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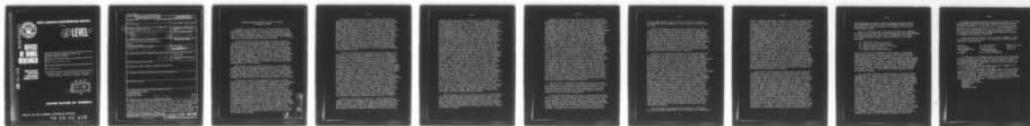
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EUROPEAN UNDERSEA BIOMEDICAL SOCIETY 4TH ANNUAL SCIENTIFIC MEETING
ROBERT GOAD, LCDR, MC, USN*
29 December 1978

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20. ABSTRACT (Continue on reverse side if necessary and identify by block number) 4) The 4th Annual Scientific Meeting of the European Undersea Biomedical Society was held in Luxembourg on the 12th and 13th of October 1978. This report summarizes the meeting which was concerned with the Medical Aspects of Diving Accidents, and reviews the 20 papers which were given. Presentations were divided into topics relating to one of the four following areas: (1) Unconsciousness of the Diver in the Water, (2) Diagnosis of Decompression Illnesses, (3) Treatment of Decompression Illnesses, and (4) Coincidental Injury or Illness While at Raised Environmental Pressure. A		

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EUROPEAN UNDERSEA BIOMEDICAL SOCIETY 4TH ANNUAL
SCIENTIFIC MEETING

A Congress on the medical aspects of diving accidents was held in Luxembourg, capital city of the country of the same name, on the 12th and 13th of October 1978. It was sponsored jointly by the Mines Safety and Health Commission (MSHC) of the European Economic Community (EEC), the European Undersea Biomedical Society (EUBS), and the Medical Committee of the European Diving Technology Committee.

The EEC has recently become interested in creating links with the EUBS as a result of the increasing number of diving-related questions being put to them following any accident involving divers of the member nations (i.e., What are the safety criteria in the North Sea? Are diving practices that jeopardise a diver's health a problem? What is the maximum depth for diving operations? Are UK regulations going to harmonize with EEC safety regulations? Should the EEC begin work on diving regulations?). Hence their sponsorship of this Congress. The southwest of Luxembourg is part of the rich Luxembourg—Lorraine iron mining area, which makes the country a major iron and steel producer. The EEC Service for Medicine and Hygiene (which is responsible for the MSHC) is headquartered in the capital, a major factor in determining the site of the meeting.

Many thanks are due the primary organizers, Mr. Peter Walker of the MSHC and Surgeon Lieutenant Commander Tom Shields, RN, Secretary of the EUBS. The surroundings and amenities were superb, and simultaneous translation of the discussions as well as the scientific papers into four languages was provided. Although a number of those expected to attend the meeting did not show up, the final turnout of 120 participants was very gratifying and compared most favorably to past years.

If one plans to visit this independent grand duchy in western Europe, one should lower his expectations if arriving by air and staying in the capital city. Prices for food and accommodation are generally quite high, and the airport consists of a very small terminal with long waits for most flights, considerable confusion, and surly personnel. On the positive side, Luxembourg city, at the confluence of the Alzette and Petrusse rivers, can boast of some very picturesque and historic areas. Once one of Europe's great fortresses, the fortifications of this walled city are now interspersed with well-kept parks and paths which are beautiful to walk through. The lower, older part of the city is particularly interesting with its casemates, networks of underground passages, and medieval shelters for weapons and troops. The Ladies' Program included a day-long tour of the north of the country (one can drive all over the 51 x 35 mi² nation of Luxembourg in a couple of days). In Hamm, which is only 3 miles east of Luxembourg city, one can visit the military cemetery where General Patton is buried. If one were a child or not around yet during WWII, it may be the first time he has a real understanding and feeling for the losses sustained in the Battle of the Bulge.

