S P U M S

SOUTH PACIFIC UNDERWATER MEDICINE SOCIETY

NEWSLETTER

Vol. 3, No. 2, NOVEMBER 1973

CONTENTS

EDITORIAL

For some time now members have been aware of the need to improve the quality of print of the Newsletter. The major hurdle to achieving this has been cost, as the $2.00 per annum subscription barely covers the cost of printing and postage of the usual type of Newsletter.

An attempt has been made to seek financial assistance from pharmaceutical companies whose products are widely used in diving and hyperbaric medicine. It would appear that one such company approached has expressed interest in the idea, however assistance from other similarly interested firms would be desirable. Your editor and secretary (we can't vouch for our absentee President) are currently investigating alternative sources of finance and are hopeful of a positive outcome. In the meantime, however, it has been decided to use some superfluous funds (very limited at present) in order to circulate at least one edition of this improved Newsletter, prior to the Annual General Meeting at Broadbeach on 17th and 18th November, 1973. This decision has been made by the members of the Executive Committee in the hope that member support for a proposed fees increase will be forthcoming at the AGM. We must assume for the moment, that financial assistance from outside sources may be delayed many months, and I feel, our Newsletter must received prior attention.

If approval of this type of Newsletter is received, as I feel it undoubtedly will be, then the proposed fees increase will be such that it will cover the cost of printing 100-200 copies quarterly. As membership numbers are increasingly constantly and demand for copies of Newsletters is growing both from within Australia and overseas, it is anticipated that the fee increase would only need to be relatively small, and in the order of $3-5.00 per annum. The exact cost analysis can, however, only be obtained following more detailed discussion with the printer, who I may add, is contributing his services on a non-profit basis at this stage. The full costing will be presented in the AGM in November.

As many members are unable to attend the AGM at Broadbeach, would those absent please write to the Editor to express their views regarding the new Newsletter, and proposed fee increases.

You will notice a blank space on the front cover - we still do not have a motif! Apart from only three proposals, our request for ideas has been very disappointing. Surely someone must have ideas, pen and paper - we are urgently awaiting your suggestions.

BOB THOMAS

CORRESPONDENCE

1. Letter to Editor from MAJ (DR) JIMMY HOW
Ag. Dy. Chief Medical Officer
SAF Medical Services HQ
TANGLIN CAMP
SINGAPORE 10

"Greetings from the SAF Diving Medical Centre.

"Due to the pressure of administrative and clinical work-load I apologise for not having written any earlier. However, we have been following very closely the activities of SPUMS.

"It is heartening to note that the Diploma of Diving and Hyperbaric Medicine has been well supported in many quarters. Since our training at SUM we have been keenly interested and have been agitating for the recognition of this diploma. You can be assured of prospective candidates from Singapore for this diploma course.

"We have been rather surprised by a statement made by you in the latest Newsletter (Vol. 3, No. 1, 1973, page 2) where you mentioned that both Carl and yourself have been expounding the merits of cessation of free ascent training in any form for several years. We would like a clarification as to the reasons why you do not advocate free ascent training. In Singapore we have a single man chamber (although a 2-man chamber is ideal) with transfer under pressure facilities which will accompany our divers wherever and whenever free ascent training is undertaken. The training is under the supervision of clearance divers with full medical standby. We believe that free ascent training gives confidence to our divers in the event of emergencies and the question of breathing out during ascent has been constantly drummed into our divers and trainees. As such your reasons for not advocating the procedure may be most helpful to us.

"As usual the months of August, September and October are the most busy months for us at our Diving Medical Centre. Last year we treated four cases of decompression sickness during these months. This year, at the time of writing this letter, we have treated four cases of decompression sickness within the last 2 months.

"I apologise for not being able to attend the scheduled conference but would wish the committee the very best in their deliberations at the Conference."

Editor's Note: Jimmy's comments on my statement concerning cessation of free ascent training are pertinent but based on a slight misunderstanding. I have advocated that no free ascent training of any form (and this includes so-called 'ditch and recovery techniques') to be undertaken by civilian or military bodies in the absence of a multiman recompression chamber capable of compression to 165 ft seawater (6 ATA) and suitably qualified medical personnel (doctor and staff). This statement is particularly referable to civilian diving training in Australia, where, almost without exception, FA training has occurred sans RCC and doctors, etc. I am happy to say

that following intensive questioning in S. Australia, Victoria, NSW and Queensland. I am informed that due to our (and others) campaign, most diving training organisations are now deleting the practical training in FA's from their courses. In essence, practical FA training is fine provided adequate means for treatment of any manifestations of pulmonary barotrauma of ascent are immediately available (ie) within feet of the surfacing diver; it must not be condoned under any other less favourable conditions.

Another essential requisite is certification by a doctor that clinical and radiological chest examination on the diver has not disclosed any condition which would predispose a diver to pulmonary barotrauma of ascent. An interesting statistical report fro the Submarine Escape training centre of the Royal Swedish Navy ('Aerospace Medicine', June 1973) shows that of 112 subjects investigated whilst undergoing FA training, 3.5% suffered from pulmonary barotrauma with cerebral air embolism. It is not difficult to realise the inherent dangers of such training fro these results, and although desirable in many cases (eg. submariners), I feel FA training is not really that necessary for ordinary sports SCUBA divers. Single man RCCs may initially save a life if threatened by cerebral aim embolism, but if a tension pneumothorax were to develop during decompression, the chances of saving the diver's life are extremely remote, hence these chambers should not be used for such training.

EDITOR.

FEDERATION OF AUSTRALIAN UNDERWATER INSTRUCTORS (FAUI)

The following has been written by the FAUI National Director, Mr Peter Cullen, in order to inform divers as to the aims of this organisation. It is included in this Newsletter for the information of SPUMS members, as it is hoped that support for this and any other organisation attempting to improve diving safety in Australia, will be readily given.

"1972 was a bad year for divers - eighteen of them died in diving accidents. 1973 looks like being even worse! The Federation of Australian Underwater Instructors (FAUI) has joined with all other groups interested in diving safety to help collect information on these diving fatalities, which are being studied by Dr Doug Walker.

"A study of the circumstances of each accident shows a disturbing feature common to many of them: the victim ignored basic safety rules. The victim never really knew the rules in some cases - about 1/4 of them were inexperienced, some were still under training. Perhaps the others knew the rules, but felt they only applied to others.

"These accidents could have been avoided. If those divers had understood more about diving, and had equipped themselves properly, they might still be diving.

"The Federation of Australian Underwater Instructors has been set up by diving Instructors, to try and make sure that people wanting to take up diving are properly taught, so they can enjoy safe diving.

"It is appalling that several fatalities have occurred to people whilst they were actually being instructed. Surely people have a right to expect that they will be looked after during their training. Anyone who wants to take up diving is advised to ensure that they only learn from a qualified FAUI Instructor. Learning from some one who is not qualified is like playing Russian roulette - as the accident records so grimly show. You might think its cheaper to learn from a mate down the street, but its hardly worth it. Chances are he doesn't really know much about it anyhow, although he will probably claim to be an expert. Even in a club, make sure that the person who offers to teach diving, really knows enough to do so - if he hasn't gone through an Instructor test programme and proved himself, don't take the risk.

"To become a FAUI Instructor it is necessary to go through the FAUI test program. This is normally spread over a weekend, and the candidates go through a wide range of tests - in practical diving, in the theory of diving, in methods of teaching both theory lessons and practical classes, in boathandling, and in the handling of underwater emergencies.

"The test that Instructors go through have been adapted for local requirements from tests developed by the National Underwater Instructors Association in Britain, and the World Underwater Federation (CMAS). Both of these bodies recognise the FAUI Instructor Certificate, and the CMAS, issued its 3 star Instructor certificate to those who have been certified by FAUI. This is done through the Australia Underwater Federation, which is a member of the CMAS.

"Not only is the FAUI Instructor Standard as good as any in the world, so is the test procedure. A top class standard is of little value if people are certified for paying a fee, which seems to be the case with some other 'standards'.

"At a FAUI test program the organisation is done by local people, but the assessments of the candidates ability are done by an outside panel, who don't know the candidates. FAUI brings experienced Instructors from interstate to each test to ensure that all candidates are examined impartially. This costs money, but it is essential if the standard is to be protected. People can't vote themselves an Instructor certificate by getting on committees, which seems to be a problem with amateur groups. The Royal Australian Navy have been assisting the Federation by providing experts to help examine candidates. This is all done so that anyone enrolling for a FAUI test can be assured that the people who examine him are both competent to do so, and absolutely impartial.

"The Federation has now held seven major test programs, and some minor ones. There are just over 50 qualified FAUI Instructors, distributed through all States of Australia. Forthcoming tests are being held at Jervis Bay, Brisbane and Flinders in Victoria.

"There are several other groups that have sprung up in Australia that claim to certify Instructors. These need to be examined carefully before people support them. I suggest there are two criteria they must satisfy to be worthy of consideration:

i. Do they have a Standard - in writing, that can be looked at,
ii. Do they test to that standard impartially, and completely.

"Any of the other Instructor groups that I have looked at have not satisfied me on both of these criteria, some have satisfied me on neither. Some groups seem to be just card issuers, some seem to be commercial organisations, and some just seem to be well intentioned amateurs.

