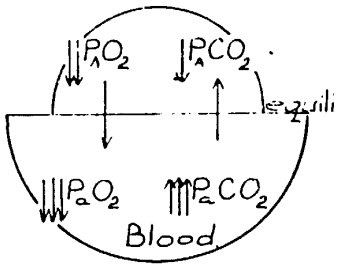
(Hypoxia may develop if there is some delay in increasing P_aO_2 (ie. circulatory.)

Surface

Increasing lung volumes.

Descent.



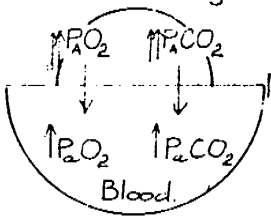


(Hypoxia may precipitate unconsciousness. This is more likely if P_aO_2 is greatly reduced by prolonged utilisation allowed by hyperventilation.)

Rapid Ascent.

Slow Ascent.

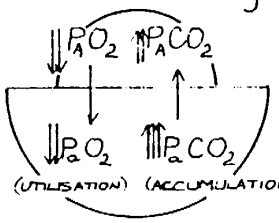
Reduced lung volumes.



Reversal of CO_2 flow.

Duration at depth.

Reduced lung volumes.



(With hyperventilation the accumulation of P_aCO_2 will need longer time before reaching threshold levels. This may permit a dangerous drop in P_aO_2.)

5. CORRESPONDENCE

The following letter has been received from the Australian Postgraduate Federation in Medicine:

25 Lucas Street
CAMPERDOWN NSW 2050

15 July, 1971

Lt Commander C Edmonds
President
South Pacific Underwater Medicine Society
C/- School of Underwater Medicine
HMAS Penguin
Naval Post Office
BALMORAL NSW 2091

Dear Lt Commander Edmonds:

The Executive of the Australian Postgraduate Federation in Medicine has considered the application of the South Pacific Underwater Medicine Society for affiliation and I have been asked to inform you that the Executive is pleased to accede to your request.

The Society is entitled to nominate one Representative Member of the Federation and I should be glad if you would let me have the name and address of your nominee at an early date.

Your representative will be eligible to attend the Annual General Meeting of the Federation which is held in Canberra each year about April/May. He will also be placed on the mailing list to receive our quarterly Newsletter and any other publications. If there are any items relating to your Society which you wish to have publicised to other affiliated members and societies this can be done through the columns of the Newsletter.

A copy of the Memorandum and Articles of Association of the Federation is enclosed for your information.

Yours sincerely
(sgd) Con Reed
FRACP
Honorary Secretary

Editor's Note: Dr Bob Thomas was subsequently invited to represent SPUMS at the Australian Postgraduate Federation in Medicine, and has discussed matters of specialist recognition with Sir Kenneth Noad at the Federation offices.

The following letter has been received from the Deputy Commissioner of Taxation:

21 Elizabeth Street
(Box 4197 GPO)
SYDNEY NSW 2001

Dr IP Unsworth
Honorary Secretary
SPUMS
C/- The Prince Henry Hospital
LITTLE BAY NSW 2036

24 August 1971

In reply please quote:
AF. 1865 Pt 4

Dear Sir

In your letter of 28 July 1971 you enquired whether expenses incurred by members in attending conventions or conferences conducted by the society would be deductible for income tax purposes.

At the outset it should be explained that a definite decision cannot be given in respect of claims that may be made by members attending future conferences. Advice given in advance of the actual circumstances may only be regarded as an expression of opinion and would not be binding on the Commissioner. Subject to these reservations the following comments may be of assistance to you.

The expenses to which you refer fall for consideration under section 51(1) of the Income Tax Assessment Act. This provision authorises a deduction for outgoings incurred in gaining or producing assessable income or are necessarily incurred in carrying on a business or profession for the purpose of gaining or producing such income, except to the extent that the expenditure is of a capital, private or domestic nature.

It is explained that, as a general principle, a taxpayer engaged in a profession or skilled occupation is entitled to an income tax deduction in respect of expenditure which he incurs for the purpose of maintaining or increasing his knowledge or ability in that particular profession or occupation provided, of course, that the expenditure meets the tests of section 51(1) outlined above.

On the understanding that members of your society can establish a nexus between the activities of the particular conference and their profession or occupation, deductions would be allow for expenditure incurred in attending the conference, for example, conference fees, travelling expenses, accommodation and cost of meals. Expenses that would be specifically precluded by the provisions of section 51(1) would include the costs of accommodation, meals, etc. of any member

of the taxpayer's family who may accompany him as well as other private expenses such as sight-seeing tours or social activities not connected with the conference business.

It would be appreciated if you would inform any of your members who intend to claim income tax deductions in respect of these expenses that they will be expected to maintain adequate records and furnish the necessary details in support of their claims.

It is hoped that the foregoing explanation satisfied your enquiry.

