ORIGINAL PAPERS

PROVISIONAL REPORT ON NEW ZEALAND DIVING-RELATED FATALITIES 1983-1984

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SUMMARY

During the years 1983, 1984 there were six fatalities in breath-hold divers (4,2) and fourteen (7,7) in scuba divers. The full facts are not available in many cases but sufficient details are known to indicate some major avoidable adverse factors.

The breathhold diving fatalities include demonstration of the dangers of fatigue, cold, hyperventilation, cardiac factors, asthma, previous chest disease and epilepsy. Such factors are only rarely themselves the sole critical cause of the fatal outcome, a common additional factor being separation from the buddy or the lack of a buoyancy vest. Two of the deaths were considered to be unavoidable in the particular circumstances of their occurrence (cases BH 84/1, BH 84/2) but to have a direct relationship to the stresses (fatigue, cold, effort) associated with their dive which made the critical illnesses non-survivable.

Scuba related fatalities similarly show separation and a lack of or failure to use a buoyancy vest, though an inflated vest is no guarantee of survival. Inexperience and absence of formal instruction in scuba diving are common findings, though even the best of supervision may not prevent a fatal outcome where cardiac factors operate strongly.

CASE REPORTS

The reviews are based on information given at Inquests. It should be remembered that "the Coroner's function is to establish the identity of the deceased person and when and where he died." This definition by a New Zealand Coroner accurately defines the basic function of any Inquest and it is fortuitous and welcome when the search to establish the "why" of a diving-related death documents all the details which are necessary to analyse the many factors influencing the final critical path. The Coroner's task is easier when the medical evidence is given by pathologists fully aware of diving apparatus and diving pathology. The term "asphyxia" should never be used without an explanation of how it has been produced: it is not the expected result of running out of air using scuba.

BREATH-HOLD DIVING CASES

Case BH 83/1

This 21 year old man, in company with a friend, dived for mussels on a reef 100m from shore. They started when it was low tide and the water was neck deep but an hour later the tide had come in and they could no longer touch bottom when standing. The victim was described as a strong swimmer but this was only the 3rd or 4th time he had dived for mussels. He was wearing a wet suit jacket, mask, a borrowed weight belt which did not have a proper quick release, and boots, not fins. The buddy noticed that the victim seemed to be in trouble but was himself feeling too tired to offer any help so he called to people ashore to come to give assistance and himself swam back to the shore. There is no mention of the sea conditions at the time. The body was found two days later, weight belt in position.

GROSS INEXPERIENCE. SURFACE PROBLEM. BUDDY TIRED SO LEFT VICTIM. BOOTS WORN NOT FINS. WEIGHT BELT NO QUICK RELEASE. NO SNORKEL. NEITHER DIVER WORE A BUOYANCY VEST. DIVING FOR MUSSELS.

Case BH 83/2

It was only the second time he had gone diving and he had borrowed equipment from a friend. He was an epileptic, on medication for 2 years, who had "warning twitches" before any full epileptic attack developed. He had permission to swim if he was accompanied, but "diving" had not been discussed. He and another boy snorkelled out to some buoys about 100m from the beach and there the buddy lost sight of him momentarily while ducking under a rope in the water near the buoy. When he looked again he could not see his friend but saw some bubbles breaking at the surface. He immediately dived but was unable to reach the sea bed, a depth of 15 metres. The body was recovered later by the police divers. It is assumed that he lost consciousness and drowned as a result of an epileptic fit. Possibly he failed to recognise the warning signals because of his concentration on snorkelling, a totally new experience. The buddy removed his attention for no longer than might occur during any in-water activity, underlining the danger of all such activities in incompletely controlled epileptics. It is not known whether the buddy was fully aware of the risk which his friend's condition posed: though he knew he was epileptic and took pills he had never seen an attack.

They had one speargun and the victim was holding it when last seen so it is possible he had made an intentional dive to retrieve it if he had accidentally let it slip from his hand, and suffered the fit underwater, but it is unlikely there was time for such a series of events during their brief separation. They were making their way to a more distant buoy when the incident occurred. The medical history is that he suffered only infrequent attacks and these were usually when he was fatigued and seemed to be limited to the early hours of the day, and for this reason he was given permission to play rugby, and swim if accompanied.

EPILEPTIC. 2ND SNORKEL SWIM. MOMENTARY VISUAL SEPARATION FROM BUDDY. EPILEPTIC ATTACK PROBABLE CAUSE OF LOSS OF CONSCIOUSNESS, DROWNING.

Case BH 83/3

Although he (probably) died from a blackout after he hyperventilated to breath-hold dive to retrieve his mask, he had his scuba equipment at hand and could easily have worn it. It is probable that the water clarity misled him in estimating how deep the water was, and his breath-hold diving skill enabled him to put himself at risk. There were 12 experienced divers on a boat dive, the victim and his buddy being among the six set down on a rocky islet as their dive base. He and his buddy dived for 20 minutes then surfaced further than expected from the rocks but were not unduly fatigued by their return swim, and then rested on the rock after removing all their equipment, including their

NEW ZEALAND DIVING-RELATED FATALITIES 1983

CASE	AGE	DIVE SKILL VICTIM	DIVE SKILL BUDDY	DIVE GROUP	DIVE BASE	WATER DEPTH DIVE	WATER DEPTH INCIDENT	WEIGHT BELT ON OR OFF
BH83/1	23	Nil	Not stated	2 Separation	Beach	Not stated	Surface	On
BH83/2	16	Nil	Trained Experienced	2 Separation	Beach	Not stated	Surface	On
BH83/3	29	Experienced	Trained Experienced	Separation Solo	Rock	70'	? ASC ?	On
BH83/4	25	Experienced	Not stated	2 Separation	Beach	12'	Not stated	On
SC83/1	25	Part trained Inexperienced	N/A	Solo	Land	15'	15'	On
SC83/2	32	Trained Experience	Experienced	(9) Buddy	Boat	25'	25'	On
SC83/3	34	Not stated Inexperienced	N/A	Solo	Boat	Not stated	Not stated	On
SC83/4	32	Not stated Inexperienced	Experienced	3 Separation	Beach	15'	15'	Not stated
SC83/5	46	Just trained Inexperienced	Trained Experienced	3 Separation	Boat	85'	? ASC ?	On
SC83/6	30	Both pupils	in a class	2	Boat	30'	Surface	On
SC83/7	22	Trained Experienced	Trained Experienced	2 Separation	Boat	30'	Surface	On

compensators.

Another diver borrowed the victim's mask to recover his and shortly after it was returned a sudden wave threatened to wash all their equipment into the sea. He succeeded in retaining everything except his mask so borrowed his buddy's and made a surface search. He called out that he could see the mask 30 feet below (he estimated) on the sea bed, then he dived. He failed to surface and two minutes later his buddy felt alarmed so attempted a "blind" (maskless) breath-hold dive search for him, but was not successful. Later two scuba divers found the body in 70 fsw water but as there was a strong current it is not certain whether this represents the dive depth. The weight belt did not have a quick-release and it required the efforts of both rescue divers before they could remove it.

SCUBA DIVER MAKING BREATH-HOLD DIVE TO RECOVER MASK. DIFFICULT TO REMOVE WEIGHT BELT AS NO QUICK RELEASE. SOLO DIVE. PROBABLY HAD A POST-HYPERVENTILATION BLACKOUT. BUDDY HINDERED BY LACK OF MASK.