"Of course, just testing Instructors is only a start. FAUI is dedicated to improving Instruction, and goes about this in several ways. The test programs that we are running are really only a short term measure to enable established Instructors to gain certification if they are good enough. But in the long term it is appreciated that we must do more, in fact we must run courses for Instructors, so that experienced divers can be helped to become Instructors. This aspect of our work has already started, and a 6 month Instructor course

is now running in Brisbane, leading up to a test program in late January. This is being run by 2 FAUI Instructors in Brisbane, John Taske and Andrew Maluish, and as candidates has some of Queensland's most experienced divers.

"FAUI also ensures that once people have passed Instructor tests they are not ignored. As well as allowing them to issue the FAUI C-Card to people who complete a basic course up to the C-Class of the Australian Underwater Federation, or the Standard 1 of Scuba Divers Association, it ensures they are kept up to date with advances in diving and teaching. This is done by a regular series of Technical bulletins. Recent bulletins have been on diving accidents, teaching techniques, the buddy system and the Electrolung. These bulletins are available to anyone interested in diving, and can be obtained by sending $4.00 to FAUI, PO Box 145, Jamison Centre ACT 2614, together with your name and address. This enrols you as an associate of FAUI, and you will receive bulletins for the next 12 months. Unfortunately, back copies of bulletins are not available.

"The Federation works closely with other bodies concerned with diving safety. The Royal Australian Navy has been giving increasing assistance over the last 2 years and have helped to make the test programs such a success. They have also supplied a lot of technical expertise on some aspects of diving. The National Safety Council, and the National Fitness Council, have also assisted the Federation in various ways. We also have close links with the Professional Divers Association of Australia.

"An organisation like FAUI that is concerned with standards has to be independent, and impartial. The Australian Underwater Federation appreciated this in 1969, and since then has had a close and warm relationship with FAUI. These bodies do not overlap - the AUF is the main body for amateur divers, FAUI is a specialized group of Instructors. The AUF provides guidelines on the things that should be taught, and these are discussed. It also provides liaison with the CMAS, of which it is a member.

"In 1972 the Scuba Divers Association realized that FAUI was an independent and impartial body, and they scrapped plans for their own Scuba Divers Instructors Association, and joined with FAUI.

"Now their President, Les Graham is a qualified FAUI Instructor.

"Perhaps it is a sign of approaching maturity for our sport that these two amateur organisations have agreed on the need for an organisation like FAUI, to prevent even further divisive fragmentation."

BOOK REVIEWS

1. OTOLOGICAL ASPECTS OF DIVING

AUTHORS: Carl Edmonds, Peter Freeman, Robert Thomas, John Tonkin, and Francis A Blackwood
Published by the Australasian Medical Publishing Co. Ltd., 71-79 Arundel St., Glebe NSW 2037, 1973 Price $6.60 - retail.

"This publication presents the combined efforts of the authors to collate their experiences of the effects of diving upon the human ear. It is intended primarily for those medical practitioners who are associated with divers and diving organisations, but it should also provide and interest for all those who dive or who may have to treat divers from time to time" - extract from the preface.

Reviews of this book received include:

i. Letter from Mr Noel Roydhouse, ENT Surgeon, Auckland, New Zealand:

"I consider that the material inside the book is matched by the superb printing and bindng of this book and consider it to be one of the best books of its kind I have ever come across. I have shown it to one or two people who are quite impressed with the book physically and its contents. I hope it gets a good circulation amongst the medical profession. Once the scuba divers realise that there are some doctors who know what they are talking about they will tend to come forward much more willingly and in greater numbers to have the less severe complaints attended to. They have mostly been to some doctor who is unaware of all aspects of diving and he tells them to give it up. This attitude is one I am trying to combat by education and publicity in NZ. Your book will give background for those who wish to know a bit about one of the most common disorders in diving, The Otological Aspects.
"There are some things in the text of the book with which I disagree and will put this in writing and forward it to you for dissemination to the authors if you think fit. I have already spoken with Peter Freeman and he is aware of my views on inner ear barotrauma."

ii. Letter from Dr Paul Fagan, ENT Surgeon, Sydney NSW

"The recent issue of a comprehensive survey of the specifically otological problems encountered by divers is a very welcome publication which can be read and studied with great profit by all interested in diving, either professionally or as a sport. The five authors have individually and collectively a great volume of experience in this field and they have combined to create a work whose audience need not be limited to medical or para-medical personnel. Any interested lay person could, with the exception of a few obviously highly technical sections, gain considerable insight into all the problems encountered by divers. The book begins with a comprehensive but readily understandable study of the anatomical and physiological background, and on this basis builds a clear picture of the many problems encountered and discusses in detail diagnosis, management and, of equal importance, prevention. The whole is comprehensively illustrated by clear and uncluttered diagrams and illustrations and there are two really excellent colour photo-micrographs of the otoscopic appearances of aural barotrauma. Medical personnel will regret that not more of these were included. For the more serious student, there is a thorough bibliography.
"The authors are to be congratulated for the production of this splendid work which will certainly become a standard text and invaluable reference for divers throughout the country. It is to be hoped that its obvious excellence brings it to the notice of divers in other countries as well."

2. MAN BENEATH THE SEA - A review of Underwater Ocean Engineering

AUTHORS: Walter Penzias and MW Goodman
Available from John Wiley & Sons Australasia Pty Ltd, CROWS NEST NSW, Price $32.50.

This book gives an excellent account of some historical aspects of diving and diving habitats. It also provides comprehensive and illustrative information on the technical and engineering aspects of diving and saturation diving complexes, underwater habitats and deep submergence vehicles. Although it encompasses a wide field, delving briefly into some aspects of diving medicine and

physiology, there is little data which is specific enough to suit the diving doctor who does not possess such sophisticated equipment. Indeed, this lack of specification throughout would render it of little use for anyone requiring exact details of equipment, etc. It does, however, discuss all types of equipment generally, especially the needs for same, and in this respect would seem a suitable primer for diving technicians, as well as some medical personnel. The cost of the book in Australia is rather prohibitive, and therefore does not represent good value-for-money for an individual, although eminently suitable for library purchase.

EDITOR

3. BUSINESS OF DIVING

AUTHOR: John E Kenny
Available from Technical Book Shop, 259 Swanston Street, Melbourne. Price A$15.00 or more.

This book covers a wide range of diving technology from submersible habitats to underwater tools, etc. There are generalisations dealing with underwater medicine and physiology, but no specifics or sections relating to treatment. It is, however, well presented and provides interesting reading for the diving medic. At a reasonable price of $12.95 US in the States, it may be regarded as slightly overpriced if costing more than $15 Australian. Excellent material for a library or diving club, but probably rather expensive in Australia for a doctor wishing for more medically orientated work.

DIPLOMA IN DIVING AND HYPERBARIC MEDICINE

The organisation of such a course is progressing satisfactorily. The Royal Australian Navy has fully approved the training of medical personnel for five weeks each year at HMAS Penguin. This includes the early intensive training period (theory) and the later practical period with RCCs, etc. Similarly, verbal approval has been obtained from the Hospital Board of the Prince Henry Hospital for the involvement of the Hyperbaric Unit in the training scheme.

The Committee has now decided to go ahead with the final planning of the syllabus and its implementation. Despite many requests, we are unable to state a firm date for 1974, except that a four week course is being planned by the School of Underwater Medicine for the period 8th April - 5th May 1974. It is hoped that this course will include Dip DHM candidates. Further information will be dispatched to all members as soon as is available.

SPUMS INVOLVEMENT WITH CIVILIAN DIVING GROUPS

a. FEDERATION OF AUSTRALIAN UNDERWATER INSTRUCTORS
TEST PROGRAMME VICTOR HARBOUR (SOUTH AUSTRALIA) 19-21 OCTOBER 1973

For some time now, Doctor's Lowry, Thomas and Walker have attended a number of such test programmes in order to lecture to the instructors, Recently Dr Thomas attended programmes in Melbourne, Sydney and South Australia. During these sessions, as assessment of the instructors' present knowledge of Underwater Medicine and resuscitation was obtained. The standard of knowledge appeared, in general, to vary widely. On occasions some instructors would show an excellent understanding of some of the problems, but next to no grasp on others. Other instructors showed an abysmal lack of knowledge on all matters. The unavoidable conclusion is that many instructors are basing their teaching of matters pertaining to underwater medicine, resuscitation, and first aid, on their own misconceptions without having first ensured that their ideas are correct. This must lead inevitably to a student obtaining a basic SCUBA diving certificate with a very elementary and probably, very confused understanding of these problems.

As a result of this feedback Dr Thomas has lectured to these groups paying particular attention to the deficiencies which were apparent. It is realised however, that it is difficult for most instructors to obtain any first hand information - usually all their material comes from textbooks which are also frequently inadequate, or incorrect.

The response to lectures given has been very gratifying. Instructors examined after such talks have invariably shown a greatly increased understanding - something which should be passed onto the students in due course. However, SPUMS members must attempt to continue such education and a programme of tuition for instructor groups in each state could well prove valuable to both parties.

