

PROVISIONAL REPORT ON AUSTRALIAN DIVING-RELATED FATALITIES 1986

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Fourteen (14) diving-related fatalities were identified as having occurred in Australian waters during 1986. Two (2) were breath-hold divers, nine (9) were using scuba, and three (3) were using surface supply (hookah) systems. One of the breath-hold (snorkel) deaths occurred from acute illness while the victim was on a day trip to the Barrier Reef and illustrates that there is an inescapable risk of the occasional "loss" of a person on such trips because complete supervision of a crowd of swimmers is difficult in theory and probably impossible in practice. While there is no clear common reason for the scuba diver incidents the one clear fact is the frequency with which the critical action of the incident occurred at the surface. Many of the victims had only slight diving experience although some were both trained and reportedly experienced. The hookah incidents indicate some of the dangers associated with the use of this equipment.

CASE SUMMARIES

BH 86/1

While on holiday at a resort near to the Barrier Reef the victim decided that he would like to try some snorkeling so attended a talk given by one of the resort staff on how to use a snorkel. He was described as being "not a good swimmer" but he apparently decided he would try snorkeling off a beach where the water was calm, warm, and shallow. Nobody particularly noticed him enter the water and his absence was only appreciated when his failure to return to his room to prepare for the mid-day meal led his wife to become alarmed. This was several hours later. She went to the beach to look for him and saw him floating quietly. He was face up and about 30 metres from the shore and the water was only waist deep where she found him. Her alarmed call for help quickly brought others to her and the victim was brought ashore. Although resuscitation was attempted there was no response. The snorkel he had used was described as being "soft". It is believed that this drowning occurred because the favourable factors of a calm, shallow, warm sea were more than balanced by the adverse factors of a lack of swimming ability and confidence, coupled with an unfamiliarity with mouth breathing through a snorkel tube with face immersed. It may be that he got some water down the snorkel and became so flurried by the unfamiliar situation that panic ensued and he forgot there was the simple remedy of standing up. Once panic strikes there is little hope of recovery if the victim is alone.

TOTAL INEXPERIENCE WITH SNORKEL.
CALM SHALLOW WATER. POOR SWIMMER. SOLO.
NO WITNESSES. DELAY BEFORE ABSENCE NOTED.

BH 86/2

This man was with a group of overseas tourists taking one of the many available day trips to visit the Barrier Reef. There is a report that he had a limp but this is all the information it has been possible to obtain concerning his health. The boat first visited a cay and after the passengers had viewed the birds there they were allowed some time for snorkeling before the boat sailed to its main destination, a reef. He was seen to snorkel at the cay in a competent manner. There was a party of scuba divers on board who went off together leaving the remaining passengers using snorkels close to the anchored boat. One of the crew now acted as guide or shepherd to this group and showed them the beauty of the reef beneath them. The sea was calm and water depth only 2 metres so after the guided tour was complete the "snorkel master" had no worries about safety when telling them they had half an hour to examine the reef near the boat before the return trip. But before he could get back on the boat he heard two of the swimmers call out that they had seen a body lying on the sea bed.

The crew member at once swam to them and dived to rescue the victim. He was soon joined by the leader of the scuba divers' group who had just returned from their dive. Resuscitation was at once started and was continued after the victim had been got back on board. It was continued despite the presence of an offensive watery regurgitation, or vomit, into the victim's mouth, a serious discouragement to continuation of EAR. The reason for the tragedy was revealed at the autopsy as shock following a haemorrhage from an acute pre-pyloric ulcer, a medical emergency with so rapid an onset he had no time to call to anyone for help. However close the supervision of a group is, it is not possible to monitor every person continuously.