Case BH 83/4

The two divers were spear fishing in 12 feet deep water. After about 20 minutes they separated, and 3-5 minutes later as the buddy was swimming to deposit a fish in their boat he saw the victim lying on the sea bed below, all his equipment in place. He dived and brought him to the surface and got him onto some rocks, ditching the weight belt to make the task easier. He called for assistance and started EAR resuscitation but the victim did not respond. He was known to have had a thoracotomy to remove a bronchiectatic right middle lobe and to suffer from asthma but the most probable critical factor is a post hyperventilation blackout as he had not been known to suffer asthma while at sea or diving, the water conditions were good, and he had shown no signs of any problems when seen a few minutes before he died.

SEPARATION/SOLO. SPEARFISHING. FOUND ON SEA BED. CALM SEA. POSSIBLE POST-HYPERVENTILATION BLACK-OUT. NO BUOYANCY VEST. MEDICAL HISTORY BRONCHIECTASIS AND THORACOTOMY WITH REMOVAL RIGHT MIDDLE LOBE. ASTHMA.

NEW ZEALAND DIVING-RELATED FATALITIES 1983

WEIGHT BELT WEIGHT LB	CONTENTS GAUGE	BUOYANCY VEST	EQUIPMENT TEST	REMAINING AIR	EQUIPMENT OWNER	WET SUIT	COMMENTS
Not stated	N/A	No	N/A	N/A	Loan	Jacket	Weight belt without quick weights release; surface problem; buddy too tired to help; good swimmer.
Not stated	N/A	No	N/A	N/A	Not stated	Yes	Only short separation time. Epileptic.
Not stated	N/A	Off !	N/A	N/A	Own	Yes	Scuba diving; lost mask, so breath-hold dive to find ! ?post-hyperventilation blackout?
Not stated	N/A	No	N/A	N/A	Own	Yes	Medical history of thoracotomy for Bronchiectasis. Asthma. Post-hyperventilation blackout?
Not stated	Not stated	No	Yes	Not stated	Own	Part only	Ex-pub, diving for eels in river. Non-divers nearby.
33	Yes	Not	Yes Inflated	1/2 full	Own	Yes	Separation by sudden water surge; buddy also at risk.
Not stated	Not stated	Not Inflated	Yes	Not stated	Loan	Yes	Friend in boat waited and waited; found 2 days later.
Not stated	Not stated	Not stated	Yes	Nil	Not stated	Yes	Refresher dive with 2 experienced divers; poor visibility, separation.
Not stated	Yes	inflated	Yes	Nil	Own	Yes	Surfaced unconscious: CAGE, Coronary artery atheroma; weight belt as worn could not be released quickly.
20	Yes	Inflated	No	Near full	Own	Yes	1st sea dive: class, surface acute cardiac arrhythmia?
21	Yes	Fault	Yes	Low	Loan	Yes	Inhalation of vomit. Wore torn

Case BH 84/1

The victim, who was wearing swim shorts and booties, was snorkelling with a companion when he suddenly started beating his chest with his fists, taken by his companion to mean that he had heart trouble. The buddy went to his aid but when he reached rocks near the shore the victim collapsed, his breathing becoming irregular. His breathing ceased prior to his being placed in the Land Rover sent to transport him and EAR was commenced before he was moved. Ambulance personnel gave oxygen and applied ECC in an attempt to resuscitate him but he did not respond.

He had a history of a heart complaint, though to what degree this was known to his buddy is unknown. At the autopsy the mitral valve was described as admitting three fingers easily but the cusps were not overtly abnormal; the heart was enlarged, mainly due to dilation with some ventricular hypertrophy; and there was a double right coronary artery arising from the right coronary cusp. There were petechial haemorrhages and ecchymoses present on the external surface of the heart over the track of the coronary vessels, and also the lungs, particularly in the hilar region. The appearance suggested gross congestion. The diagnosis was that he suffered "oedema of the lungs consistent with irregularity of the heart beat, consequent on past rheumatic fever". This indicates that the pathologist was unaware of the true medical history as a consequence of the usual practice of non-contact with the regular medical practitioner of victims with medical conditions.

His medical history is that at age 12 he presented with an episode of rapid supraventricular tachycardia which had required electrical conversion. There was another episode at age 16 which required hospital treatment. He apparently experienced numerous episodes which settled spontaneously and he only went to the hospital if such resolution did not occur. He was advised by the specialist who first made the diagnosis, that he was suffering from the Wolf Parkinson White syndrome, that he should lead a full active normal life. He followed this advice by playing football, and he had been a keen scuba diver for over two years. In fact he had been scuba diving prior to his death and only changed to snorkel after emptying his tank. He had

NEW ZEALAND DIVING-RELATED FATALITIES 1984

CASE	AGE	DIVE SKILL VICTIM	DIVE SKILL BUDDY	DIVE GROUP	DIVE BASE	WATER DEPTH DIVE	WATER DEPTH INCIDENT	WEIGHT BELT ON OR OFF
BH84/1	22	Not stated	Not stated	2	Rocks	Not stated	Surface	Off
BH84/2	16	Not stated	Not trained Some	Group Solo	Beach	Not stated	On land	Off
SC84/1	24	Not trained Inexperienced	Trained Experienced	2	Boat	45'	Surface	Not stated
SC84/2	24	Not trained Experienced	Trained Experienced	2 Solo	Dock	38'	30'	On
SC84/3	34	Not trained	Trained	Separation	Rocks	10'	Not stated	On
SC84/4	20	Not trained 1st Scuba Dive	Not trained 3rd Scuba Dive	Separation Solo	Boat	8'	8'	On
SC84/5	43	Not trained Inexperienced	Part trained Some	Separation Solo	Boat	Not stated	Not stated	On
SC84/6	36	Not trained Inexperienced	Not stated Separation	3	Boat	15'	Surface	On
SC84/7	54	Not stated	Not stated	Separation Solo	Boat	35'	Not stated	On

been collecting mussels and was at the surface when the fatal episode occurred, presumably a severe tachycardia. It is thought that he managed to pull himself onto the rocks unaided before he collapsed but as no inquest was held there is no copy of the buddy's deposition in the case records.

SNORKELLING AFTER SCUBA DIVE. BREATH-HOLD DIVING FOR MUSSELS. ACUTE CHEST PAIN AND CARDIAC DEATH FROM WOLF PARKINSON WHITE SYNDROME, 10 YEAR HISTORY THIS SYNDROME. LED ACTIVE LIFE DESPITE CONDITION.

Case BH 84/2

This boy went to the beach with four friends and spent most of his time spearfishing, though they spent most of the time ashore. It is not known how successful he was, but as he was not wearing a wet suit and the water was cold he must have been tired when he came ashore. He rarely smoked but may have smoked part of a cigarette with his friends before they all started to walk back to their car. He then began to feel ill and had to sit down for a time to rest while a friend ran to get his "Ventolin" inhaler from the car. His friends were used to his lagging behind them so were not alarmed at this time but when he became breathless they asked a person in a nearby house to call an ambulance and a passer by started giving EAR resuscitation. It is not known at what stage he died but he could not be resuscitated on arrival at hospital. He had required hospitalisation, two and a half years before, for a severe asthma episode and since then had strictly followed the prescribed routine meditation with "Ventolin" and "Becotide". The autopsy examination showed the presence of active asthmatic changes (widespread mucus plugging with tenacious viscid mucus in the medium sized bronchioles and the bronchiolar basement membranes were thickened with numerous eosinophils present in the surrounding tissues). This death was due to an acute asthmatic episode.