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The Congress itself consisted of 20 scientific papers divided among 4 sessions, with both a panel and open discussion from the floor following each session. There were 2 "invited" general review papers leading each session, followed by anywhere from 2 to 5 "submitted" papers. The papers were up to acceptable standards for the most part. Unfortunately the few that were not ate into discussion times and on 2 occasions, discussions had to be terminated owing to time constraints just as they were becoming interesting. The texts of the 8 invited papers were pre-circulated to all registered participants, in their native tongue, several weeks prior to the Congress. The full Congress proceedings are to be published by the EEC in early 1979 and distributed to all attendees. I have learned that it is planned to print enough copies so that requests from other interested parties can be met. Those interested in obtaining a copy should write directly to Mr. Peter Walker, Mines Safety and Health Commission, European Economic Community, Jean Monnet Building A2, Avenue de Gasperi, Luxembourg, Kirchberg. At this writing it is not yet known what the charge for this service will be.

Session I was concerned with Unconsciousness of the Diver in the Water. Dr. C.M. Childs (Univ. of Aberdeen, UK) gave an extensive review paper covering the altered conditions to which man is subjected during diving and which acting singly or in concert can lead to loss of consciousness. Environmental factors such as hypoxia, hypercapnia, narcosis, and cold, as well as predisposing factors such as drugs and intercurrent illnesses, and the diver's physical and psychological performance were discussed. Conclusions were that pathological pathways leading to sudden loss of consciousness are few, but the factors leading to a given accident are easily lost in the confusion of the many changes associated with diving. Continual recording and analysis of all diving problems is essential if answers to questions raised by loss of consciousness underwater are to be found. In the discussion session, Dr. D.A. Youngblood (Oceanering International, Houston, TX) said high-pressure neurological syndrome (HPNS) and hypothermia might be potentially greater problems in the operational diving setting than is commonly felt. He pointed out that in this regard, some thought has been given to selecting those divers less sensitive to HPNS and to ensuring that at least one bell occupant has had previous exposure to it. There was some discussion as to whether CO₂ tolerance tests should be considered in the screening of potential divers. This has generally been regarded as a waste of time in the past, but recently Morrison, et al., have re-raised the question, citing two diving accidents where low individual ventilatory responses to inspired CO₂ were thought to have been partly responsible [*Undersea Biomed. Res.* 5(2), 179-187].

The second invited paper in Session I, given by George Arnoux (COMEX Diving Limited, Aberdeen, UK), dealt with that particular diving company's approach to the problem of rescue and resuscitation of the unconscious diver. The rescue of a surface-oriented diver from depths up to 50 m was examined first, with emphasis on prevention of lung barotrauma during ascent, immediate recompression when indicated, not

delaying resuscitation during transportation to the chamber, and continuing drills at the work site. He outlined the very practical reasons for their method of rescuing bell divers which essentially consists of raising the water level in the bell, securing the victim in a vertical position by means of a hoist and harness with the lift point between the shoulder blades, ensuring an airway with the combination of an oropharyngeal tube and a quick-fit cervical collar, and performing cardiac-pulmonary-resuscitation (CPR) by mouth-to-mouth alternated with cardiac massage accomplished by facing the patient with both arms passed underneath his shoulders and applying pressure with the head. This was followed by another paper by Dr. A. Marroni (Saipem Diving, Milan, Italy) concerning another method of getting an unconscious diver into a bell and resuscitating him. The only differences were that they utilize a harness with the lift point anteriorly at the top of the sternum, do not use a cervical collar, and perform cardiac massage by facing the patient, right arm under his left shoulder, left arm holding his harness, and applying pressure with the right shoulder. Discussions that followed showed differences of opinion as to which method is the most tiring, and whether enough pressure can be generated by any method in the vertical position to cause effective circulation (although it's generally impossible to get a bell diver in a horizontal position). It was suggested that in addition to flooding the bell partially, the possibility of raising the diver's legs by a separate hoist to assist venous return might be worth considering. All agreed that it is important to start resuscitation as soon as the diver's head appears above the water in the bell (how to accomplish this is less clear). The absolutely critical role of the bellman was acknowledged and the importance of diver first aid training emphasized. Mention was made that a "standard of training" is needed, and Surgeon Vice Admiral J. Rawlins, RN (London, UK) stated that the Diving Medical Advisory Committee (DMAC) to the UK Association of Offshore Diving Contractors is working on such a proposal, which should be ready soon. It was noted that a detailed study of the various suggested methods of recovery and resuscitation of a bell diver is still needed. For my part, I find the COMEX method to be very logical and practical until such a study is done. I have seen a very well illustrated, clear, concise publication on "The Handling of an Unconscious Diver in a Diving Bell" issued by the COMEX Safety Department and intend to write Arnoux for a copy (charge not known). For anyone wishing to do the same, the address is George Arnoux, COMEX Diving Limited, Bucksburn House, Howes Road, Bucksburn, Aberdeen AB2 9RQ, Scotland.