The recent tests at Victor Harbour (South Australia) proved to be of typical character. It also afforded Dr Thomas the chance to spend a day discussion some exciting new concepts relating to decompression sickness with Dr DH LeMessurier of the Aero Medical research Laboratory at the University of Adelaide. A report on these concepts will appear in the next Newsletter. A lecture on the medical requirements of divers was also given to a mixed group of medical practitioners, medical students and ambulance staff. It would appear that students in South Australia only receive three lectures on the physiology of diving throughout the entire medical course - a situation which should undoubtedly be improved. Discussion on these matters is expected to arise at the Annual General Meeting in November 1973.

B. QUEENSLAND UNDERWATER FEDERATION'S SYMPOSIUM
"MAN AND THE SEA", BRISBANE, QUEENSLAND 10, 11 AND 12 AUGUST 1973

This symposium consisted of an initial inaugural reception held on the 10th August. Following this, on the 11th, there was a trade display, and a series of lectures and films on subjects ranging from compressors, otological problems of divers, safety in diving and diving accidents, black marlin fishing, sea snakes and night diving on the Great Barrier Reef. Doctors Dough Walker and Bob Thomas attended and addressed the symposium on matters dealing with safety and project 'Stickybeak'. As this represented the initial attempt at such a symposium, the QUF is to be congratulated on the success of the meeting in general. It is understood that plans for a similar symposium for 1974 are already under way, and it is hoped that this contact between members of SPUMS and the public will continue.

An interesting, although disappointing, sidelight of the meeting came during a showing of the film "Night Diving on the Great Barrier Reef". Although a superb film technically and photographically, an amateurish attempt at producing a dramatic diving incident appeared particularly galling in the light of previous addresses to the meeting. It is disappointing to see such renowned divers present such an unsafe diving practice as separating a pair of divers during a night dive. The sequence of events following this amply illustrated the folly in such diving procedure. Fortunately this drama only occurred 'on film' and not in reality. *[illegible]* members who see this film will undoubtedly realise that similar problems could easily arise under similar circumstances. The method by which the attendants handled the so-called emergency will certainly enforce one's realisation of the necessity of 'buddy diving' and lines at night.

C. EYRE PENINSULAR MEDICAL GROUP MEETING ON ABALONE DIVERS
PORT LINCOLN, SA 25-26 AUGUST 1973

Doctors J (Fred) Gilligan and Bob Thomas attended a meeting held by the Eyre Peninsular Medical Practitioners in which a proposed system for medical examinations of abalone divers was discussed. Other subjects included the initial treatment of divers suffering from decompression sickness, the proposed recompression chambers to be sited at Port Lincoln, Adelaide and possibly Mount Gambier, and the radiological evaluation of the long bones of the local abalone divers. These latter tests have only just begun - but an unofficial report would indicate that possibly 2 of the 5 divers examined show evidence of dysbaric osteonecrosis.

A discussion was also held with a representative group of abalone divers and considerable progress was made towards increasing the rapport between divers and the local medical practitioners. It had been assumed that the medical examination may have been used as a means whereby the SA Fisheries and Fauna Conservation Dept. may have been able to reduce the number of abalone divers - the error in this assumption was made very obvious, and it is hoped that this will encourage all these divers to undertake regular medical examinations and long bone x-rays.

It is extremely encouraging to see a local group of medical practitioners approaching the problems concerned with diving in such a sensible and co-ordinated manner, and it is hoped that some useful data concerning the health of abalone divers will soon be available as a result of their efforts.

INTERNATIONAL SYMPOSIUM ATTENDED BY SPUMS PRESIDENT

1973 International Symposium and Workshop
on
DECOMPRESSION GAS BUBBLES
SCIENTIFIC PROGRAM
3 East Conference Room Providence Hospital 500 17th Ave, Seattle WA

FRIDAY AUGUST 17

0830 Registration
0900 Welcome, Introductions, Announcements
Program Chairman: Merrill Spencer, Seattle, Wa
SESSION I Chairman: Albert Behnke, San Francisco, Calif
0910 Reid, John M. REVIEW OF ULTRASONIC BUBBLE DETECTION: METHODS AND SAFETY. Institute of Environmental Medicine and Physiology, Seattle, Wa.
0930 Martin, Frank E., Wonn, James W. INCIPIENT BUBBLE DETECTION USING NON LINEAR ULTRASONIC PROPAGATION Westinghouse Electric Corporation - Industry and Defence, Annapolis, Md., Pittsburgh, Pa.
0945 Horton, JW, Wells, Charles H. RESONANCE ULTRASONIC MEASUREMENTS OF MICROSCOPIC GAS BUBBLES. IBM Scientific Centre, Houston, Texas
1000 Grulke, David C, Hills, BA PRODUCTION AND PRECISE CALIBRATION OF MICROBUBBLES FOR THE EVALUATION OF ULTRASONIC BUBBLE DETECTORS IN VITRO. FG Hall Laboratory for Environmental Research, Duke University, Durham, North Carolina
1015 Behnke, Albert MOVIE OF IN VITRO BUBBLE FORMATION.
1030 General Discussion
1045 Coffee
SESSION II Chairman: Suk Ki Hong, Honolulu, Hawaii
1100 Spencer, Merrill P, Johanson, David C Clarke, Howard F PRECORDIAL BLOOD BUBBLE DETECTION AND BUBBLE SIGNAL ANALYSIS. Institute of Environmental Medicine and Physiology, Seattle, Wa.
1115 Hendricks, P Lance BUBBLE DETECTION DURING US NAVY SATURATION DECOMPRESSION. Submarine Development Group I, San Diego, Calif.
1130 Williamson, Roger PRECORDIAL ULTRASONIC DOPPLER BUBBLE/BLOOD FLOW DETECTOR GENERAL STUDIES. Naval Submarine Medical Research Laboratory, Groton, Connecticut.
1145 Van, RD; Widell, Penny J; Youngblood, DA; Hills, BA DECOMPRESSIONS OF WIDELY DIFFERING PROFILE MONITORED BY THE DOPPLER ULTRASONIC BUBBLE DETECTOR. FG Hall Laboratory for Environmental Research, Duke University, Durham, NC; Harbor Branch Foundation Laboratory, Fort Pierce, Fla; Queen Elizabeth College, University of London, England.
1200 Pilmanis, Andrew A INTERVASCULAR BUBBLE DETECTION IN MAN AFTER OPEN OCEAN DIVES. Santa Catalina Marine Biological Laboratory, University of Southern California, Avalon, Calif.
1215 Postles, William EXPERIENCES WITH BLOOD BUBBLE DETECTION AT COBB SEAMOUNT. Project Sea Use, Milwaukie, Oregon.
1230 Discussion
1245 Lunch
SESSION III Chairman: Kent H Smith, Seattle, Wa.
1345 Haugen, Dean P DEVELOPMENT OF AN ULTRASONIC DOPPLER EMBOLI DETECTOR. Applied Physics Laboratory, University of Washington, Seattle, Wa.
1400 Jacobson, Jon O; Smith, Kent H BLOOD-BUBBLE GROWTH PHENOMENA. Virginia Mason Research Center, Seattle, Wa.
1415 Hlastala, Michael P; Farhi, LE ABSORPTION OF NITROGEN BUBBLES IN FLOWING BLOOD. Department of Medicine, University of Washington, Seattle, Wa. Department of Physiology, State University of New York, Buffalo, New York.

1430 Strauss, Richard H BUBBLE FORMATION IN GELATIN: A MODEL FOR PREVENTION OF DECOMPRESSION SICKNESS. Department of Physiology, University of Hawaii, Honolulu, Hawaii
1445 D'Aoust, Brian BUBBLE DISEASE IN FISH: A NEW PERSPECTIVE. Virginia Mason Research Center, Seattle, Wa.
1500 Powell, Michael R DETECTION OF VENOUS GAS BUBBLES IN PIGS FOLLOWING DECOMPRESSION FROM PROFILES OF GRADED SEVERITY. Ocean Systems, Inc. Tarry town, NY
1515 Akers, Thomas K THE PLACE OF BUBBLE DETECTION IN DECOMPRESSION RESEARCH. Department of Physiology and Pharmacology, University of North Dakota, Grand Forks, North Dakota.
1530 Discussion
1545 Cockett, ATK; Pauley, SM; Cockett, BS; Zehl, DN THE PATHOPHYSIOLOGY OF DECOMPRESSION SICKNESS: AN OVERVIEW. School of Medicine and Dentistry, Division of Urology; University of Rochester, Rochester, NY.
1600 Announcements and Coffee
1615 Founding Business Meeting; North Pacific Chapter of the Undersea Medical Society.
1900 Banquet - Vance Motor Hotel, 620 Stewart, Seattle, Wa.