ACUTE FATAL GASTRIC ULCER HAEMORRHAGE. SURFACE SWIMMING. NO WARNING CALM WARM WATER. NEARBY SWIMMERS UNAWARE OF TROUBLE. RESUSCITATION PROBLEM FROM GASTRIC CONTENTS REGURGITATION. MEDICAL HISTORY NOT STATED

SC 86/1

Although he was trained he had only dived intermittently. As he did not own a scuba tank he had to hire one whenever he wished to go diving. His health was reportedly good. This day the sea was calm so he decided he would go for a scuba dive and hired a scuba tank and asked a non-diver friend of his to accompany him when he went to the beach. It is assumed that he intended to hunt for abalone as he was seen to be carrying an abalone iron when he entered the water off some rocks. As soon as he had submerged his friend left the scene and went for a walk, returning to the car they had used to reach the beach. There he fell asleep. When he awoke he became alarmed when he realised how much time had passed without his friend returning. So he walked along the beach, in the hope of seeing him. Once he saw something in the sea and asked a windsurfer to check. But it was not his

friend. So he decided to inform the police that there was a missing scuba diver. They mounted a full search. Bubbles were identified by the helicopter searchers and two police divers were directed to the area. They found the bubbles were due to the slow escape of air from the victim's regulator, which was floating above his head as he lay on the sea bed with all his equipment in its correct place. The autopsy appeared to provide no clues as to the cause of this incident but the histology report indicated the possibility that he was suffering from Toxoplasmodic myocarditis, a diagnostic possibility which was apparently never reported to the coroner. This could explain why he might have suddenly suffered a loss of consciousness. He died despite the sea being calm because he failed to ditch his weights, had no buoyancy vest, and was alone. His chances of survival would have been much better in the absence of such adverse factors. It cannot be known whether he attempted to call for help when he first began to feel ill. Nor is it known how long was the time from onset till death.

SOLO. CALM SEA. SUDDEN ILLNESS. PROBABLE TOXOPLASMODIA MYOCARDITIS. NO BUOYANCY VEST. FAILED TO DITCH WEIGHT BELT. NO WITNESSES.

SC 86/2

This case illustrates how easily a dangerous situation is able to develop even when those present respond to some seemingly minor misadventure in a rapid and reasonable manner. As this case has been reviewed at length previously (*SPUMS J*, 16, 1986.4.153-4), it will be summarised here. There were seven divers in the group, the victim and one other being newly certificated. The chosen dive platform was a rock ledge over which water occasionally came. The most experienced diver checked the water near the entry point before indicating to the others they should prepare to make their water entries. As the victim and another diver were standing near the edge of the rock shelf another of the group shouted a warning that a larger wave was coming and although it was noticed as only a mild swell by the divers who were in the water it knocked the two divers over as it washed over the shelf and poured into a channel on the other side. They were helped up but again tumbled over and the victim, much handicapped by the tank on his back, ended in this channel. As water was continuing to pour off the rocks and back to sea via this channel it seemed to the nearest member of the group to be a safer, easier, and quicker way to assist the victim resolve his problems if he used this route to reach open water than by an attempt to climb back onto the rock ledge and risk being knocked over again. But for the unfortunate outcome of the dive the decision might well have been applauded as being an eminently sensible response to a wild-water situation because it offered an opportunity for the diver involved to recover from his experience before encountering any further problems.

The victim was calmed by the presence of a diver who kept in close contact with him and he managed to

partially inflate his buoyancy vest and started using his regulator. While he was being helped to reach open water he was noticed to show some panic, then he ceased using his regulator and became unconscious. He rejected his regulator, spitting it out each time it was replaced. Both the divers were now close to the other divers of the group. Also they were close to the rock ledge they had chosen to be both entry and exit point when planning the dive. It was agreed that it was more practical to get him speedily out of the water and onto the rocks than to make an attempt at in-water resuscitation and delay his removal to dry land. This was done. At the subsequent inquest it was suggested that the correct action would have been to start in-water EAR. However the likelihood of such a course of action leading to a successful resuscitation is highly debatable. Another matter on which the divers were criticised was their failure to be aware of the fact that although the sea appeared to be calm there were, every 30 or 40 minutes, sets of several large waves. It was stated by a Counsel that they should have known about these waves. As the dive leader had observed the proposed dive site for nearly 40 minutes before declaring the location safe he was possibly rather more careful than others. Had the water entry been commenced some few minutes earlier or later this tragedy would not have happened as the divers would have either been in the water, and hardly felt the surge or they would have seen it coming before they collected on the ledge in preparation for entering the water.