The final paper in the first session by Dr. Med. O.F. Ehm (Facharzt für Einner, Heidelberg, FRG) discussed the problems of hyperventilation in breath-holding underwater distance swimmers and in divers. In essence, the conclusion was that this particular problem has virtually been eliminated in Germany among the snorkel and skin-diving population, thanks to education and training, but that it continues to be a cause of mishaps in public swimming baths and emphasis on education of school-age children is needed.

Session II, held on Thursday afternoon, was entitled "Diagnosis of Decompression Illnesses." The first paper by Dr. G. Masurel [Centre d'Etudes et de Recherches Techniques des Sous-marins (CERTSM), Toulon, France] was a historical review of ultrasonic detection of bubbles in hyperbaric conditions, combined with a proposal to establish a standardized data bank to permit rapid exchange of information between the various international diving centers. Later in the afternoon Masurel gave another joint paper [with investigators from CERTSM and Groupe d'Intervention sous la Mer (GISMER), Toulon-Naval, France] describing Doppler techniques used and results obtained during a recent series of deep saturation dives. Dr. M.R. Powell [Deutsche Forschungs und Versuchsanstalt für Luft und Raumfahrt (DFVLR), Bad-Godesburg, FRG] presented the results of ultrasound monitoring during decompression in a series of chamber dives at 100 to 200 m. Powell (formerly of the Institute of Applied Physiology and Medicine in Seattle) has always seemed to me to be a voice of sanity in a bubble detection quagmire. His group's opinion is that Doppler control of a decompression is not possible in that bubbles measured have their origins in muscle and fat and are not the ones responsible for joint pain. After analysis of the largest series of monitored human dives to date, some French authors are of the opinion that when high grades of bubbles are detected, at rest, during the initial rapid pull of a decompression or during decompression from an excursion dive, there is a high likelihood of an incipient vestibular hit, and immediate recompression should be undertaken. With the possible exception of this particular set of circumstances, however, it is becoming increasingly obvious that ultrasonic bubble detectors, as even reasonably accurate tools to predict bends, must await a better understanding of bubble physics and secondary bubble effects and their relationship to the clinical signs and symptoms of decompression sickness. There was some discussion as to whether any bubbles are acceptable during decompression. While there was certainly no resolution to this question, food for thought was given in Powell's observation that although some divers are more prone to form precordially detected bubbles, these divers are not the ones most susceptible to decompression sickness.

The other paper concerned with ultrasonic techniques was given by S. Daniel (Univ. of Oxford, UK) and described their method of ultrasonic imaging to study stationary as well as moving bubbles. This work may ultimately bear fruit as initial observations, in animals, seem to support the hypothesis that stationary bubble formation is primarily a feature of severe decompression.

A review of the present status as well as possible future developments of methods for the diagnosis of decompression illnesses was given by Dr. R.F. Goad (Institute of Naval Medicine, Alverstoke, UK). Particular emphasis was placed on post-therapy investigation, and making basic, technically easy, diagnostic and monitoring techniques available to the physician charged with managing accidents at the work-site chamber. Along these lines, it is hoped that through the aegis of the DMAC, a standard range and form of electrical penetrations will

soon be recommended for the UK and the its sector of the North Sea as suggested by Surgeon Commander R. Pearson (Institute of Naval Medicine, UK).

The last two papers in Session II were given by Dr. J.D. King (UK) and Dr. C.W. Sem-Jacobsen (EEG Research Institute, Norway). King, calling for better education of divers and tunnelers, suggested that a check list and/or a questionnaire be completed after each exposure to pressure in order to identify many minor episodes of decompression sickness (DSC) that are not now being reported, and in turn, that would lead to better methods of avoiding DSC. Sem-Jacobsen reported on a continuing pilot study involving the recording of brain-evoked responses during operational diving in the Norwegian sector of the North Sea. These records will be compared with the record from the same diver if he is involved in a decompression illness or experiences an episode of altered consciousness at pressure, and it is hoped that they will provide insight into the origin of such incidents.