SEPARATION/SOLO SPEARFISHING. NO WET SUIT. COLD WATER. ASTHMATIC ON REGULAR MEDICATION. EASILY BREATHLESS ON EXERTION (?). "NON SMOKER" BUT FEW PUFFS OF CIGARETTE POST DIVE. FATAL ASTHMA WALKING TO CAR.

SCUBA DIVING CASES

Case SC 83/1

After a reunion which included some beer a group of six people went to a nearby river to catch some eels for a hinaki pot. While the others were to swim the victim intended to use his scuba to search in a deeper (15 feet) area in the river. After he had dressed in his wet suit etc., he entered the deeper area where he seemed to remain. His friends became alarmed when he had still not surfaced one hour later and made an unsuccessful search for him. His body was found later in a shallower area of the river.

NEW ZEALAND DIVING RELATED DEATHS 1984

WEIGHT BELT WEIGHT LB	CONTENTS GAUGE	BUOYANCY VEST	EQUIPMENT TEST	REMAINING AIR	EQUIPMENT OWNER	WET SUIT	COMMENTS
N/A	N/A	No	N/A	N/A	Own	No	Wolf Parkinson White Syndrome. Sudden chest pain: cardiac.
N/A	N/A	No	N/A	N/A	Own	Yes	Asthmatic. Fatigue. Cold. Rapid post-dive death.
Not stated	Not stated	Yes Inflated	No	Not stated	Loan	Yes	Third scuba dive. Asthmatic. Pre-dive use of inhaler. CAGE. Difficult to get into boat.
24	Yes	Yes Not inflated	Yes	Low	Own	Yes	Cleaning the hull of ship in dock. Found unconscious. Cause unknown.
Not stated	Yes	No	Yes	Nil	Own	Yes	Rough sea. Solo. Failed to drop weight belt. Crayfishing.
14	Yes	Yes Not Inflated	Yes	Low	Hire Loan	Yes	First use of scuba. Asthmatic. Rough sea; cold; lost mask; failed drop weights; inexperienced buddy separation; solo swim.
Not stated	Yes	Yes Not Inflated	Yes	Nil	Own	Yes	Failed to ditch weights. Alcohol was a health risk factor. Started dive low on air.
Not stated	Yes	No	Yes	1/3	Loan	Yes	Asthmatic. First use of scuba. Surfaced solo. Crayfishing.
Not stated	Yes	Yes Not inflated	No	Half	Own	Yes	Surfaced in distress then died. Coronary artery disease. Possible air embolism.

Although he was proud of his scuba knowledge it was found that he had not completed his training and was uncertificated. His equipment was checked and no defect noted but there is no record of any check to note the remaining air pressure.

SOLO. INCOMPLETELY TRAINED. INEXPERIENCE. FAILED TO DROP WEIGHT BELT. NO BUOYANCY VEST. RIVER DIVE? ALCOHOL?

Case SC 83/2

The charter boat brought a party of nine experienced divers to an offshore islet dive site and anchored in 25 fsw deep water 50-60 feet from the shore. The divers entered the water as three pairs and a threesome, the victim and his buddy being last to enter. They planned that the buddy would catch crayfish while the victim was to carry the catchbag. Five of the divers surfaced and had been collected, then the skipper saw the buddy surface and start to signal for help, obviously in distress. After he had been brought aboard he described how a sudden surge had tossed him to the surface and torn off his fins, and told of seeing the victim rushed past him by the surge. An immediate surface search was not successful and the skipper then organised an underwater search by the scuba divers. This also was unsuccessful until the catch bag was located near the white water line and outside the original search area. The skipper and another diver now searched this area and located the victim's body, to which they attached a line and thereby were able to pull it up. He was wearing a 5mm wet suit and his 33 lbs weight belt was considered acceptable though a few pounds more than usual. He would have found himself considerably overweighted in the white water area where the bubble content of the water reduces its density. During the recovery of the body the buoyancy vest was inadvertently activated and inflated, which demonstrated that it was in good condition. It is possible that the victim lost his regulator and was unable to recover it while he was tumbled about in the rushing water. The autopsy reported the cause of death as drowning with terminal inhalation of some gastric contents. No signs of any head injury were found.

WATER POWER. SUDDEN POWERFUL UNEXPECTED SURGE AMONG ROCKS AND WHITE WATER. DIVE LOCATION DANGER NOT RECOGNISED. BUDDY EQUALLY AT RISK. EFFICIENT RESPONSE TO EMERGENCY BY SKIPPER OF DIVE BOAT.

Case SC 83/3

During an outing with some friends and relatives the victim intended diving for scallops. He was rowed out in a dinghy about 500 yards from the shore, with three non-divers remaining in the 8 foot boat when he dived. He soon surfaced and reported that there were scallops there but they were too small, so he held onto the stern of the dinghy and they towed him a bit further out from the beach. He asked that the boat follow his bubbles, then dived again, but because of

the chop and the wind his friends soon lost track of the bubbles. The boat remained in the dive area for one hour before any real anxiety was felt. One of the people in the boat twice thought he had seen something at the surface but these sightings were false, nothing being found when the boat reached the areas of sightings. They returned to the beach after making an unsuccessful surface search and waited there for a time before notifying the police. Shore line and diver searches that day and the next were unsuccessful but a diver found the victim's body two days later, all equipment in place. There was no direct comment to confirm that a weight belt was worn and still in position.

The equipment was reported to be in good condition, though no record was made of whether there was any remaining air. He wore a compensator which could only be inflated orally so was of no value in an underwater emergency situation. The scuba had been borrowed but there is no indication of its source. As he was apparently untrained and had very little diving experience, if his friend is correct, the loan of equipment to him was irresponsible. When he was found he held his regulator in one hand and the catch bag containing scallops in the other, indicating that he had not realised in time his critical need to surface, had concentrated on retaining his catch rather than on his own survival. There is no record of whether he wore, retained, or ditched a weight belt.

UNTRAINED. INEXPERIENCED. SOLO DIVING FOR SCALLOPS. BUOYANCY VEST OF ORAL INFLATION TYPE. WEIGHT BELT NOT STATED. REMAINING AIR NOT STATED. NO CONTENTS GAUGE OR RESERVE SYSTEM. FAILED TO DROP CATCH BAG. BORROWED SCUBA.

Case SC 83/4

The purpose of this dive was to refamiliarise the victim to scuba as he had not dived for about three years: nothing is known of his previous experience or whether he was trained, and the source of his equipment (his own or borrowed or hired?) is unknown. For this reason his two friends were swimming in a leisurely way in water no deeper than 25 feet. They swam in line, the victim as the tail ender. When they noticed his absence they were in water of poor visibility, 15 feet deep. One immediately surfaced to look for his bubbles and the other buddy started to make an underwater search. They were now concerned for their friend's safety so they started a search pattern dive in the area where they had last seen him and soon found him face down on the sea bed. As soon as they surfaced him they started giving EAR and continued this as they towed him to the beach. There was no response to continued resuscitation efforts and the police were notified.

The equipment was checked for the police by a diver with extensive experience and found to work correctly. The tank was empty when examined. There is no comment concerning whether a weight belt was worn and retained/dropped.

The autopsy was conducted with full awareness of the special relevance of diving factors. It was concluded that death was due to drowning, with inhalation of vomit as a terminal event. It is assumed that he must have either failed to recognise his low air situation or have attempted to swim to contact his two friends to tell them his air status, then found himself out of air and failed to try to reach the surface, so drowned. A possibility exists that he made an emergency ascent and suffered a cerebral arterial gas embolism without there being signs of any pulmonary barotrauma, lost consciousness, sank, and drowned. This is unlikely.