This incident illustrates how rapidly a change in the sea conditions can occur and transform some apparently completely safe situation into one of high risk. This inquest also illustrated the danger which faces anyone who has responsibility for a dive should there occur any serious misadventure. The danger arises not solely from any errors they may have made but also from the methods which are likely to be used by Counsel for some aggrieved party who will be quick to quote texts, such as the training manual of an instructor organisation, which suggest a different problem management.

It may be opportune to consider the validity of any proposition that the words in a Diving Manual have Divine Inspiration as their basis.

NEWLY TRAINED. GROUP DIVE. UNEXPECTED WAVES WASHED OFF FEET WHILE PREPARING WATER ENTRY FROM ROCK LEDGE. VALIANT BUDDY ASSISTANCE. DROWNED DESPITE INFLATED BUOYANCY VEST. RESUSCITATION DELAYED TILL BROUGHT OUT OF WATER. INVOLVEMENT OF COUNSEL IN INQUEST PREVENTED IMPARTIAL APPRISAL OF CRITICAL FACTORS.

SC 86/3

Although the victim was apparently trained, for this was a basic requirement before anyone was accepted by this club, she was certainly inexperienced and possessed none of

the equipment which is necessary for diving. She hired the wet suit, mask and snorkel, borrowed a buoyancy vest, regulator and tank from the club, the fins came from one friend and her torch from another. The other divers also were largely dependent on the club equipment store when they prepared for this dive, the first night dive most of them had ever made. Despite the club rules one of the divers had apparently not yet completed her scuba training course. Another diver was making his first post-course dive. The objective was an offshore wreck, the dive platform a pier from the beach. It was a cold, rainy, dark night and the sea was choppy but they did not let this affect the proposed dive. There were five divers so they arranged to dive as a buddy pair and a group of three, which included the victim. The buddy pair started out first. The others were close behind at first but then lost contact. Then the "O" ring blew on the tank of one of the trio. The experienced diver in the trio turned his air off for him. As he obviously could not now scuba dive they decided he should return to shore and they would continue without him. It was agreed that it was safe for him to return alone as they still could clearly see the pier they had recently left. However only a short time later, while they were still snorkeling out towards the wreck, the victim indicated that she was finding difficulty taking a breath because of the tightness of her wet suit. Her buddy came to her assistance, orally inflating her vest, and she soon said she felt much better. They conferred and decided she should return to the shore, which she apparently now felt fit enough to do alone as her breathing had returned to normal, the wind was onshore, and her buoyancy vest was inflated. Her buddy advised her to start to use her scuba but it is possible that for at least part of her return swim she used her snorkel. The buddy now continued his journey to the wreck, there joining the original buddy pair. It was only when this dive was completed and the three divers returned to the pier that the victim's absence was noticed as naturally the person who had returned first had not known anyone was following him back to shore.

The body was washed ashore about 2 1/2 hours later, all of her equipment save for her mask and fins being correctly in place, but these were missing. Skin marks confirmed her complaint of the wet suit's tightness. Examination of the equipment showed that a much larger than normal effort was required to work her regulator. It lacked a neck strap (as did all the regulators in the club store). The fins had been too loose for her so she had worn socks. It was noted she had 10 kg on her weight belt, which was considered to be excessive for her. It is surmised that the combination of adverse factors, night dive, sea conditions, inexperience, the solo surface swim with inflated buoyancy vest, fatigue and anxiety, and then the loss of her fins and possibly letting the regulator fall from her mouth (as it had no restraining strap it would have been difficult to find again), all contributed to her drowning, which occurred despite an inflated "horse collar" buoyancy vest.

TRAINED. INEXPERIENCED. 2ND DIVE

SINCE COURSE. NIGHT DIVE. COLD. WINDY, RAINY WEATHER. CHOPPY WATER. BORROWED AND HIRED EQUIPMENT. ONE BUDDY HAD RUP-TURED "O" RING AND ALLOWED SOLO RETURN. VICTIM TROUBLED BY TIGHT WET SUIT. EXCESS WEIGHTS. BUDDY ALLOWED HER ALSO TO MAKE SOLO RETURN. FAILURE DIVE DISCIPLINE BY TRIO GROUP. DELAYED REALISATION THAT DIVER MISSING. FAILED TO DITCH WEIGHT BELT. DROWNED DESPITE AN INFLATED BUOYANCY VEST AND ADEQUATE AIR.