Yours faithfully,

(sgd) RR Gray
DEPUTY COMMISSIONER OF TAXATION

Subtended is a copy of the latest communication received from the Undersea Medical Society:

UNDERSEA MEDICAL SOCIETY

NEWS RELEASE

To: Dr C Edmonds Release Date: Immediately

The Undersea Medical Society was founded on April 10, 1967 in Washington, DC to aid the advancement of undersea medicine and its supporting sciences. One of its prime functions is the development of channels of scientific communications among all researchers dedicated to the acquisition of knowledge to insure man's safety under the sea. The Undersea Medical Society, recognizing the broad communality of interests among aerospace and hydrospace physicians and physiologists, is affiliated with the Aerospace Medical Association.

-END-

(sgd) E Joseph Wheeler Jnr
Chairman, Membership Committee
Undersea Medical Society
1150 Connecticut Avenue, NW
Washington, DC 20036

Phone (202) 659 1867

• BUBBLES

MISNOMERS

May I take this opportunity to stress to all members of the South Pacific Underwater Medicine Society, and Dr Terry Horgan specifically, that the official abbreviation for the society is SPUMS. not, as has been suggested, SPERMS.

Any correspondence sent to the editor, will not be answered if addressed to Dr Bubbles.

IS THERE AN RCC NEAR YOU?

The request was submitted to members of SPUMS during the last Newsletter, to supply information regarding any recompression chambers known to them. I wish to express my gratitude for the overwhelming response of the members. It appears that throughout the length and breadth of Australia, New Zealand and New Guinea (the latter with some justification) there are no recompression chambers.

- Editor

HYPERBARIC UNIT

Yes, it was stated in the last Newsletter that an article on the Hyperbaric Unit at Prince Henry Hospital would be written by Dr. Ian Unsworth. Unfortunately the article has not yet eventuated, and thus, unless he comes up with the goods, I am going to write an article in the next SPUMS Newsletter entitled "Is There a Hyperbaric Unit at Prince Henry Hospital?".

UNDERWATER PHYSIOLOGY SYMPOSIUM

For those with tax concession in mind, there is a UPS schedule for 1972 in the Bahamas, August 22-26th.

RIGHT HEATING

Why was a prominent ENT surgeon sent by a United States colleague as an emissary to the RAN School of Underwater Medicine to document literature on ENT problems in diving? Don’t they have a high powered computerised reference library service, bursting its binary seams, to do this very type of searching. The possible conjectures are of interest.

An epidemic of electronystagmograms has been reported at a certain harbourside resort. most of the aquatic guinea pigs expressed surprise to the point of panic, when the iced water hit their tympanic membranes. There is no truth to the rumours that the divers are logging the caloric tests as ‘time underwater’.

FAMOUS LAST WORDS

Les Graham - ‘I don’t usually have trouble with clearing my ears’.

Bob Thomas - ‘Look and I’ll demonstrate how this flameproofing works’.

Terry Horgan - ‘I will just add a little gasoline’.

John Manley - "I have hardly seen anything of Australia".

Pilot of Piper Aztec, when told that his starboard engine was belching smoke - ‘That’s nothing to worry about, it’s been doing that for some weeks’.

The consequences of a psychiatrist taking up Underwater Medicine are numerous:

Doc: Tell me what is your problem?

Patient: Well - glug, glug, glug (drowns)

Doc: Wrong bloody hat.

7. DIVING DOCTOR'S DIARY:

Diving Details. Semi-closed circuit rebreathing equipment, using 60% O_2 and 40% N_2, with a flow rate of 4 L/min (instead of the manufacturer's recommendation of 6 L/min), depth 60 feet, duration 60 minutes. The two divers were buddied together with a 10 foot line. Swimming speed 1.0 knots.

Both divers surface, one appears unconscious.

(CORRECT DIAGNOSIS - TOP MARKS)

On checking the diving information it was ascertained that the diver started with enough gas, at that flow rate, to last 90 minutes. There was no evidence of diving set malfunction, and the CO_2 absorbent used was of the CIG sodasorb type (the correct type for that equipment).

The buddy diver described the dive as uneventful until his companion lost consciousness. Loss of consciousness occurred during or immediately after ascent, and there was no evidence of any difficulties encountered during the dive, while at depth.

The unconscious diver was fortunate in that he wore a full face mask, preventing him from losing his mouthpiece during his comatosed state. The buddy diver was astute enough to ditch the man's weights and turn the mouthpiece cock so that the affected diver could breathe from the atmosphere once the surface was reached. He was then assisted inboard the diving tender and made a rapid and uneventful recovery.

(CORRECT DIAGNOSIS - TOP MARKS STILL)

The history, as obtained from the affected diver after his recovery, was that he had no difficulty during the dive, and that the reason for the ascent was to obtain a check bearing on his compass. He believes that he was actually on the surface and taking a bearing when he lost consciousness. In discussing the possible prodroma, there was no clearly defined history of these, but there was some suggestion that the diver was a little 'lightheaded', again while he was on the surface.