TRAINING NOT STATED. EXPERIENCE NOT STATED. OUT OF PRACTICE. THREESOME OF DIVERS. CALM SHALLOW WATER. SEPARATION WHEN LAST IN LINE. NO CONTENTS GAUGE OR RESERVE. NO BUOYANCY VEST. PROBABLY FAILED TO DITCH WEIGHT BELT. PROBABLY OUT-OF-AIR SITUATION.

Case SC 83/5

Members of several dive clubs were together on this charter boat trip to hunt for scallops. The boat carried fifteen persons, ten of whom were divers. There was no formal organisation and each club was expected to assess its own divers' fitness for the 85 fsw dive. The victim had only recently completed his basic scuba course and had made three sea dives on the course and four subsequently, two on each of two days a fortnight after completing the course. The fatal dive took place ten weeks later.

The president of the "host" club was an instructor and was aware of the inexperience of some of those aboard though he did not formally vet any of them as he believed this to be the responsibility of their own clubs. He was first in the water, with his buddy, when they reached the scallop bed, and had got back onto the boat only a short time before the victim came to the surface and gave a distress signal. His first intimation that anything was wrong was when the boat pulled up its anchor and started to move to reach the victim.

One of the divers aboard was involved in a project which involved tagging scallops, a Government investigation, and he noted the absence of any safety officer, or indeed of any control of the divers, so asked a non-diver who was remaining on the boat to make a log of divers as they entered and left the water. This information was produced by the police but no formal deposition of the facts by the witness was brought forward at the inquest.

The victim dived with two others, fellow members of his diving club. They surfaced after diving for 20 minutes, quite untroubled by the absence of the victim, assuming he had decided to surface without them. The scallop bed was at 85-90 fsw and a fairly level area. The victim's depth gauge had a maximum depth recorder which showed he had been at 90 fsw. Some of the divers declined to dive at this spot, deeming it too deep. The instructor gave it as his opinion that it is every diver's responsibility to decide whether or not to dive. This may not hold true where a commercial rather than an informal social dive situation exists.

It is probable, though not stated, that the victim's buoyancy vest was inflated when he surfaced. It is known that its carbon dioxide cylinder had been fired and that his tank, which had a contents gauge, was empty. The equipment was tested and was found to work correctly. His dive had lasted about 17 minutes.

The victim was described as surfacing only a short distance from the dive boat (launch). He raised his arm in the distress signal and did not respond to a call. As he was reached by the boat he rolled onto his back, let out a gurgle, his pupils became dilated, and froth appeared at his mouth. His weight belt was undone and he was brought aboard. No pulse or breathing was found so full CPR was commenced, which produced a faint pulse for a time. The instructor, who had entered the water as soon as it was apparent something

serious had occurred, noted that his weight belt buckle was twisted and had slipped towards the left side so was difficult to release: it was an unusual double-buckle type of belt. The evidence points to him having failed to remain near to his buddies and to have been too engrossed in scallop hunting to watch his contents gauge. In his inexperience he failed to note the warning his regulator would give of the development of a low air situation so would be suddenly faced with a no-air situation at 90 fsw depth, alone. He would probably be overweighted (nobody offered advice and he probably never dived any significant depth previously) and his weight belt would be difficult to drop even in a non-panic situation, so the buoyancy vest would be used to initiate his "emergency lift-off". Unfortunately this ascent was not associated with adequate venting of air from his lungs.

The autopsy was conducted with the special care any death like this requires, with X-ray before commencing and search for evidence of air embolism during the examination. Fractured ribs, from resuscitation efforts, were noted plus air shadows over the heart outline and air in the right ventricle, left pulmonary artery, the aortic arch, in the axillae and anterior neck, and some in the right mid zone indicating a possible area of the lung rupture. This massive air entry would defeat any resuscitative efforts.

NEWLY TRAINED. GROSS INEXPERIENCE. GROUP OF THREE. EXCESSIVE DEPTH FOR EXPERIENCE. NO DIVE DISCIPLINE. SEPARATION/SOLO DIVE. "BUDDIES" IGNORED ABSENCE OF VICTIM. SENIOR DIVER DID NOT ACT AS DIVE MASTER ON BOAT. BUOYANCY VEST INFLATED. FAILED TO DROP WEIGHT BELT. WEIGHT BELT TWISTED AND DIFFICULT TO REMOVE. HAD CONTENTS GAUGE BUT OUT OF AIR. MASSIVE AIR EMBOLISM. OVER-VIGOROUS ECC DAMAGES RIBS.

Case SC 83/6

The seven trainee divers were allowed to accompany a club boat dive in order to take their sea tests. They all checked their own and their buddy's equipment before entering the sea, the instructor being present and watching. The victim, who wore a wet suit, compensator, and 20 lb weight belt, had a contents gauge and a full tank and was in the third buddy group to start the surface swim using snorkel. The test was planned to be a surface swim in full equipment to a rock and back, about 400m, followed by a scuba dive. After swimming about half way to the rock the victim pulled on his buddy's arm and indicated he had some trouble, so the buddy orally inflated his vest for him and called to another diver for assistance. The victim appeared to be breathless so they started to tow him back to the dive boat. Their actions were seen by the instructor, who was following the fourth pair, and he soon reached them and took command, giving in water EAR as the other two towed the victim to the boat. He was so buoyant there was no need to ditch his weight belt. There was no apparent response to the EAR and after being brought aboard the boat he was not breathing, no pulse was apparent, and he was unconscious, so CPR was instituted and this was continued by various divers during their return to land on a boat which came in response to their radio call for assistance. Supposedly their request for the helicopter medical response team was discounted because someone in the control chain of command stated "a heart attack doesn't warrant a helicopter", a fact not noted at the inquest. This rescue service had only very recently become operational and the person responsible may have made a judgement appropriate to a land incident, forgetting that the present circumstances were different. This may not have made any difference to the outcome, however. The victim was not known to have any ill health and had a physically demanding job.

The victim's heart was noted to start beating and he began to breath as the boat was docking. An ambulance awaited their arrival and emergency therapy was given during the journey to the hospital, which lasted half an hour. His condition changed when they were 10 minutes from the hospital and CPR was resumed. Death was certified 40 minutes after he arrived at the hospital.

The instructor noted two valuable lessons from this tragedy, the first being the importance of maintaining effective buddy contact with frequent checking even when at the surface, and the second was the need to check the emergency medical supplies before every dive trip as the oxygen bottle was empty when needed. The alertness of the skipper was recorded with appreciation as he pulled on his anchor line when he saw what was happening, thereby drawing the boat nearer to the returning divers, to their benefit.

At the autopsy there was marked haemorrhagic oedema of the lungs with only tiny areas of aeration. Multiple fractured ribs were noted, the result of enthusiastic resuscitative efforts. The pathologist concluded that death was from heart failure, which he thought resulted from a sudden cardiac arrhythmia triggered by an inhalation of salt water.