SC 86/4

So great was his determination to go scuba diving despite his obesity and poor sight (and other adverse medical facts which he failed to disclose, discussed in *SPUMS J* Vol 18 No 1 p 12-15) that he visited a number of dive shops and doctors in order to obtain permission to receive instruction. His final acceptance was a conditional permission to attend a course. His instructors early decided that he could never be permitted to obtain scuba certification and the limited acceptance was granted subject to him producing a medical certificate stating he was fit to dive. He obtained such a certificate after telling a doctor he was to join a special group of blind divers, a deliberately untrue statement. He also omitted to mention he had a history of asthma, though none of his diving problems arose from this risk factor, and his instructors never suspected him of having this condition while under their supervision. One of the several instructors he approached later stated that had he produced a fit to dive certificate he would have checked out the authenticity of such a document, then required a second opinion by a doctor with some knowledge of diving medicine, as he had grave doubts concerning the victim's fitness to scuba dive.

When he attended this class dive he had already been told he would not be certificated. He was only permitted to attend the lectures because he claimed this could not be prevented as he had previously paid for this course. Possibly the instructors were to some degree influenced by his extraordinary determination to make a scuba dive. They therefore permitted his attendance but had one of the assistant instructors assigned as his buddy. There were on this dive seven other student divers, all of whom had nearly ended their course, and the chief instructor was in charge of them. When the victim was descending he flooded his mask but seemed to have no difficulty in clearing it, which would have reassured his buddy concerning his skill level. After they reached the sea bed he had need once more to clear water from his mask and again managed the task in the correct manner. They then swam to a nearby rock shelf and it was now that he gave a signal that he wished to ascend and both started to ascend together. The buddy did not know why he wished to abort the dive but knew it was not due to a lack of air as they had checked the contents gauge readings as soon as they reached the sea bed and subsequently maintained hand holding contact. His buddy now noticed that his weight belt had slipped so tried to assist him get it

back to its correct place only to find the task beyond their joint efforts, his corpulence defeating them.

The instructor came over and decided it would be best for him to retain his weight belt and for them to help him to ascend. He was instructed to keep his knees bent, to keep the belt resting on his legs (this also prevented him for assisting his ascent by finning). They inflated their buoyancy vests to assist the ascent and the victim successfully controlled the venting of air from his own buoyancy vest. At the surface he was told he could straighten his legs to allow his weight belt to fall away but it tangled on his fins and had to be disentangled by his buddy. As there seemed to be no problem now remaining, the instructor now descended again in order to rejoin his patiently waiting seven pupils. The victim and buddy were close together with inflated buoyancy vests, plenty of scuba air, only about 100 feet from the dive boat, in a calm sea but as the victim appeared to be fatigued the buddy signalled for the boat to come and pick them up, then started to tow him towards the dive boat. After he had been helped aboard he suddenly became unconscious and only replied with groans to all questioning about what was wrong. Resuscitation efforts were immediately commenced, and though he was kept alive until they reached land he died soon afterwards. Although the autopsy report initially stated that the cause of death was drowning this diagnosis was amended when there was discussion with a RAN doctor versed in Diving Medicine and in consideration of the finding of widespread evidence of changes in the myocardium due to ischaemia the diagnosis was made that death was due to a "heart attack", the consequent failure of his cardiac function causing the observed symptoms. There was evidence of his having suffered a "silent infarction" a few days previously.

WELL SUPERVISED, UNFIT PUPIL DIVER. OBESE. PART BLIND. FAILED REVEAL COMPLETE MEDICAL HISTORY. MEDICAL FITNESS ASSESSMENT IS DEBATABLE. SUDDEN ILL HEALTH UNDERWATER. UNABLE TO REPOSITION WEIGHT BELT SO ASSISTED ASCENT WEIGHTS ACROSS BENT LEGS. BELT SNAGGED ON FINS AT SURFACE. CONTROLLED INFLATION BUOYANCY VESTS HELPED ASCENT/SURFACE. VALIANT BUDDY ASSISTANCE. UNCONSCIOUS ON BOAT. HEART DISEASE DEATH.