SATURDAY AUGUST 18
0900 OPEN HOUSE - Department of Hyperbaric Physiology, Virginia Mason Research Centre, 1200 Terry Avenue, Seattle, Wa.
1100 Laboratory Demonstrations
Institute of Environmental Medicine and Physiology, 556 18th Avenue, Seattle, Wa.
Lab A: Decompression Bubbles Demonstrations - David D Johanson
Lab B: Experimental Venous CO_2 Injection and Detection - Merrill P Spencer
1200 Lunch - Providence Hospital Cafeteria (main hall, ground floor)
1300 Lab C: Ultrasonic Bubble Counting - Howard F Clarke
Lab D: Directional Doppler Flowmeter and Transducers - John M Reid, Don Davis
1500 Lab E: Carotid Doppler Imaging - Merrill P Spencer
Lab F: Doppler Bubble Tapes - David C Johanson

SUMMARY OF THE SEATTLE INTERNATIONAL SYMPOSIUM ON DECOMPRESSION GAS BUBBLES by Dr Carl Edmonds

SPENCER summarised the research finding using doppler techniques. He pointed out that intravascular gas emboli are caused by super saturation of the blood and tissues resulting from decompression after breathing high pressure atmospheres. They are clearly detected with a doppler ultrasonic flow meter and sound like chirps, or whistles or snaps on the audio output of 5/10 MHz detectors. These gas emboli form early in the veins and appear in systemic arteries only after severe violation of the accepted decompression schedules. The doppler flowmeter can detect bubbles in superficial peripheral vessels including the jugular, brachial and femoral veins and presumably their associated arteries. The doppler flow-meter detector if placed over the precordial skin at the left mid-sternal border detects venous gas emboli which arrive from any peripheral vein as they pass through the pulmonary blood flow, from the right ventricle. The venous gas emboli collect initially in small peripheral veins or capillaries and are extruded by local blood flow and compression or movements of tissues. They have been heard for as long as 72 hours after decompression even though signs of decompression sickness were not apparent. They are most reliably detected in the left mid-sternal border over the right ventricular outflow tract, and the pulmonary artery, and they can usually be detected before signs of decompression sickness. They are frequently produced in hyperbaric exposures on the conventional US Navy Tables of exceptional exposures over 150 ft of seawater pressure. They are also heard more frequently over venous outflow of tissues where pain develops. They are not associated with skin bends. It is believed that the super-saturation bubbles are not induced by the 5/10 MHz ultrasound which is applied to detect these bubbles. Venous gas emboli may pass through the pulmonary vasculature of sheep when intravenous nitrogen gas injection rate exceeds 0.015 ml per kilo per min, and the pulmonary systolic arterial pressure rises above 35mm. The human brain and other body tissues can tolerate hundreds of gas emboli (detectable by the doppler technique) which do not produce overt signs or symptoms.

HLASTALA and FAHRI measured the absorption of nitrogen bubbles in flowing blood and showed the massed transfer co-efficient to vary between .0022 cm/sec and .0059 cm/sec.

GRULKE and HILLS demonstrated that bubbles of 150 microns diameter could just be heard above background noise and a stream of 110 micron bubbles was barely audible as a low rumble in both the instruments they used in vitro experiments.

HORTON and WELLS described a resident ultrasonic measurement of the presence, size and location of the small gas bubbles in soft tissues of animals. It was designed to ultrasonically resonate bubbles of 26 microns in diameter. The importance of this work was that the bubbles were detected by resonant and not a reflected technique.

HAUGEN described the doppler system and also suggested not using a chest probe as there were too many other sounds influencing the results.

HENDRICKS described the abortive efforts to use the adopted system in operational diving. No bubbles were detected during those dives, but these were in dives that had previously produced some cases of decompression sickness.

JACOBSON described a series of 1-hour assimilated man dives to 300, 400, 500 and 600 feet. Detectable bubbles were observed between 10 and 30 minutes subsequent to beginning the decompression.

PILMANIS described the use of the doppler in practical diving and attempted to qualify the number of bubbles or events as recorded on the doppler system. His quantification method seemed not to be the final answer.

WILLIAMSON reported the results of precordial ultrasonic doppler techniques on the NOAA dives stating that these resulted in bubbles heard but no decompression sickness. A frequency analysis of the sounds was being performed.

MARTIN and WONN claimed that the Westinghouse non-linear ultrasonic propagation technique detected bubbles both within the venous an the capillary system, that it could count and otherwise characterise these bubbles an that it could do this long before the diver detected symptoms.

STRAUSS claimed to have introduced the technique of monitoring bubbles in gelatine. As Le Messurier had described this 8 months earlier in the Melbourne Symposium in Aerospace Medicine, Strauss' claim must be accepted with reservations. he claimed to use this technique to demonstrate the invalidity of the Haldane concept of decompression.

POWELL demonstrated the presence of gas bubbles in animals under most diving situations and claimed that the intensity and number of bubbles was more an indication of the degree of decompression sickness than their presence.

VANN, WIDELL, YOUNGBLOOD and HILLS used the doppler technique to compare US Navy diving tables and Hills' own tables taking the same overall decompression time using goats. Of interest was the observation that one goat had no bubbles but did demonstrate decompression sickness. The overall results suggested that the detection of bubbles afforded little indication of the probability of symptomatic decompression sickness. Bends failed to develop in 8 out of 11 cases in which bubbles were recorded. On the other hand there appeared to be a significant correlation between the symptomless exposures and the failure to detect bubbles; only one case of bends occurring in 8 bubble free decompressions.
VAN LIEW and BUCKLES demonstrated work which has been well described elsewhere.

ACKERS described his experience in many different methods of monitoring of decompression sickness.

The demonstrations on the doppler techniques were impressive but not conclusive. In summary one doubts whether this whole subject has advanced very much over the last few years. There seems to be no reason to modify in any way the observations made by Le Messurier Elsner and Edmonds some 4 years ago when it was demonstrated that decompression sickness could occur without the demonstrable evidence by doppler bubble detection. As such, it means that this technique is not the answer to detection of bubbles does not mean the occurrence of decompression sickness. Thus this technique has both false negative and false positive inferences. As such it will not be an acceptable method of monitoring for decompression sickness until it becomes far more objective and less amenable to artifact.

OTOLOGICAL SURVEY

As many are now aware, the School of Underwater Medicine has become increasingly involved in research into all aspects of otological disorders resulting from diving. The result of this research is discussed in the book "Otological Aspects of Diving" reviewed earlier in this Newsletter, but a new line of surgical treatment has been pioneered and has resulted in significant improvement of vertigo and/or deafness in divers suffering from round window fistulae.

Clinical material is readily available from within the RAN, but since all RAN divers are strictly supervised both medically and otherwise, serious cases have yet to occur. Most of the clinical cases to date have been civilian sports divers and it is with this in mind that you are asked to contact:

> The Officer in Charge (Dr Bob Thomas, or Dr Carl Edmonds)
> School of Underwater Medicine
> HMAS Penguin
> BALMORAL NSW 2091

whenever you examine or treat a diver suffering from any of the following conditions:

i. deafness (partial or complete) following a dive in which barotrauma occurred or a forceful Valsalva was required for equalisation.
ii. vertigo of any degree persisting after the dive;
iii. either of the above, whether immediate or following a latent period.

You will then be sent a questionnaire to complete and return to the School of Underwater Medicine. In this way, it is hoped that the SUM can act as a central registry of all such cases, such that the collection of clinical data can be vastly improved (especially from a statistical/retrieval point of view). It is anticipated that the SUM will then be able to advise re further treatment if necessary, or if and when research uncovers a new line of therapy. Such assistance can already be given if requested, but some method of routine evaluation of the diver is essential - hence the questionnaire proforma.

Your participation in such a survey will be greatly appreciated.

MERCENARY DIVING SCHOOL

Early last week an American tourist diver suffered mediastinal emphysema whilst diving at Heron Island. On returning to Sydney she was still suffering from symptoms and being worried about possible 'embolism' she rang a SCUBA teaching school. After explaining her predicament she requested assistance as to what she should do. She was promptly informed that if she liked to pay $25.00 and attend a course she would be told all about the condition.

Fortunately she contacted another agency and was eventually referred to the School of Underwater Medicine where the condition was confirmed, and advice given.

How's that for a responsible attitude?

AUTOMATIC DECOMPRESSION METERS

Once again we hear of divers needing treatment for decompression sickness which occurred following routine decompression in accordance with an automatic decompression meter. There have been three such cases treated at the School of Underwater Medicine this year, and the records show many others occurring over the last few years since then general acceptance by the public as safe alternatives to the 'tables'.

It never ceases to amaze me how divers place such blind faith in mechanical gadgetry! It seems that one can write almost anything in a diving magazine, and there will be gullible divers eager to accept every word as 'gospel'. Such has been the sales spiel on these DCMs (see *Skin Diver* magazine, November 1967 and November 1970).

The DCMs in common use today make no allowances for individual variability in physiology, and strict adherence to the meters' decompression schedule is bound to result in some cases of decompression sickness. Similarly there is no allowance made for this factor with recognised RN or USN decompression tables - however, the records here are evident. Providing the table is followed exactly, the rate of development of DS in divers is never greater than 2-3%. I'm sure the record of divers on the DCMs is nowhere near good - certainly not in my experience.