IN TRAINING. SURFACE SNORKEL SWIM IN FULL EQUIPMENT WITH BUDDY. BECAME BREATHLESS. BUOYANCY VEST ORAL INFLATION TYPE INFLATED ON REQUEST OF VICTIM BY BUDDY. GOOD BUOYANCY ACHIEVED. EXCELLENT HELP FROM BUDDY, OTHERS, INSTRUCTOR. EAR RESUSCITATION COMMENCED IN-WATER RADIO ASSISTANCE CALL PROBLEM. EMPTY EMERGENCY OXYGEN CYLINDER. ACUTE CARDIAC ARRHYTHMIA POSSIBLE CAUSE OF DEATH. OVER-VIGOROUS CPR FRACTURES RIBS. IMPORTANCE TRUE BUDDY DIVING "EVEN AT THE SURFACE".

Case SC 83/7

Three friends decided to go diving for crayfish from the 8 foot runabout owned by one of them. The victim had made 14 dives since his scuba training 2 years previously and was using borrowed equipment both he and his buddy checked before he used it. He removed 3 lbs from the belt after this check. One diver descended and checked the anchor, then boarded the boat again and remained there as boatman and surface cover when the other two made their dive. They had an uneventful dive for 45 minutes, maximum depth being 30 fsw, then surfaced together. The buddy checked and established that while the victim had 400 psi remaining air he had 650 psi, so agreed to his suggestion that he swim back to the boat with the catch bag and its single crayfish while the buddy made a final search for more cray fish. The sea was moderate with a northerly wind, not uncomfortable conditions for diving, and the boat only 30-50 yards distant. Shortly after he dived he heard the boat's engine start then stop again so he surfaced to see what was happening. It is not known whether the victim was feeling fatigued by his dive as he started his return swim.

The diver who remained in the boat saw the victim at the surface about 50 yards from him and about 10 yards from the shore line rocks when he raised one hand above his head and called out, indicating a desire to be picked up. He seemed to be looking around for

his buddy, so when he raised his hand a second time the witness thought something was wrong with the buddy as the victim did not appear in any difficulty. The witness started the boat and motored over to him after an initial difficulty in getting the anchor free. When first sighted he had been floating well above the swell and no waves were breaking over him, then he was seen swimming towards the rocks, but he had drifted into a gut among white water by the time the boat reached him. He was face down, his snorkel above the water, and it took a few moments for the witness to realise that he was not moving, then he threw the anchor overboard, jumped into the water, and swam to give him assistance. On reaching the victim the witness, the third diver of the party, turned him face upwards and noticed that his mask was full of water and vomit so pulled it off. He then noticed a white froth in his nose and mouth and his facial cyanosis. With difficulty he dragged him onto the rocks and tried to give him a few breaths by EAR but waves were breaking over them so he ditched the victim's weight belt and scuba and pulled him out of the water. Shortly after this he was joined by the buddy, who had first returned to the boat but discovered it was unoccupied and then heard him calling. Together they applied CPR but obtained no response.

The autopsy revealed evidence that inhaled food had reached the smaller bronchi and the cause of death was given as drowning plus inhalation of vomit. The reason for his initial problem is unknown but the equipment check revealed two adverse factors, a tear in the back-pack-attached compensator (unknown brand, tear pre dated the incident) and a leak past the mouthpiece which could cause some salt water inhalation. The snorkel he was using belonged to his buddy, who gave it to him for his return swim as he was not carrying one.

TRAINED. MODERATE EXPERIENCE. BORROWED EQUIPMENT. TORN BUOYANCY VEST NOT NOTED AT PRE-DIVE CHECK BY TWO DIVERS. DID NOT CARRY SNORKEL, BORROWED SNORKEL FOR SURFACE SOLO SWIM. LOW AIR/OUT-OF-AIR STATUS. BUDDY MADE SOLO LOW-AIR DIVE LEAVING COMPANION AT SURFACE. VALIANT ASSISTANCE OFFERED BY BOTH COMPANIONS. DIFFICULTY EXITING IN WHITE WATER ONTO ROCKS. INHALED VOMIT.

Case SC 84/1

The victim had been a snorkeller for 4 or 5 years and was keen to try scuba diving. His friend had taken a scuba course nearly three years previously and apparently offered to give him some instructions, at the same time taking him collecting kina. The victim was a severe asthmatic who used one "Ventolin" inhaler per month, his allergy being to pollens.

This was the third time he had used scuba, the second being the previous day in the same area, to 20 fsw. He was using borrowed equipment and was with two companions, diving from a 14ft outboard runabout. They had difficulty getting the anchor to hold where they had dived the previous day so moved closer in to the island where the water was expected to be shallower. Before they entered the water the buddy told the victim to breath out as he ascended, to breath shallowly if he needed a breath during ascent, and to travel at the speed of his bubbles, and showed him the basic hand signals. The victim told his buddy that he had a tendency to hold his breath during ascent. Instruction completed, they dived.

Before he entered the water the victim had used his Ventolin inhaler, then he tucked it into one sleeve of his wetsuit and entered the water. While in the water at the side of the boat he was out of sight of his buddy, who entered the water from the other side of the boat (but the man left in the boat saw him use the inhaler a further three times). He replied to his buddy that he was all right when asked how he felt before they descended the anchor line. Water depth was about 45 fsw and they each carried a sack for the kina they collected. Visibility was about 15 feet and they kept in visual contact at all times, exchanging signals when they had full sacks and then both started to ascend. Although the victim started a little before his buddy the latter overtook him and surfaced first, about 30 feet from the boat and 7 feet distant from him. He again answered a query from his buddy, saying he was all right, then suddenly one of his legs stiffened and he let out a cry of pain, so his buddy told him to hand over his sack of kina and this he did without speaking. His compensator was noted to be inflated at this time. The buddy now signalled to the man in the boat to collect the victim first, and told the victim to lie on his back and ignore the tide current as the boat was coming to collect him. At this time he gave another cry as if he had pain, but did not indicate the nature of his problem, and lifted the face mask from his face. He then slowly drifted away from where the buddy was floating holding both bags of kina. Gradually the buddy tired and before the boat returned for him he had emptied one bag to lighten his load.

The man in the boat saw them surface, one a little in advance of the other, then give the arranged signal requesting him to collect them. They had been diving about 15 minutes. When he reached the victim he was floating on his back with a vacant look on his face and did not respond to speech or when thrown a line with an inflated tube attached. He realised something serious had occurred and managed to tie a line to one of the victim's arms. It was very difficult but he managed to get him in the boat by securing a line to his backpack belt and pulling, first ditching his weightbelt. He was still breathing at this time but was unresponsive to questioning. The rescuer gave him a couple of breaths by EAR then collected the buddy (who found it difficult to board the boat).

The buddy started giving EAR but soon tired so asked the boat man to replace him. During their return trip they passed some fishermen who had a radio and they sent a message to alert the shore emergency services of a seriously ill diver. Both his friends continued their CPR efforts on arriving at land until the ambulance arrived. It is assumed from the autopsy finding that he was intubated, but there is no information on whether this was in the ambulance or at a hospital, nor is it clear whether he was still living when he reached land. At the autopsy both lungs were over-inflated and somewhat waterlogged "but there was no evidence of mucous plugging". The microscopy of the lung tissue samples was reported as "the small airways showed quite marked residual mucous plugging. Elsewhere the lungs show congestion, some intra-alveolar haemorrhage, and oedema. Although these appearances are complicated by resuscitation, it is clear that there was a significant degree of small airways obstruction consistent with asthma at the time of death". The official finding as to the cause of death was "Severe Bronchial Asthma in the course of Scuba diving". On that basis of the history it is highly probable that the critical factor was a Cerebral Arterial Gas Embolism (CAGE), symptoms beginning a short time after he surfaced. He was totally untrained and uninformed, he had active asthma symptoms before he made his descent, and was aware himself of a tendency to breathhold during ascent. It is unfortunate the Coroner made no comments on the gross impropriety of lending such a man scuba or taking him

on a scuba dive. It may be thought the buddy's course failed to make him understand the basic facts of safe diving as he saw nothing wrong in his actions.