Session III, held during the morning of the second and final day of the Congress (for those of us who were able to stagger in after the combination of an excellent lunch and the large evening banquet provided by our EEC hosts the previous day), concentrated on the Treatment of Decompression Illnesses. Dr. E.E.P. Barnard (Institute of Naval Medicine, UK) led off with a review of the use of oxygen and pressure as independent variables in the treatment of decompression sickness, surely the best paper of the entire Congress. When he pointed out that a review of the literature of the past decade showed that there are more than 60 papers that could be described as case reports but only 4 that contained experiments relating to the treatment of decompression sickness, I couldn't help recalling again the century-old words of Mark Twain; "There is something fascinating about science. One gets such wholesale returns of conjecture out of such a trifling investment of fact." Both Barnard's presentation and the other excellent invited paper in this session, a review of drugs used for the treatment of decompression sickness by Dr. B. Broussole [Centre d'Etude et de Recherches Biophysiques Appliquées à la Marine (CERB), France], clearly emphasized the empirical nature of everything we do in the treatment of decompression disorders. Two things are still needed in our specialty: more controlled clinical trials to evaluate our treatment methods and continued work towards rationalization of therapy on an international basis. The latter point was evident in the discussion that evolved around the use of steroids. The French feel they should be discontinued in the relatively high doses in current use, while most others at the meeting argued that they do have a place (interestingly, some French centers have also discontinued using steroids in several nondiving clinical disease entities, such as endotox_{ic} shock, whereas US and British experience indicates their use in similar situations).

The other paper Friday morning that provoked some interesting discussion (although unfortunately it was cut short) was a presentation

by Dr. L. Fagraeus (Duke Univ., Durham, NC) on normoxic nitrogen saturation as a therapeutic procedure. Recently there has been ongoing controversy in the medical literature over this issue (if interested in more details see *Lancet*, 1978, 169-171; 468-469; and 782-783). Fagraeus clarified his group's position somewhat by pointing out that they are recommending it for severe (generally sport) diving accidents only as a last resort when all other recognized therapies have failed. It is unfortunate that at least one of the three cases in the original paper that sparked these arguments never really received the benefit of a full hyperoxic treatment. Several physicians feel that "time" and repeated hyperoxic therapy have been observed to give results comparable to those obtained in the two remaining patients. Since that original paper, Fagraeus and colleagues have treated another case which he described at this meeting and which seems a better test of their hypothesis. Most would agree that oxygen/nitrogen saturation therapy (which is not normoxic by the way) is useful in getting a badly mismanaged patient to the surface or as a recourse after pulmonary oxygen toxicity has developed. However, there are no facts as yet to support the procedure's being efficacious in other circumstances. To be fair to the authors, many of the objections were based on hypothetical situations for which they actually never advocated using the procedure. At the same time, in this day of legal repercussions, particularly in the field of diving incidents, the hypothetical situations deserve consideration. One can only hope that discussions will continue at the Undersea Medical Society meeting in Key Biscayne, Florida next May and that groups having experience with similar methods (i.e., U.S. Naval Experimental Diving Unit) or pursuing alternative treatment approaches will be encouraged to contribute.

The fourth and final session on Friday afternoon was titled "Coincidental Injury or Illness While at Raised Environmental Pressure." Both the invited papers in this session were quite good. First, Dr. Y. Kermorgant (Hôpital d'Instruction des Armées St. Anne, Toulon-Naval, France) gave a very scholarly review of what is known and what remains to be learned about anesthesia in a hyperbaric environment. It is obvious that this has been a badly neglected area, and work is particularly needed on respirators at pressure, fire risks of different anesthetic agents and equipment, and the pharmacokinetics at pressure of a wide range of intravenous and possibly inhalation agents. The point was made in the discussion session that regional techniques should be carefully considered since probably 90% of all surgical cases can be dealt with using such methods and they offer the advantage of not interfering with cerebation. Again, the need for an international approach (and a good reason to continue international meetings like this) was apparent; i.e., in that regional block has been rather neglected in the UK so the British anesthesiologists were quick to point out potential problems, while on the other hand such techniques are used extensively in America so that US anesthesiologists present argued the benefits. In general, I suppose it's true that both surgeons and patients will tend to favor and request whatever techniques the anes-

thesiologists are most adept in their geographical location, however, this is apparently an area in which free exchange of ideas can only be beneficial in trying to anticipate the problems of caring for an injured diver at depth.