For some time, we have been asked - especially by ex-patients treated for decompression sickness after following the DCM schedules - to evaluate these meters and publicise the results. At long last we have managed to obtain 12 such meters (10 secondhand and two brand new and never exposed to pressure/water) and have started evaluation testing. This has been conducted on a basis compatible with practical diving to depths varying in 20 ft increments from 60 ft to 200 ft. The results are far from being completed, however, several significant features are already outstanding. These are inconsistencies which are evident when the DCMs are tested in a 'wet pot' and show.

i. that the decompression schedules recommended by individual DCMs for identical dive (depth/time) factors vary considerable,
ii. that the decompression schedules recommended by the same DCM for identical dives vary considerably - and this followed a much longer than normal non-dive period, and
iii. that the decompression schedules recommended by the DCMs in some cases were more conservative (time wise) than corresponding RN or USN tables; and yet in others were far outside the limits of staging according to the tables.

These features are apparent on single ('bounce') dives - repetitive dive testing has only just commenced, and results are unknown as yet. The fact that variables such as movement of the DCM (tapping, vibration, etc), sunlight (warmth, etc) are known to markedly affect the non dive recovery period of the DCM, is sure to create interesting variations when these tests are finalised.

In the meantime, it would appear that our best advice to divers concerning these DCMs is to never rely on them for any dive in excess of 120 ft or for any repetitive dives, and to follow the most conservative regime when the DCM is compared to a recognised decompression table ie., dive with both table and meter, and decompress according to the deepest first stop and longest decompression times.

Certainly these techniques will make diving more complex for 'fools' - but anyone who dives to depths in excess of 100 ft and thinks all is rosy when following a DCM is a fool. Deep diving in a hostile environment requires careful planning and thoughtful techniques, and no mechanical mechanism exists which can always reliably predict decompression schedules for divers at various depths for various periods. Surely, it is safer to err conservatively and stick to the 'deepest depth X longest time' method. There are many ex-patients who can recommend this practice from personal experience with DCMs which failed.

The full results of the tests on the DCMs will be printed in the SPUMS Newsletter when completed.

EDITOR

GAS GANGRENE IN NEW SOUTH WALES
Dr Ian Unsworth

An extract from the Medical Journal of Australia, June 2, 1973, 1:1077-1080 Reproduced with permission)

Surveys taken from the major conflicts of this century have shown a decline in both the incidence of and the mortality from gas gangrene. At the beginning of World War I, in early 1914, the incidence in the British Expeditionary Force reached 12% to 15% of all wounded with a mortality rate of 30%. After the first year of the war, the incidence among British and Australian forces receded to 10% to 12% and the mortality rate was reduced to 22%. The later introduction of early excision of dead muscle and delayed wound closure reduced the incidence to 1%, though the mortality rate rose to 30% (Matheson, 1968). A monthly report fro August, 1918, from No. 1 Casualty Clearing Station, Australian Army Medical Services, on the Western Front, recorded 12 cases of gas gangrene (1%) from 1,240 surgical patients cleared in the month. Of these 12 patients, 9 died (75%). The report also stated that the Welchii gas gangrene antiserum was still being used, but with discouraging results (Butler, 1940).

The incidence of the disease rose and remained fairly constant throughout World War II, at just under 5%, the mortality rate remaining, as in the previous war, at 30% (Matheson, 1968). However, the Korean war (1951-54) brought about a dramatic decrease in the incidence of gas gangrene. Latta (1951) reported only three cases from 1,850 wounded patients whom he saw, with no mortality. The conflict in Borneo (1963-65) resulted in no reported cases of the disease from 119 wounded over two and a half years (Wheatley, 1967). The last war in which gas gangrene could have been prominent was in Vietnam (1965-1972). Moffat (1967) recorded two cases of gas gangrene from 60 cases of wounded for the 10 month period July 1965 to May 1966. Since that report there have been no further cases recorded from among the combined Australian and New Zealand troops fighting in Vietnam (Cook, DC 1972, personal communication). It would thus seem that gas gangrene is now virtually extinct as a disease of warfare.

In civilian surgical practice, it is generally held that the disease is rare (Leading article, 1972). An epidemiological report from the United Kingdom for the year 1971 cited 16 cases of gas gangrene from a total of 95 cases for the years 1967-1971 inclusive (Notes and News, Brit. Med. J, 1971). One London hospital treated only 20 cases in the four years between 1966 and 1969 (Bourke et al. 1972). The population of the United Kingdom report included that of the British Isles plus the Republic of Eire, thus giving an extremely low incidence of the disease per 100,000 head of population. Similarly, Roding et al. (1972) described 130 cases of patients with gas gangrene treated over 10 to 12 years from the population of some 15 million in Holland.

PRESENT SERIES

In a period of 21 months (March 1971 to November 1972 inclusive) 27 patients from Sydney and throughout New South Wales were referred to the Department of Surgery and to the hyperbaric unit at the Prince Henry Hospital with a diagnosis of gas gangrene. This represents a considerably higher incidence of disease per 100,000 head of population than that in the United Kingdom report. A further six cases of gas gangrene occurring in the same period have been brought to the attention of the writer; these patients had died or been successfully treated elsewhere in the State.

The details of 20 patients treated by surgery and oxygenation at the Prince Henry Hospital are listed in Table 1. The commonest cause of injury contributing to gas gangrene is traffic accident trauma (45% of the series) with 9 patients sustaining compound fractures or crush injuries - 4 automobile or truck accidents and 5 motor cycle accidents (Cases 1, 2, 5, 8, 9, 12, 14, 16 and 19). Four further cases (25%) of gas gangrene were initiated by other trauma, namely, firecracker injury (Case 3), a waterskier overrun by a powerboat (Case 2), a minor abrasion (Case 13), and a crush injury to the little toe (Case 18). Clostridial uterine myonecrosis is a serious complication of septic abortion and there were two cases of this type (Cases 6 and 7). The remaining cases of gas gangrene were a result of elective surgical procedures - two orthopaedic and one abdominal, and two amputations for ischaemic vascular disease.

TABLE 1
Details of 20 patients treated at the Prince Henry Hospital (1972-1972)

CASE NO.	AGE YEARS	SEX	LESION	CAUSE	HYPERBARIC SESSIONS	SURGERY	RESULT
1	47	F	Compound fracture of tibia and fibula; gangrene to mid thigh	Motor vehicle accident (car)	6	Above knee amputation	Alive
2	40	M	Crush injury to bdomen and buttock; gangrene in buttock	Motor vehicle accident (truck)	1	Debridement	Cardiac arrest three hours after admission
3	10	M	Blast injury to upper arm; gangrene to root of neck	Fire-cracker	4	Debridement	Alive
4	80	F	Thornton pin to hip; gangrene of hip and thigh	Surgical operation	5	Debridement	Alive; subsequent amputation for deformity
5	19	M	Compound fracture of femur; gangrene in knee to upper thigh	Motor vehicle accident (motor cycle)	5	Debridement	Alive; subsequent amputation for chronic osteomyelitis
6	28	F	Uterine gas gangrene	Septic abortion	5	Hysterectomy	Alive
7	35	F	Uterine gas gangrene	Septic abortion	4	Hysterectomy	Alive
8	22	M	Compound fracture of patella; gangrene in lower end of femur	Motor vehicle accident (motor cycle)	1	Debridement	Alive
9	19	M	Compound fracture of fibula; gangrene in foot to mid thigh	Motor vehicle accident (motor cycle)	6	Through-knee amputation	Alive
10	16	M	Operation on tibia and fibula; gangrene in lower leg	Surgical cosmetic shortening of leg	7	Debridement	Alive
11	32	M	Crush injury to lower leg, amputation below knee; gangrene to stump	Motor boat accident	4	Debridement	Alive
12	17	M	Crush injury to lower leg, amputation above knee; gangrene from thigh to abdomen	Motor vehicle accident (motor cycle)	18	Debridement; subtrochanteric amputation	Alive
13	50	M	Abrasion to elbow; fulminating spread to arm, chest and abdomen	Minor injury	1	Debridement; guillotine amputation of humerus	Died eight hours after admission
14	23	M	Below knee amputation after avulsion of foot; gangrene to mid thigh	Motor vehicle accident (car)	3	Debridement; through knee amputation	Alive
15	63	M	Gangrene in abdominal wall	Surgical operation for resection of colon	1	-	Died five hours after admission
16	12	F	Compound fracture of femur; gangrene to mid-thigh	Motor vehicle accident (truck)	6	Debridement; mid thigh amputation	Alive

TABLE 1 (Cont'd)

CASE NO.	AGE YEARS	SEX	LESION	CAUSE	HYPERBARIC SESSIONS	SURGERY	RESULT
17	67	M	Gangrene in below-knee stump	Amputation for diabetic ischaemia	7	Debridement	Alive
18	54	M	Gangrene in lateral aspect of foot; amputation of little toe	Crush injury to little toe	5	Debridement	Alive
19	21	M	Compound fracture of tibia; gangrene to above knee	Motor vehicle accident (motor cycle)	8	Debridement; above knee amputation	Alive
20	64	F	Gangrene in below knee stump	Amputation for diabetic ischaemia	7	Debridement; above knee amputation	Died 10 days after admission

In the 20 patients treated, the sites of initiation of the disease varied. The figures are set out below:

Upper limb	2
Abdominal wall	1
Uterus and adnexa	2
Buttock (trauma)	1
Hip (open operation)	1
Femur	5
Tibia, fibula or both	7
Foot	1

Gas gangrene is produced primarily by Clostridial organisms, though other bacteria may produce necrosis and gas, a picture similar to Clostridial gas gangrene - for example, Klebsiella, anaerobic. Streptococci and Escherichia coli (Brightmore, 1972). Of the anaerobes responsible for true Clostridial myonecrosis, Clostridium welchii (perfringens) is the most prevalent and usually in combination with one or more of the other Clostridia found in gas gangrene: C. oedematiens, C. histolyticum, C. sporogenous or C. septicum. In the present series, C. welchii predominated in 18 cases; in Case 13 the sole anaerobic organism was C. septicum, the incidence of which is one in 250 cases of Clostridial gas gangrene. In case 14 a pure culture was found of E. coli, after full bacteriological investigation was performed and although the patient had presented with all the features of clinical gas gangrene, he in fact received no further hyperbaric oxygenation after the initial three sessions. This patient was managed by surgical debridement and massive intravenous dose of antibiotics.