The Coroner did not consider it necessary for there to be any inspection of the equipment used by the victim.

UNTRAINED. GROSS INEXPERIENCE. THIRD SCUBA USE. COLLECTING KINA 45 FSW. APPARENTLY CORRECT RATE ASCENT BUT NOT WITH BUDDY CLOSE TO HIM. INFLATED BUOYANCY VEST. CRIED OUT THEN UNRESPONSIVE AT THE SURFACE. BORROWED EQUIPMENT. ACTIVE ASTHMA WHEN DIVED. AIR EMBOLISM. (CAGE).

Case SC 84/2

A ship heavily fouled by marine growth was requiring hull cleaning while loading timber in harbour and a small firm of diving contractors arranged to perform the job. This was a normal type of contract for them. There were four divers involved though only two were in the water at any one time while one was standby on the wharf. They used scuba, each dive usually lasting for 60-70 minutes, the diver then surfacing to refill his tank while an other diver took his place. Some of the growths were too heavy for the scrubber brush to clear so one of the divers was using a spade to clear such areas. The divers worked independently of each other.

The victim was not diving the first day because he was recovering from a mild "flu" infection and was undertaking a non-diving job, but the second day he declared he was recovered and fully fit to dive. He was experienced, having been scuba diving 10 years, but untrained, and he had been undertaking commercial diving jobs such as this for 2 years. The ship had a somewhat flat hull bottom with bilge keels as deep as the main keel and deeper than the main area of the bottom. The maximum draft unladen was 8.78 m, and when loaded 9.39 m. The harbour depth here was about 11.4 m.

First intimation of trouble was when it was noticed that the victim had not surfaced as expected and no bubbles could be seen breaking at the surface. They hurriedly made a search but could not find him beneath the ship so informed the police, asked for other divers to be sent to assist the search, and themselves organised a painstaking search, the three divers swimming from bow to stern with a rope between them from port to starboard to keep in contact. It was during one of these searches that they found the spade used by the victim, then one diver put his hand down and felt the victim, face down on the harbour floor. The finder guided another diver's hand to confirm the discovery and he reacted by a sudden ascent holding the body, the safety rope between the search divers pulling the finder unceremoniously up with him. The victim's vest was inflated and his tank contents gauge read 500 psi, though it was a faulty gauge and the actual remaining air was about 400 psi.

Check of the equipment also showed that the pressure in the hose proximal to the regulator was low, making it harder to obtain air than it should have been. Neither finding explains the incident.

At the autopsy there were several unexplained deep puncture marks under the jaw and there was marked mucosal damage of the buccal mucosa of both upper and lower lips, mucosal loss of the insides of the cheeks and lacerations of the tongue. Findings such as this suggest an epileptiform fit occurred (reason unknown). There was no pneumothorax but both ventricles contained frothy blood and there were air bubbles in the surface vessels over both cerebral hemispheres and filling the basilar artery. Both lungs were over-inflated and waterlogged but fluid could not easily be expressed. There was frothy fluid in the main bronchi, larynx, and trachea. It is difficult to account for an air embolism occurring as he was not out of air, was still wearing his 24 lb weight belt, had an uninflated buoyancy vest, and was beneath the hull where it would be unlikely a body would reach if it sank after some cerebral air embolism caused loss of consciousness during a hurried ascent. No explanation has been found for the punctures beneath the jaw. The autopsy did not reveal any signs of unresolved respiratory tract infection, though the pathologist was looking for such evidence.

During the loading a log fell into the water and this might have created a water movement which tossed him about, though no such effect was noted by the other diver. No scenario has been put forward which can explain the known facts.

UNTRAINED. EXPERIENCED. COMMERCIAL CLEANING HULL OF SHIP LOADING AT WHARF. TWO DIVERS WORKING SOLO BENEATH HULL. NO SAFETY LINES. WEIGHT BELT DITCHED. BUOYANCY VEST NOT INFLATED. SOME REMAINING AIR. IMPERFECT REGULATOR FUNCTION. IMPERFECT CONTENTS GAUGE. MYSTERY OF PUNCTURES JAW SKIN. APPARENT AIR EMBOLISM. CAGE. LOG FELL INTO WATER.

Case SC 84/3

Because of the swell it was decided to dive from the shore rather than from their aluminium run about, so they dropped off their gear on the rock point they intended using as their dive platform, leaving their non-diving friend to watch its safety while they tied up the boat at the wharf about 200 yards away. After they had walked back and kitted up they walked through a gap in the rocks to the seaward side of the point, decided the sea there was too rough for them, so returned to the wharf side of the point and entered the water. Their dive purpose was to collect crayfish.

Within a matter of minutes they became separated but they continued diving separately. The victim was seen to surface a number of times in a normal manner and it was only after his buddy surfaced an hour later with an empty tank that any anxiety was felt, as the victim was "heavy on his air" and always emptied his tank first. The buddy had been diving in water depths between 10 and 50 feet, as was his habit, working in from the point towards the wharf and expected his friend to have a similar plan. When he had last surfaced, 5 minutes before the buddy came ashore, he had been about 30 feet out and had been seen to clear his mask and to snorkel at the surface for a short time before again going down.

His buddy climbed the rocks to get a better view of the water but could see no sign of the missing diver so they took their boat and made a surface search of both sides of the point, then informed to police. The chop was now too dangerous for their runabout but the police launch and two other boats continued the search till dark while two Coast Guard divers made an underwater check. Next day searching resumed using two boats, an inflatable, and five divers. The victim was found 20-30 feet from the point, in 10 feet deep water, after searching for an hour. His equipment was complete and his mask, a little displaced, contained some blood stained water. Visibility, which was 20 feet the previous day, was now reduced to 4 feet. The buddy was certified but the victim was not and had picked up his knowledge by diving with the buddy over

ten years. He was said to be a common-sense diver not likely to take risks, one who had never previously had any trouble while diving. The autopsy showed evidence of drowning. When checked his tank was empty but the equipment was in good order. The weight of the belt was not recorded nor whether its quick-release worked: it is not known why he did not drop his weight belt or cry for help, but the lack of a buoyancy aid plus diving habit of continuing to dive till completely out of air critically compromised his safety.

UNTRAINED. EXPERIENCED. SEPARATION/SOLO. DIVING FOR CRAYFISH. SHALLOW, MODERATELY ROUGH WATER NEAR ROCKS. LOW-AIR OR OUT-OF-AIR SITUATION. HAD CONTENTS GAUGE. NO BUOYANCY VEST. FAILED TO DITCH WEIGHT BELT.

Case SC 84/4

Against the wishes of his parents this young man, who was totally ignorant of scuba diving and suffered from asthma (he was on regular, four times daily, "Ventolin" and "Becotide" aerosol inhalations plus "Nuelin" 250mg tablets twice daily) had decided to go diving with a friend. They hired scuba equipment, signing a declaration of competence in diving. The friend was also totally untrained and was making his third scuba dive, while this was the first time the victim had used scuba. He was wearing a wet suit, mask and flippers belonging to the buddy, and a hired compensator and weight belt as well as hired scuba unit.