Perusal of the diving equipment after the dive did not demonstrate any mechanical fault or water contamination. Pressure testing of the supply bottles allowed the examiners to rule out the possibility of inadequate gas supply. Retrospective perusal of the diver's history reveals that he had been diving for four years as a professional, without any evidence of a personality disorder, anxiety state or neuroticism. He was considered a reliable and competent diver, well versed in diving techniques and practices.

(CORRECT DIAGNOSIS - TOP MARKS)

MEDIC: There seemed to be many obvious causes why this man should suffer loss of consciousness. The first question is whether he could have decompression sickness?

DIVING MEDIC: Not possible under these conditions. The maximum N_2 pressures in his gas supply was under 1.2 ATA, although this would have been increased slightly in his inspiratory mixture. Even assuming that the inspiratory O_2 dropped to an average of 20% during the dive, one would still not have expected decompression sickness.

MEDIC: How about the possibility of air embolism and pulmonary barotrauma?

DIVING MEDIC: Although this is possible it is most unlikely. He was an experienced and competent diver, he apparently reached the surface and was taking a compass bearing prior to losing consciousness, and finally the improvement in his clinical state occurred without the advent of either recompression or O_2 administration. There was also no mention of focal neurological features.

MEDIC: I know of three common causes of unconsciousness in rebreathing equipment, namely hypoxia, CO_2 build up and O_2 convulsions. Could any of these be incriminated in this case?

DIVING MEDIC: Let’s take them one at a time. Hypoxia is a very likely provisional diagnosis. The diver was using less than the proposed O_2 flow, and in fact a quick calculation shows that he was introducing only 2.4 litres of O_2 into his breathing bag each minute, and with semi-closed circuit one must accept a considerable loss of O_2 during the dive, over and above that consumed by the diver. He was swimming at a reasonably fast speed, and would have been expected to have consumed something like 2 litres O_2 per minute. This is likely to result in a progressively diminishing O_2 concentration in the inspiratory gas, and even though the latter may finally have something like 10% O_2 or less, this is not likely to cause problems until he ascends and has to breathe this low percentage O_2 mixture at surface pressures. This case could well have been the result of such a situation, especially if it were ascertained that the diver did not purge his breathing set with fresh gas prior to his ascent.

MEDIC: If he did purge his diving set, is the diagnosis still tenable?

DIVING MEDIC: Probably not, however one should also check from the attendants as to whether the diver appeared cyanotic during the resuscitation procedures or while in the water.

MEDIC: How about O_2 toxicity?

DIVING MEDIC: This is a possibility, but is most unlikely unless there has been a mistake in the gas mixtures used. The diver had anticipated using a 60% oxygen mixture. If his equipment was filled with 100% oxygen then O_2 toxicity would be a likely result at that pressure, for that duration. Let us get an O_2 estimation performed on the gas in the cylinder.

(Laboratory estimation - 60% O_2 in gas cylinders).

That excludes O_2 toxicity producing epileptic fits and unconsciousness, as the maximal O_2 pressure he could have experience was less than 1.7 ATA (2.8 ATA x $f_{(60,100)}$ = 1.7).

MEDIC: Oxygen Syncope could still be a cause.

DIVING MEDIC: Does anyone believe in this disease any more? I understood it to have lapsed into diving folklore. There are no well documented cases of O_2 syncope that I can find in the literature - and repeated attempts to produce it under experimental conditions have failed.

MEDIC: I understand that with most rebreathing equipment, carbon dioxide toxicity in the commonest cause of unconsciousness. Is there any way in which we could verify or disprove this possibility in this case?

DIVING MEDIC: Yes, very simply. As soon as the diver is taken from the water, the set should be turned off and passed over the an Underwater Medicine unit for testing. We can test this very simply and easily by putting another diver on the set, and with due precautions, get this second diver to swim at a reasonably fast speed. Needless to say, one has to have an adaptor for the set to regularly remove gas samples of the inspiratory mixture. If the inspiratory mixture starts rising to levels of CO_2 in excess of 10mm Fg, then there is something seriously wrong with the absorbent system. It is then likely to rapidly rise to about 40mm Hg in pendulum breathing equipment, and at this stage the diver is usually incapacitated. I would strongly advise against using this technique unless there are full resuscitation facilities at hand, with immediate CO_2 analysis capability and feedback.

This investigation was performed with this case and the second diver, who was asked to swim at a depth of approximately 3 feet up and down a swimming pool, lasted about five minutes before he became incapacitated with an inspiratory CO_2 in excess of 35mm Hg. More sophisticated tests can be performed on the CO_2 absorbent remaining in the canister, and in the CO_2 absorbent that had not been used, to ensure that it was of an adequate standard. Although these investigations are more sophisticated, they are far less informative than simple tests I have described.

(CORRECT DIAGNOSIS - Top Marks. Anyone who can get the correct diagnosis without the last two paragraphs of information deserves top marks for luck. Those who have waited for the results of the exercise testing of the absorbent canister also deserve top marks, as this is the most rational approach).