SC 86/5

A tourist, one of a dive group which was accompanied by an instructor from her own country, died while scuba diving with some of her compatriots during a boat trip to the Barrier Reef. Though she was trained, as were all the members of the group, her exposure to diving was possibly under closely controlled conditions. She and her buddy made three dives without apparently experiencing any problems on the first day of the trip. On the second day, the boat had been moved to another location and it was anchored close to a reef where water depth was 20 metres at the boat,

and shallower close to the reef, becoming deeper further out. The other passengers included six trained scuba divers, five under instruction who were with two instructors, and several divers with dive master status or trying to achieve this qualification. There was no lack of people well qualified to provide the resuscitation correctly when it unfortunately became necessary.

Two divers were noted at the surface seawards of the dive boat's stern. They submerged without replying to signals from some dive masters who were standing there. A short time later one diver was seen to surface and as there was again no response to calls or signals they decided to send the safety boat to check that all was well. The correctness of this decision was confirmed shortly as the diver began to signal for assistance. Some of these watching divers dived into the water and swam quickly to help the diver in distress. It was only after a diver leaned out of the safety boat, an inflatable, to inflate this diver's buoyancy vest that he saw first a fin, and then a body, floating a few feet below the surface. One of the divers attempted to inflate the victim's vest underwater but was unsuccessful because her tank was empty of air but he nevertheless managed to raise her to the surface where she was grabbed and pulled into the inflatable. Her equipment was removed and resuscitation was commenced. This was maintained while on the dive boat and during the emergency helicopter flight back to land and to the hospital. She never regained consciousness and died in hospital six days later. Her symptoms were diagnosed as being due to cerebral anoxic damage due to the "near drowning" lung changes she had suffered. There was a possibility that she had suffered a cerebral arterial gas embolism (air embolism) so she was moved to a hospital near a recompression chamber. Unfortunately the extent of the lung and brain changes precluded survival and she died six days later.

Both of the divers were keen underwater photographers and were swimming back to the dive boat when they realised they might have come too far because the water had become deeper than the 20 metres depth which existed between the boat and the reef. Unknown to them a strong current ran off the reef. They therefore came to the surface to check their position, then descended again with the intention of continuing their return underwater. The victim began to experience some difficulty with her air supply before they had descended more than 3-4 metres so her buddy held her and assisted her to ascend. It is uncertain exactly what happened as the death did not occur for several days and the buddy returned home before there was any reason for the police to investigate this incident. As a consequence no deposition of evidence was obtained from her.

The autopsy revealed the changes expected for cases where death follows several days after immersion lung injury and anoxic damage to the brain. On the basis of the history of what happened it is reasonable to believe that she suffered a cerebral arterial gas embolism during her out-of-

air ascent, lost consciousness, then inhaled water. Why she failed to ascend before running out of air cannot be known as she had a contents gauge. From 3-4 metres depth a reasonably experienced diver should have surfaced safely though cases of air embolism certainly occur where the victim has seemed to ascend in a correct manner.

TRAINED. SOME EXPERIENCE BUT POSSIBLY ONLY SHALLOW PROTECTED WATER. CONTENTS GAUGE BUT DESCENDED WITH NEAR EMPTY TANK. RAN OUT OF AIR BUOYANCY VEST INOPERATIVE AS TANK SUPPLIED. UNDERWATER CURRENT SO SWAM TOO FAR FROM DIVE BOAT. LOST CONSCIOUSNESS DURING ASCENT. RAPID RESPONSE FROM DIVE BOAT. RESUSCITATION BUT DIED LATER FROM EFFECTS CEREBRAL ANOXIA AND IMMERSION. CLINICALLY AIR EMBOLISM DEATH.

SC 86/6

While working at an island branch of his organisation the victim noticed an advertisement for boat dives and decided that he would like to join such a dive. He told the instructor who was in charge of the dives that he was trained but was without his card, it having been left on the mainland. The instructor hired him the necessary equipment and then checked how he managed it and how he managed himself swimming at the surface wearing full equipment, in this manner assuring himself that the victim really had knowledge of scuba diving. The dive location was a sheltered area which was nowhere deeper than 60 feet. This was because two of those making the trip had been diving earlier that day, another was newly trained and the victim was an unknown quantity to the instructor.