They swam out from a beach after an initial problem with the victim's regulator, but this functioned well after using the purge button. There was a 10-15 knot wind and visibility was only 3 metres. They snorkelled out parallel to the beach, then the victim said he felt cold and sat on a rock while his buddy dived for paua. He borrowed the victim's weight belt because he was too buoyant with only his own but he returned it before they started a swim back towards their entry point. The buddy remained at the surface, his buoyancy vest part inflated, while the victim swan a little ahead and underwater. The buddy became fatigued and unable to keep up with the victim so diverted to the beach, the victim continuing to swim parallel to and 20-30 metres from the beach.

Just after the buddy care ashore he saw the victim surface, maskless and shouting for help. He submerged, resurfaced and cried out again, then submerged and failed to reappear. The buddy removed his tank with the assistance of a nearby fisherman (who then had the foresight to send a message to the police) and swam out to where he had last seen his friend. He was too buoyant however to be able to descend to search for him and unable to remove his wet suit in the water to reduce his buoyancy, so returned to the beach. The body was found after an intense search involving beach, boat and helicopter searches. The body was found floating face down one metre below the surface in 2-3 metre deep water, all equipment in place: the weight belt was on and the compensator was uninflated (oral inflation type). Remaining air was 300 psi. The autopsy finding was death due to drowning without evidence of active asthma. Both divers had a little snorkelling experience.

UNTRAINED. GROSS INEXPERIENCE. FIRST USE SCUBA. BUDDY'S 3RD USE SCUBA. HIRED AND BORROWED EQUIPMENT. SEPARATION/SOLO. COLD. BUDDY FATIGUED. SURFACED WITHOUT MASK AND CALLED FOR HELP. BUDDY TOO BUOYANT TO DIVE TO SEARCH. UNINFLATED ORAL INFLATION TYPE BUOYANCY VEST. ASTHMATIC ON REGULAR TREATMENT BUT THIS NOT CRITICAL FACTOR. FAILED TO DITCH HIS WEIGHT BELT.

Case SC 84/5

The 15 year old son of the victim described the dive events clearly. He and his eight year old brother accompanied their father on a friend's boat to some islands to collect crayfish and scallops. The two adults were trained and his father, after being away from diving for some years, had been diving regularly for the past 12 months. He was not trained, "though studying for the Basic Scuba Diving Certificate". They made dives at three locations. At the first the victim and his son dived together, the latter having 1000 psi remaining from an initial 3300 psi while his father used 3000 psi. At the second island the two men dived, the victim using a fresh tank and having 1400 psi remaining on surfacing. They had lunch after moving the boat to a little bay and then the friend and the boy descended the anchor line and collected scallops from the adjacent sea bed. When the boy was down to 500 psi they surfaced and saw the victim swimming at the surface towards the boat. When they reached the boat he had again dived. They estimated that his tank would then probably contain 500 psi air. The boy used up his air swimming near the boat, boarding it when his tank was empty. A short time later his buddy returned and also boarded the boat. It was some time before they realised the victim had not returned and they could see no bubbles. They rowed around the area looking for the missing diver but found nothing so notified the police.

The body was found floating out at sea about eleven weeks later, all equipment in place. The equipment was tested and no faults discovered, though his buoyancy vest was damaged during recovery of the body. Identification was through dental records. The autopsy was of limited assistance because of the extensive decomposition. He had a history of excessive alcohol intake and smoked 25 cigarettes a day but had no shortness of breath. He was regarded by his son as "not totally fit but fit enough for diving".

TRAINED. EXPERIENCED. CRAYFISH/SCALLOP HUNTING. SEPARATED/SOLO DIVE. STARTED DIVE LOW ON AIR. IMPERFECT BUDDY SYSTEM. BUDDY/ PART TRAINED BOY. HAD CONTENTS GAUGE AND BUOYANCY VEST. FAILED TO DITCH WEIGHTS. IMPERFECT HEALTH FROM ALCOHOL. DELAYED RECOVERY OF BODY.

Case SC 84/6

Two divers decided to take a friend with them diving for crayfish. The wife of one of them remained in the boat, which was anchored about 100 metres from the shore in shallow water. It was the first time the victim had used scuba and they loaned him the necessary equipment. Water depth was 10 to 15 feet, visibility was 20-30 feet, and there was some kelp on the rocky bottom. While one kept close by the victim at all times underwater the other diver seems to have gone his own separate way. After a time the two divers surfaced and a little later the third one joined them. They checked the victim's contents gauge, which showed between 800 and 1000 psi: they had larger tanks and over 1000 psi remaining so when he said he wished to return to the boat they decided to swim underwater while he swam at the surface. They saw he was making good progress, then they submerged. They had surfaced 30-50 metres from their boat and he probably covered little of this distance before he lifted his head, took off his mask, and cried out "HELP!" then disappeared from view.

The person remaining in the boat was unable to offer him assistance and it was about 3 minutes before the two divers surfaced and learned what had occurred.

They dived and soon found the victim on the sea bed, unconscious. He was brought up and EAR was performed in the boat but he did not respond. His tank still contained 700 psi air when tested so it is uncertain whether his return swim was started using snorkel or regulator. It is not on record whether he wore/ ditched/retained a weight belt, but almost certainly he wore and did not ditch a weight belt.

The equipment was tested and no faults noted. There is no mention of a buoyancy vest being worn. The autopsy showed only the changes of drowning. There is no report of lung sections being examined for evidence of asthma but there is nothing in the accounts of the incident to implicate any other factors than the victim's gross inexperience and the solo situation resulted from the surface separation from his friends.

As a footnote it is worth recording the remark of one of the divers who loaned him the equipment well aware that he had never before used scuba: "Had I been aware that he was asthmatic there is no way I would have let him dive". A strange evaluation of the relative risks of Asthma and Total Ignorance of Scuba use.

UNTRAINED. GROSS INEXPERIENCE. FIRST SCUBA DIVE. SEPARATION/SOLO SWIM AT SURFACE. SURFACE PROBLEM. REMOVED MASK AND SANK. HAD AIR REMAINING. HAD CONTENTS GAUGE. .NO BUOYANCY VEST. BORROWED SCUBA EQUIPMENT. CALM SEA. ASTHMATIC BUT THIS NOT RELEVANT.

Case SC 84/7

There is no record of the training or experience of either the victim or his buddy (his son). They and two non-diving friends went in the victim's boat to an island and set out a long line for fish, then journeyed on to another bay where they planned to dive for crayfish off the rocky shore. They entered the water, here 35 feet deep, and descended to the bottom together but in the poor visibility, 15 feet at best, became separated. Following their usual practice when separation occurred, the buddy surfaced to wait for his father to rejoin him. The people in the boat indicated to him that the breaking bubbles showed his father was continuing on to wards the rocks so he resubmerged and attempted to find him, but was unsuccessful so again surfaced. He now attempted to reach his father by swimming at the surface to the area of the bubbles but this proved difficult because the surface chop slowed his progress and he could not gain on him. Then the victim broke the surface 40-50 feet from him and appeared to be in a distressed state. The buddy immediately swam as fast as hi could to him, reaching him shortly after he ceased struggling and had started to sink.

The buddy called out to those in the boat to come as quickly as they could, then "pumped up" the compensator his father was wearing and his own, ditched his father's weight belt, and gave him support until the boat reached them and got them aboard. They applied EAR during the return to land. Fortunately they passed a launch which had a radio and sent a message ahead of them to have an ambulance waiting their arrival, and a man from the launch came and took over the job of driving their boat, a vital piece of help as the person in the group not able to give EAR was unskilled in managing a boat.