From the clinical aspect, all 20 patients presented with most of the typical features of clinical gas gangrene. Sixteen patients showed some degree of toxic mental state ranging from euphoria, complete apathy with a raised paid threshold to frank hallucinations, while all presented with tachycardia, the range being from 96 to 164 beats/min. In ten cases, the pulse rate was greater than 130, and in only 4 was it less than 100 beats/min.

Of the 19 patients whose temperatures were recorded on their admission to Prince Henry Hospital, two had temperatures, high than 40°C, six were higher than 39°C, three were higher than 38°C, three were higher than 38°C, seven higher than 37°C, and one patient had a temperature of 35°C. It is of interest to note that the temperatures on admission of two of the three patients whose condition rapidly proved fatal were 37.5°C and 37°C, with the third being unavailable. Skin changes were present in 80%, though classical skin changes ('bronze erysipelas', bullae)(McSwain et al., 1966) were present in only 8 of the 20. As Clostridial and some other anaerobic organisms form gas during the necrotizing process, the presence of palpable gas as subcutaneous crepitus was noted in 11 cases while in 6 further cases gas was demonstrated on x-ray examination, mainly situated round the ends of fractured long bones or in deep tissue planes. However, to use radiology to locate the presence of gas as an aid to diagnosis is a practice abhorred by this writer. The diagnosis of gas gangrene remains essentially a clinical one. Subcutaneous gas was palpable in neither case of uterine myonecrosis, but one of these showed possible uterine intramural gas on x-ray examination.

Some degree of anaemia was present in 75% of cases either through blood loss at the time of accident or through active bacterial haemolysis. Ten patients had haemoglobin levels of 9gm/100ml or less on their admission to hospital and in the two patients with uterine myonecrosis, massive haemolysis had occurred. In Case 6, a free haemoglobin level of 1050mg/100ml of plasma was found. Both these patients were in acute renal failure on their admission to the Prince Henry Hospital and were subsequently treated by haemodialysis (Renal Unit, Prince Henry Hospital) for this severe complication of Clostridial gas gangrene (Hanson et al., 1966).

The established mortality rate of Clostridial gas gangrene treated not with hyperbaric oxygen, but with surgery alone and some form of antibiotic therapy, is usually given as between 40% and 60% (Hitchcock et al., 1970). The mortality rate after treatment with hyperbaric oxygen, surgery and antibiotics has been put at 20% to 25% (Roding et al., 1972). In the present series, four deaths occurred of which two (Cases 13 and 15) were directly from Clostridial infection, one (Case 2) from direct myocardial damage received at the time of the accident, and one (Case 20) from cardiac failure. The first 3 deaths occurred within 12 hours of the patients' admissions to hospital (8, 5 and 3 hours respectively) and it was possible to give only one 2 1/2 hour session of hyperbaric oxygen to each. Roding et al. (1972), have reported that, if the patients can survive five hyperbaric oxygen sessions, the gas gangrene will be cured. The fourth death from cardiac failure occurred 10 days after the patient's admission to hospital.

Of the medical conditions that predispose to Clostridial gas gangrene, Diabetes Mellitus is the most common and patients suffering from this have featured prominently in many series. In the Prince Henry Hospital series, 3 patients were diabetic. Two underwent elective lower limb amputation for ischaemic vascular disease and subsequently contracted gas gangrene of the stump. It is important to note that neither patient was covered by prophylactically administered penicillin at the time of operation, which today is considered mandatory. The patient in Case 13 was suffering from Hodgkin's disease (state 4) at the time of his admission to hospital with fulminating gas gangrene. He had been receiving massive doses of immunosuppressive drugs for some years and investigations showed a leucocyte count of only 2000/cm^3, with a platelet count of 61,000. This man died from an overwhelming C. septicum infection.

TREATMENT

Limb salvage, which is the aim of surgery, has produced some interesting features. Of the two patients with upper limb involvement, one was discharged from hospital with an arm intact and will full function. The other patient died within 8 hours of admission to hospital. Of the 14 patients with lower limbs involved, 4 remained intact, but only one retained full function, the others having varying degrees of altered function. There were 10 amputations (or further amputations) of which 8 were carried out for gas gangrene. The remaining 2 were late amputations for long-term developments - chronic osteomyelitis and chronic limb deformity. It should be of special note that no disarticulation of any limb was performed. This used to be considered the operation of choice for high Clostridial limb infection. However, the emphasis today is on limb salvage and retaining as much tissue, muscular and bony, as possible (Hoffman et al. 1971). In case 12, a previous above-knee amputation after trauma developed gas gangrene spreading up to the abdomen and required further amputation. Even in this case it was considered expedient to perform a subtrochanteric amputation rather than hip disarticulation.

In all cases, as seen from Table 1, hyperbaric oxygen was administered, ranging from a single session to a lengthy 18 sessions, with an average of approximately 6 per patient (excluding the single treatment sessions in the case of patients who died). Each session lasted two to two and a half hours and was conducted at 3 ATA, or the pressure equivalent of 66 feet of sea water. Usually 3 sessions were administered in the first 24 hours with a further 2 sessions each subsequent 24 hours, dependent on clinically evident improvement in the patient's condition. No serious complications from the use of hyperbaric oxygen at 3 ATA occurred. There were no convulsions in any patients during any of the 104 sessions, though on several occasions early warning signs - increased restlessness and anxiety, nausea, pallor, profuse sweating and a rise in blood pressure - were noted, especially in the severely toxic patients. Aural barotrauma from an inability to equalize pressure on the tympanic membrane occurred in 2 patients. Both suffered middle ear haemorrhage with subsequent hearing loss. Their hearing improved after a few weeks. No other form of barotrauma was noted.

Penicillin was the antibiotic used in every case of Clostridial gas gangrene in this series. The policy as Prince Henry Hospital is to use large doses of benzyl penicillin administered intravenously every hour. No patient received less than 600mg hourly, with the exception of the patients in Cases 6 and 7, who being in renal failure, received 600mg every 4 hours. The upper level of penicillin dosage has been 1800mg hourly, given to 4 patients with the most severe and rapidly spreading gangrene. This dose was reduced to 600mg hourly after 3 days in the case of 3 of these patients, but one (Case 12) continued on this regime for two weeks, and developed the comparatively uncommon condition of penicillin-induced haemolytic anaemia. Such high doses reported initially to be sensitive to penicillin. They were both challenged with purified penicillin (purapen) and found not to have sensitivity. They then were given full intravenously administered therapeutic dosages of penicillin. Gas gangrene antitoxin is not used prophylactically or therapeutically.

Of the 13 cases of trauma, only 5 patients had received penicillin prophylactically at the time of injury. The doses ranged from 300mg intramuscularly every 4 hours to 600mg given every 6 hours. In only 2 was an immediate high dose administered intravenously (both 6gm). It is obvious that more thought must be given to improved penicillin prophylaxis in cases of trauma.

CONCLUSION

Of the 27 patients referred to the Prince Henry Hospital with a diagnosis of gas gangrene, the condition of 20 was severe enough to warrant the triple treatment of hyperbaric oxygen, surgical debridement or selective amputation, and high doses of penicillin. That these cases occurred in the space of 21 months in New South Wales alone has suggested an abnormally high incidence in this State, but the management of this severe disease has proved reasonably satisfactory, with a mortality rate well in line with the best of overseas experience.

RECENT RESEARCH IN MARINE PHARMACOLOGY

by John Fox

The Americans with their usual enthusiasm for statistics recently analysed 1.05 billion prescriptions which were dispensed through higher community pharmacies in the USA. Of these 50% of the medication prescribed was of a synthetic nature, 25% came from higher flowering plants, 12% from microbes, 6% from animals and 7% from mineral sources. However, of these non-synthetic preparations only a fraction, perhaps less than 1%, originated in the sea. This is surprising when one considers that 71% of the earth's surface is underwater and four fifths of the 500,000 species of animals live in or near the sea. If one looks at it purely from a statistical point of view there must be a great potential to find pharmacologically active substances in the marine environment.

With this in mind I had a look at the recent research being done in this field. The first thing you notice is that it is being carried out by a very small number of people, small not only in numbers but also in their financial backing - often individuals or one or two people working in aquariums and universities and perhaps occasionally working for a drug firm. This situation is about to change with the development by Roche of its $4 million Institute of Pharmacology at Dee Why.