Next Dr. J.N. Norman (Dept. of Surgery, Aberdeen Univ., Aberdeen, UK) made a very good case for a mobile intensive care unit, after logically and clearly outlining the priorities for management of sick divers in an offshore pressure chamber. These are felt to be, in order of importance:

- (1) Training of divers in first aid,
- (2) Clear and concise communications,
- (3) Trained doctors willing to go offshore,
- (4) Mobile intensive care unit,
- (5) Transfer under pressure facility.

This in no way detracts from Andre Galerne's efforts in pioneering international underwater contractor's (IUC) transfer under pressure (TUP) rescue system, but it does emphasize that a seriously ill or injured patient's condition must be first stabilized by an expert medical team before transfer can take place. In the discussion session Fagraeus made the suggestion that a General Purpose Civil Submarine manufactured by Kockums Shipyards in Sweden might provide an ideal stable platform for a mobile intensive care unit operating team. This 1250-ton vessel is 62 m long and has 2 separate chamber facilities on board (capable of saturation to 350 m). (It was determined that Fagraeus does not hold stock in Kockums).

Dr. J.W. Sykes (Institute of Naval Medicine, UK) presented eight selected cases of coincidental medical or surgical disease in divers. Although once again raising the question of "how strict should medical standards be?", the paper was valuable in that it gave graphic evidence that regular examinations are valuable in detecting potential problems and reaffirmed the adage, "if in doubt, recompress." This was followed by a review of autopsy findings in a series of diving related deaths by Dr. I. Calder (London Hospital Medical College, UK). While the conclusion was that the majority of these deaths was entirely unpredictable, perhaps even with the most advanced noninvasive diagnostic techniques, I for one found it refreshing to have a pathologist giving his views. The underwater medicine fraternity is a rather closed one, and we must continue interchanges with other disciplines to prevent stagnation, a view which must also have been held by the Congress organizers as the final paper of the day was about a new approach to underwater accident statistics by C. Missirliu (Laboratoire Lacharte, Paris, France). His suggestion was that by using a "Bayesian" method, it may be possible to assess the statistical significance of minor diving incidents in light of their likelihood to contribute to a serious incident. If successful, of course, such a technique would be valuable in identifying weak points in our system and so reduce the chances of a disaster. (Such an approach has apparently achieved success in reducing the number of fatal automobile accidents in some areas.)

For anyone interested in previous reports on the EUBS or the various workshops and scientific meetings that organization has held, the appropriate *ESN* numbers are: 26-11:300; 27-7:161; 28-8:287; 30-12:561; 31-10:415. Additionally the full text of all the presentations from the Third Annual EUBS meeting held in Toulon, France on 15 and 16 July 1977, has been published now in the last three issues (numbers 63, 64 and 65) of the French *Journal de Médecine Aéronautique et Spatiale et de Médecine Subaquatique et Hyperbare*.

A short EUBS business meeting was also held in Luxembourg. There was nothing significant to report. For information, current elected officers of the Society are:

President	Dr. Xavier Fructus	Marseille, France
Vice President	Dr. David Elliot	Surrey, UK
Treasurer/Membership	Surgeon Lieutenant	Hants, UK
Secretary	CDR Thomas Shields	
Secretary	Med. Princi Rene Hyacinth	

(1) There will be a workshop held at the Institute of Naval Medicine in Alverstoke, UK, on the 4th and 5th of October 1979 on the Lung in Diving (pulmonary function tests, selection of divers, sequelae of pulmonary barotrauma). EUBS members will be invited and the workshop will be reported in *ESN*.

(2) The 5th EUBS Annual Scientific Meeting is scheduled to be held in Bergen, Norway on 6 and 7 July 1979.

(3) A Technical Symposium on The Human Factor in North Sea Operational Diving was held in London in November, 1976. Air Products has acted as the publisher of the proceedings, and copies have just been sent to all attendees. Additional copies are available upon request at a cost of \$5.00 per copy (if writing from outside the UK, add another \$1.00 for postage and handling). The address to write to is:

Air Products Limited
 Attention: S.R. O'Neill
 Downmill Road
 Bracknell
 Berks RG12 1QF, UK