The autopsy was preceded by a chest X-ray, which did not show any pneumothorax, and the pathologist then proceeded with an examination directed at establishing whether there was any air in the major blood vessels, and found none. He commented that "the appearances of the lungs were not suggestive of barotrauma". When the coronary arteries were examined it was noted that there was a 70% stenosis of the proximal left anterior descending artery with a focus of severe narrowing due to atherosclerosis involving the origin of a diagonal branch and severe narrowing from this cause effected the proximal portions of the intermediate and circumflex arteries. There were only scattered changes in the right coronary artery and none were severe. No evidence of any recent myocardial damage was found on microscopy". It was not possible to completely exclude the possibility of a cerebral arterial gas embolism or to assess the relevance of the severe coronary artery disease", said the pathologist, then recorded his conclusion that "in his opinion the appearances are consistent with drowning", and this was given as the official cause of death. Nothing is known of the victim's previous health history.

His equipment was sent for testing and the remaining air was noted as 1500 psi and the maximum depth indicator showed at 130 fsw. It is not known whether this represented the depth of his first dive or related to a previous occasion as no record was made of the dive details in the depositions. The air was clean on test but there is no record of the equipment being tested. It can be assumed from the buddy's evidence that the buoyancy vest worn by the victim could only be orally inflated. The type of vest was not stated so it is not possible to know whether the tank inflation hose was not connected by error or because the vest could not accept such a hose supply.

The reason for this fatality is unknown but it might have been the consequence of an anginal episode which led him to make an emergency ascent which resulted in an air embolism, or the cardiac condition may have led to a rapid cardiac death. Drowning would be the terminal event with either scenario.

TRAINING NOT STATED. EXPERIENCE NOT STATED. SEPARATION/SOLO. BUDDY ACTIVE ATTEMPT TO REJOIN COMPANION. SURFACED IN DISTRESS. ADEQUATE REMAINING AIR. BUDDY MADE CORRECT PERSISTENT ATTEMPTS TO LOCATE AND REJOIN FRIEND. SURFACED IN DISTRESS. BUDDY ASSISTANCE RAPID TO INFLATE BUOYANCY VEST (ORALLY) AND DITCH WEIGHT BELT. CAREFUL AUTOPSY PROCEDURE. CAGE? CORONARY ARTERY DISEASE. POSSIBLE AIR EMBOLISM.

DISCUSSION

Examination of the details of these cases reveals an over representation of several factors commonly regarded as being highly adverse to safety. The victims, with a few exceptions, were inexperienced and separated from their buddies, and generally kept their weight belt on to the bitter end. Several of those who wore a buoyancy vest failed to inflate it, in one instance because of a tear present before the dive commenced. In this series the water depths were shallow and several deaths occurred after "completing" the dive, at the surface. Of a particular interest is the unusual number of victims who had a history of asthma, though this was not necessarily a factor in their demise. Significant cardiac disease was present in one victim but it is not known whether any routine medical fitness assessment would have discovered its presence. In the case of the unfortunate youth with the Wolf Parkinson White syndrome there is much to be said for the advice he received that he should choose to live rather than to follow a cautious fearful existence. Whether scuba diving as such was a critical factor or merely the trigger of the fatal episode is debatable and opinions will reflect each person's philosophy on life.

Of the six breath-hold divers, five were alone at the critical time and none wore a buoyancy vest. Significant factors included fatigue, hyperventilation, epilepsy, a cardiac condition, an asthmatic history, and gross inexperience. Three incidents occurred at the surface and one after leaving the water. It is clear that it is unsafe to allow some asthmatics to undertake prolonged and tiring in-water activities, that even snorkelling may hold dangers. It was only chance which prevented this death occurring during or after his scuba activities.

The scuba divers were alone at the critical time in twelve out of the fourteen cases, either because of separation or because they were diving solo. In the two remaining cases there was nothing more that the respective buddies could have done as water power was irresistible in one case and the cardiac problem probably unsurvivable except in a hospital setting in the other. Once an incident occurred buddies reacted but by this time there had developed an irreversible situation. It is apparent there are still many who fail to accept the self discipline of buddy-diving procedures, and there are graves to prove it. Readers may care to consider what influence a buddy could have had if nearby at the critical time. If it should be decided that the outcome would probably have been the same, consider what other changes in the dive protocol would have resulted in survival, in a danger-free dive.

That three instances occurred in 1984 where totally scuba-ignorant persons were taken for a sea dive by friends is an indication that diving education had not reached everybody. There can never be a method of completely preventing such tragedies, but a well publicised action for damages by a widow or other relative might work wonders.

The cheering fact in this report is the absence of deaths among those who were trained, experienced and following the generally accepted guidelines for safe diving. Consider this well.

ACKNOWLEDGMENTS

This report would not have been possible with out the generous support given by the New Zealand Department of Justice and the New Zealand Underwater Association. There has also been valued information provided by other persons.

These deaths are among those referred to in the summary "Diving Fatalities in New Zealand 1982 - 1985" on page 22 of the SPUMS Journal 1985: 15(4).

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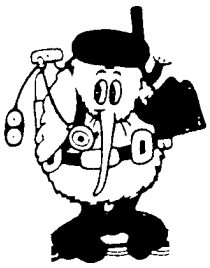
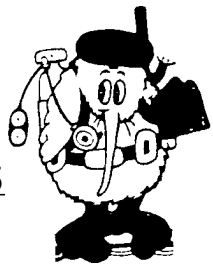


DIVING KIWIS

PAPERS AND ABSTRACTS FROM THE NEW ZEALAND CHAPTER OF SPUMS MEETING 7 TO 9 NOVEMBER 1985 KAIKOURA ISLAND, GREAT BARRIER ISLAND



ROYAL NEW ZEALAND NAVY CHAMBER TREATMENTS 1984 and 1985

Peter Robinson

SUMMARY

In 1984 six cases of decompression sickness (DCS) and six cases of pulmonary barotrauma were treated in the recompression chamber at HMNZS PHILOMEL and at the RNZN hospital. Five of the cases of decompression sickness and three of the cases of pulmonary barotrauma had done dives shallower than 21 m (70 feet). One person developing DCS and three with pulmonary barotrauma had dived deeper than 21 m. There were 11 males and one female in this group of damaged divers. Their ages ranged from 16 to 37.

1985 was a busier year for the chamber and the hospital. By 7 November 1985, the day the conference started, 17 males and one female had been treated in the chamber and four other people with mediastinal emphysema had been seen but not recompressed. The diagnoses of those treated were DCS in eight, arterial gas embolism in 9 and one had a presumed coronary occlusion at 33 m (110 feet). Of those who developed DCS only one had not been deeper than 21m. He had only been to 18 m (60 feet). Five of the arterial gas embolism cases had been deeper than 21 m and four shallower. The ages ranged from 15 to 49.

Enquiries about possible diving accidents reach the hospital at least once a week. The chamber is used to treat civilians about once a fortnight and approximately once a month there is a diving death, unrelated to the previous contacts, which never reaches the chamber. This is a depressing commentary on the attitude to safety of New Zealand divers.

Surgeon Commander P Robinson's address is the Naval Hospital, Devonport, AUCKLAND.

POSTSCRIPT

In the month 7 November 1985 to 6 December 1985 five more people required recompression, four males and one female. Two developed DCS, one had dived deeper than 21 m, and three had pulmonary barotrauma. Of these two had dived to less than 21 m and one deeper. Their ages ranged from 24 to 49. In the same period there were two diving deaths in the Auckland area.