The drug firms generally are not very interested in this field, because, while many of them appreciate the tremendous potential of a new find, and obviously the sea can yield many of them, the problem arises that it is difficult to get large quantities of pure active material from a marine source. For example, the recent research carried out by Peter Williams to isolate Macula Toxin from the Blue Ringed Octopus at the Macquarie University is a case in point. Williams followed on work done by Howden - the whole work has taken approximately thirteen years. He himself spent at least two years in isolating the toxin. To get sufficient material to work with he used 400 octopi to make something like 200 mgm of crystalline material, half of which is sodium chloride, so you might say four hundred blue ringed octopus produce 100 mgm of pure macula toxin. One can gauge the potency of the toxin particularly when it is realised the blue ringed octopus bite is like a parrot's, that he has a very small beak and that the toxin is not injected by merely runs into the wound as part of the saliva. Therefore it must be lethal to adult humans in quantities of the order of less than 0.25mgm without allowing for wastage, etc. In fact tests with the blue ringed octopus in tanks have revealed that, when the creature has not been starved, live crabs dropped into the tank are not bitten by the octopus. It merely releases some of its toxin near the crab and waits for paralysis to take place then devours its prey at leisure. However, when the octopus is very hungry it will attack the dorsal surface of the crab, biting through the shell and clinging to the creature until death, when it efficiently removes the shell and consumers the flesh.

However, to return to the main topic, this is hardly an encouragement to any of the drug companies to rush in and start to analyse the various possible therapeutic values of macula toxin, although it perhaps has an eventual use as an anaesthetic or as a tool in the better understanding of nerve activity in excitable membranes. Nevertheless, one well known manufacturer of anaesthetics is already working on this.

Usually a drug company, when they come to do the vase research necessary to find the therapeutic activities of a new substance requires tremendous quantities of the material in a pure crystalline state. One can be a little sympathetic to the drug companies when one looks at the situation with cephalosporin. The original work was started back in 1948 by Professor Brotzu, University of Cagliari, Italy, but it was not until 1964 that a product had been sufficiently developed to market. During that time as many as 200 researchers were working on the substance at any one time, particularly in the latter years, and quantities of the raw material were required in kilograms. It will be remembered that Professor Brotzu found his original spores in the sewerage outlet off the coast of Sardinia. There may be an important link here with recent research into the sea sponges (by Clive Wilkinson of University of Queensland and Dr Ross Nigrelli of Osborne Marine Laboratories in New York) which are found to possess antibiotic properties in 50% of all sponges so far tested. It has been further noticed that sponges tend to increase in number in areas near sewerage outlets - Roche has made this one of their first areas of research at their new Institute. So far the first named antibiotic 'Ectyonin' has been isolated from the sponge Microciona Prolifera (reference Marine Biotoxins, Dr R Endean). From a West Indian Sponge a unique form of Nucleic Acid has been isolated by Cohen which is effective against certain viral infections and Leukemias in man and a synthetic derivative is capable of inhibiting the growth of Sarcoma 180, Ehrlich Carcinoma and L-1210 Leukemia in mice.

I think we are all familiar with the number of substances which are in current use today which have a marine origin, such things as protamine which is obtained from the sperm and testes of certain fish such as salmon. Tetrodotoxin, from puffer fish, has been in use in Japanese folk medicine since the days of the Saurai for the treatment of a wide variety of disorders from myalgia, asthma, neuralgia, syphillis and arthritis but has recently been re-examined, and is in use in Japan today as a palliative in terminal cancer being 160,000 times more effective than cocaine. Its obvious drawback being its toxicity (10,000 times that of Sodium Cyanide).

Research in the marine field is carried out in much the same way as research on land. Observe then investigate. An interesting observation was that the Antarctic penguin has an absolutely sterile gut. This fact was followed up and it was found that this was due to the fact that they eat certain crustacea (Krill) and these in turn feed on Blue Green algae which in turn contain a powerful marine antibiotic, Acrylic Acid - an active and effective antibiotic against pathogenic bacteria and yeasts.

It has been found that certain sea cucumbers when molested eject material called Cuvierian tubules which are highly toxic to almost all sea creatures and which are effective in a dilution of one in one hundred million. Surprisingly, the same substances appear to have anti-tumor activities and when tested against Sarcoma 180 and Krobe 2 tumors in mice cause regression. Certain extracts of this toxin are found to have a digitalis like action and it is thought that perhaps this might be more effective than digitalis in the correct dosage. The toxin also ha haemolytic properties blocking nerve condition and is useful in controlling spastic conditions in humans following brain or spinal damage.

Certain anti-cancer characteristics are exhibited by the clam and it is interesting to note that these anti-cancer characteristics vary with the time the clam is harvested. If it is harvested during the summer the anti-tumor characteristics are much higher and if the clam is allowed to develop in polluted water it has no anti-cancer characteristics. If it is harvested during the winter the anti-tumor characteristics are very very low. Clams yielding the greatest amount of anti-tumor characteristics are those which have been allowed to winter in especially heated clean salt water. Another substance to be isolated from clams is the herapin like group of mactins.

First interest in the clam's anti-viral characteristics were commenced by a scientist - who possibly did not care for them as a food when he made a pathological examination of tinned clams intended for human consumption.

A potential drug which may be obtained from the Toad Fish is contained in the venom of four poisonous spines on its back and gill covers and has the characteristic of increasing the metabolism of sugar in much the same way as insulin does. Certain fractions of the stone fish venom are found to be very hypotensive as are some of the fractions from the macula toxin of the blue ringed octopus. One researcher claims that liver lipids obtained from the shark enhance the body's resistance to cancer and the sting ray produces a potent cardiac depressant. Of course one of the substances which is undergoing a tremendous amount of research at the moment is prostaglandin. The problem has always been, and still is for that matter, the tremendous difficulty in producing any large quantities. These have come from mammal sources until recently when it was found that certain kinds of sea whip or sea fan produce something which is very similar to prostaglandin and only requires a small amount of chemical treatment to yield the active varieties of prostaglandin.

From the Star Fish, which is a relative of the prickly spined Sea Urchin, comes an excretion which has proved valuable as a muscle stimulant as well as an effective contraceptive.

Perhaps an area of somewhat bizarre research covers such things as the investigation into the electric eel which produces a discharge of some 350/650 volts over a distance of 20 feet. It is thought that if some sort of biological battery could be developed along these lines for man it would be of great value in space travel.

Another unusual item of research is that being done on barnacle cement. It is a liquid which hardens in some 15 mins and has a strength of 22lbs per square inch and would obviate the need for dentists to 'key-in' fillings if it could be developed to the necessary extent.

The ability of certain star fish and amphibians to regenerate limbs is being researched by Dr Robert Baker - Veterans Hospital, Syracus, USA. Dr Baker, through study of the Salamander has found that regeneration seems to depend on electric stimulation at the site of loss which causes cells to turn from their normal formations and form blastemas (the protoplasmic building blocks necessary for new growth). he theorises that while humans use a similar electrical process to heal broken bones (the broken ends causing an electric field with different polarity at either end of the break) evolution has caused mammals to have most of their electrical activity in the brain and it is therefore not available to regenerate limbs. (Current at the amputation site in a mammal id 30 times less than in a similar site on a starfish or salamander). Using electrical stimulation Dr Baker has been able to cause the regeneration of an entire humerus from the site of an amputated leg of a mouse.

One field of research I have not touched on is the use of sea creatures as a tool in research itself, eg. the use of sea urchins, because of their relatively simple life cycle, to test the teratological effects of drugs and give the results in a matter of days rather than months or years.

The Hag fish is being used for experiments in skin grafting because it is devoid of a thymus gland and therefore is thought to have no immune reaction to grafting. However, skin grafts are rejected after a period of 70 days (compared with 14 days for mice) and secondary

grafts are rejected in 30 days, indicating an immunological memory. Hagfish only produce one type of serum antibody which is through to be a basic evolutionary 'building block', and which should be useful in the understanding of the evolution of the immune response.

As can be seen a great deal of the research being done at present will take many more years before fruition and possibly much of it will amount to nothing, but undoubtedly many breakthroughs will be made in this virtually untapped field of potential in the years to come.

CLINICAL CASE REPORT

HISTORY

SUNDAY 15TH APRIL (Sydney time) 1973

Dive 1.30pm The patient (a 29 year old Nauruan Islander) underwent a dive to approx. 250 ft (bottom depth) for 20 min. Reason for the dive was treating another diver for 'pain only' bends. No previous dives on Sunday. Dive to ?200 ft for ?10 minutes preceding day (details of depths and times difficult to ascertain). Shortly after leaving bottom the patient ran out of gas and surfaced immediately (? using emergency supply).

10 minutes after surfacing he noticed dizziness and vertigo (self rotating in environment) and inability to walk straight. There was also some 'numbness' of both lower legs.

One hour late rthe patient noted weakness of the right leg. This progressed over the next hour to a total paralysis of the right leg and a marked weakness of the left leg. He was then admitted to Nauru General Hospital.

Five hours after the dive he was noted to have severe abdominal pain, vomiting, paralysis of right leg, paresis of left leg with a total sensory loss of mid thigh level right leg and knee level left leg. He was given 100% O_2 by mask during which time the vertigo apparently settled and the leg anaesthesia largely resolved.

Arrangements were then made to transfer him to HMAS Penguin by Air Nauru (Fokker Fellowship).

MONDAY 16TH APRIL

4.00am On arrival at the School of Underwater Medicine at HMAS Penguin, he was noted to be conscious but drowsy and weak. Pulse rate: 100/min. BP 130/100. HS normal, chest clear. Abdomen soft but tender, non-distended and no bowel sounds noted. Bi-lateral grade I aural barotrauma. In-dwelling bladder catheter in situ. IV infusion into (R) leg had become blocked.

Positive neurological findings were :-

Right beating nystagmus - exaggerated on right lateral gaze, abolished on left lateral gaze.
Mild left upper limb inco-ordination.
Equal power, tone and reflexes in both upper limbs, but weak.
Complete paralysis of right lower limb with marked weakness of all muscle groups of left lower limb (could just flex knee and ankle).
Lower limb tone was equal, perhaps reduced, but reflexes were increased on the right side of ankle clonus. Plantar responses were flexor.
Sensation. Light touch and pin prick sensation intact but equivocal results were obtained with proprioception and two-point discrimination.

A diagnosis of Spinal Decompression Sickness (involving lumbar segments L2. L3-L4 region) was made. An IV infusion was recommenced and he was given Lasix 20mg and Decadron 8mg in infusion.

5.45 am He was placed in the recompression chamber and was given Stemetil 25mg IMI for nausea. At this stage the nystagmus was no longer present. After 10 minutes at 30 ft on 100% O_2 no change was noted except that lower limb reflexes were absent. No further change after 10 minutes at 60 ft.

He was changed to 40% O_2 and compressed to 120ft for 10 minutes - no change. After 10 minutes at 165ft on 40% O_2 the reflexes were noted to be brisk but there were no other changes. He was decompressed to 60ft at 10 ft/min and then decompressed according to Table 6B (RAN) - the long O_2 table.

7.00 am A Rheomacrodex infusion was commenced (500ml over 5 hours). No improvement was noted until 1.30pm when slight contraction of the right quadriceps was noted.

2.00 pm The chamber reached the surface. On examination, the patient was able to elevate his right knee 4-5" off the bed. Power had increased in the left leg. Reflexes were brisk with slight right ankle clonus. Abdominal tenderness was less. 100% O_2 by mask was continued 1 hour on, 15 minutes off until 8.00pm.

TUESDAY 17TH APRIL

An attempt at spontaneous voiding overnight was unsuccessful and he had to be re-catheterised. There was no change in his neurological status. He was still on IV fluids and Decadron.

10.00 am He was given hyperbaric O_2 for 60 minutes at 60ft with an ascent of 3 min/ft. Following this session there was a marked increase in the right quadriceps contraction and some slight hamstring contraction noted.

2.00 pm A further episode of OHP was given. Following this a further improvement in power in te right quadriceps and hamstrings was noted and for the first time, weak plantar flexion at the ankle. Power in the left leg had also improved. More detailed sensory testing

than previously revealed slight dullness of sensation of left leg below mid thigh. There was marked dullness (almost anaesthesia) of sacral and perianal region. Joint position sense was normal. The catheter was removed but again had to be replaced that evening.

WEDNESDAY 18TH APRIL

In view of the encouraging response to OHP on the preceding day a further session of hyperbaric oxygen was given. Assessment after surfacing showed a minimal paresis in the left leg and on the right leg, strong quadriceps and hamstring contraction, moderate plantar flexion and weak extension of the ankle and moderate plantar flexion of the toes. Sensation appeared intact in all areas. He was still unable to void, had not opened bowels and had slight lower abdominal tenderness. The chest was clear and there was no evidence of pulmonary O_2 toxicity.

He was then transferred to the Royal North Shore Hospital for intensive rehabilitation in the Spinal Unit.

The discharge summary from that hospital noted that "over the next six weeks he made a gradual improvement in muscle power in the lower limbs. The catheter was able to be removed from his bladder, and on discharge he had a residual volume of less than 100ml. He wa able to micturate by tapping above the pubis. His walking improved and on discharge he was able to walk safely with two sticks and could manage steps."

COMMENT

Once again the benefit of hyperbaric oxygen as opposed to recompression per se was demonstrated.

There was no improvement at all once down to 165ft, but after several hours in the chamber at 60ft or less on 100% O_2 there was some slight improvement.

Further improvements were noted after each session of hyperbaric oxygen.

The mechanism is obviously not just reduction of bubbles at this stage. The most logical answer is that the OHP overcomes ischaemia of tissues not already infarcted, but whose function is impaired, however other processes may be involved.

Several studies have shown, in animals whose spinal cords have been artificially injured, an elevation of the cord pO_2 under hyperbaric conditions. Some workers also mention a reduction in spinal oedema, although the mechanism of such is not clear. It may just be secondary to improved tissue oxygenation. The vasoconstrictive effect of OHP is said to have a beneficial effect in reducing cerebral oedema, although this has not been proven in spinal oedema.

Two main points arise from this case and that reported in the previous Newsletter. One is that a beneficial effect of recompression/ hyperbaric oxygen is seen even up to 50 hours after the onset of symptoms so that in serious cases an attempt to reach a chamber should always be made.

Secondly, the improvement seen with repeated sessions of OHP gives support to the concept that this may be a useful therapeutic modality in the management of traumatic spinal injuries as well.

The School of Underwater Medicine, in association with Royal North Shore Spinal Unit will investigate this concept further in 1974 using sheep with mechanically injured spinal cords.

SPUMS MEETINGS

i. NSW BRANCH MEETINGS - 14 JULY 1973

a. Venue for 1974 Conference

The general feeling present was that the conference should be held in Summer because of the warmer water temperature for diving. A weekend in late November 1973 was suggested as being suitable for the 1973 Annual General Meeting and it was decided to ask the Queensland members if they would care to organise such an event. February 1974 was tentatively suggested as a suitable time for the Diving Medicine Conference.

b. A suggestion that SPUMS communicate with the Minister for Customs and Excise in order to attempt to have the levy on imported compressed air inflatable life jackets diminished or waivered. It was pointed out that the SDAA in NSW had failed in its moves in this direction, and it was felt by all, that an approach from a professional medical body such as SPUMS may receive more attention, as this item of safety is considered an essential part of diving equipment for all divers.

c. Discussions (preliminary) concerning the design of a motif for letterheads and the Newsletter. Bob Thomas and Jim Hazel both produced some interesting designs. Opinions were divided and it was decided to press for a decision, based on submitted designs from any source, at the AGM.

d. Bob Thomas informed the meeting of initial discussions with MR Fred Hayes, Managing Director of Fred Hayes (Printers) Pty Ltd. General agreement had been reached concerning the printing of 150-200 copies of an improved Newsletter for a cost of approx. $120.00 per edition. This offer was particularly generous as it was essentially a non-profit contact. The Newsletter at this stage was envisaged as consisting of approx. 16 pages of quarto (bookshelf size) format. The Editor also repeated his request for more contribution by members for the Newsletter.

e. A letter to the Secretary from the Diving Retailers was read. This concerned the involvement of SPUMS in safety aspects of diving and included divers medical examinations. Advice was requested as to SPUMS attempts at rectifying the shortage of suitable qualified diving doctors.

f. Brief discussions were held re the Diploma of Diving and Hyperbaric Medicine and the Certificate of Underwater Technology.

The meeting closed after 90 minutes of pleasant but argumentative discussion.

ii. ANNUAL GENERAL MEETING

VENUE: BROADBEACH INTERNATIONAL HOTEL, QUEENSLAND

DATE: SATURDAY 17TH - SUNDAY 18TH NOVEMBER 1973

The Annual General Meeting for 1973 has been organised by the Queensland Branch members and all should have received details of costs, accommodation, travel, etc. by now.

It is hoped that there will be a good attendance, as the agenda to be discussed is vital to SPUMS activities in 1974.

For interested members who may have lost their circular, or not have received same (thanks to the PMG these last few weeks) further information can be obtained from:

Dr P Nicoll
Pathology Department
Princess Alexandra Hospital
Ipswich Road
WOOLLOONGABBA QLD 4102

In order to stimulate some though beforehand, a copy of the agenda is included in this Newsletter.

AGENDA FOR SPUMS ANNUAL GENERAL MEETING, 1974

1. Apologies
2. Minutes of 1973 AGM at Heron Island
3. Business arising from Minutes
4. President's report
5. Secretary's report
6. Treasurer's report
7. Editor's report (Newsletter)
8. Correspondence
9. Discussion of Constitution
10. Discussion of possible subscription increase
11. Election of Office Bearers for 1974 (Treasurer)
12. Diving Conference 1974 - as you are all aware, the French nuclear testing in the Pacific tragically curtailed what would have been a most successufl conference on the Isle of Pines, Noumea. Much preparation is needed now in order to preclude such cancellations have to occcur for our next conference. A venue and date are needed.
13. Other business (SPUMS Educational Programmes)