There were seven divers so they were assigned into a trio and two buddy pairs of divers, the instructor remaining aboard the boat as safety cover. The victim and his buddy had an uneventful dive lasting about 35 minutes at 45 feet depth. They maintained a good buddy discipline at all times, keeping contact during ascent, surfacing about 35 metres from the dive boat. They were observed to exchange "OK?" signs and inflate their buoyancy vests, and then to start swimming back to the boat in the calm sea. At some stage the victim changed over from scuba to snorkel and dropped back to the rear of his buddy who consequently reached the boat first and was hanging onto its stern when he heard a diver jump in and swim towards his lagging dive partner. He therefore swam back in order to see whether his help was needed.

The instructor had been watching their return so had seen the victim suddenly stop swimming and float quietly as if now too tired to continue. He therefore asked a diver who had boarded the boat after completing his dive to swim to him and ask if any help was needed. Unexpectedly he found that the victim was unconscious and floating face down so immediately turned him over, dropped his weight belt and

commenced resuscitation (EAR) while waiting other divers to come to assist. Despite continued resuscitation efforts after getting him in the dive boat there was no response to their efforts. The autopsy showed that he had not drowned but failed to show a cause of death. Having regard to his recent ascent and the absence of any identified disease it was proposed that this death was presumed to be the delayed consequence of a cerebral arterial gas embolus. However this is diagnosis by exclusion rather than a positive finding.

TRAINING NOT STATED. EXPERIENCE NOT STATED. EQUIPMENT HIRED BUT SCUBA ABILITY WAS QUICKLY CHECKED BEFORE BOAT DIVE. BUDDY DISCIPLINE GOOD. CALM SEA. LOST CONSCIOUSNESS DURING SURFACE SWIM. INFLATED BUOYANCY VEST BUT FLOATED FACE DOWN. AIR EMBOLISM AS POSSIBLE CAUSE.

SC 86/7

There were seven divers taking part in this boat trip, one having failed to turn up in time. All were trained and the victim and his buddy were both experienced divers. Though there was some swell the conditions were safe for diving and never became unsafe despite a later increase in chop and swell. The two divers, victim and buddy, descended the anchor line to the sea bed, 27 metres, then moved to a shallower area for the next 20 minutes. They wished to avoid decompression problems and allowed time to reach the anchor line and ascend without requiring decompression stops. Because of their failure to locate the anchor they decided to make an ascent together in the open water, without the comfort and guidance which a line affords. The buddy at this time had 1500 psi remaining and the victim somewhat less but comfortably above the warning sector on his contents gauge. The buddy saw his companion start to leave the sea bed, then falter and sink down again and partially inflate his vest orally. As he was still unable to initiate an ascent the buddy put air into his own vest, took his hand, and by finning hard they managed together to leave the sea bed. They ascended face to face at an apparently normal rate without further problems so the buddy was surprised when the victim signalled for assistance from the dive boat as soon as they had surfaced. He assumed this to be from a dislike of making a 20-30 metres surface swim in what were now windy conditions and a surface chop.

Believing his companion would welcome some assistance, the buddy linked arms with him and started to tow him, both continuing to use their regulators. The victim seemed too breathless for the circumstances and was making frequent signals to summon help. Then he became limp. Fortunately at this time a line reached them from the boat and the man who had swam it across was able to take over from the buddy, who was very fatigued. He ditched the victim's weight belt, which failed to drop away, caught by a strap belonging to the buoyancy vest. This was no problem as the vest provided all necessary buoyancy despite this. As soon as he had been pulled into the boat resuscitation efforts were

commenced, first EAR, then CPR and oxygen, but he failed to respond. These resuscitation efforts were only interrupted to clear away froth and vomit. This is a problem that practice mannikins do not provide.

The autopsy showed marked lung changes were present which were interpreted as indicating an acute myocardial failure death, and the history of the incident could be interpreted as showing a developing cardiac failure. However there may also have been some element of pulmonary barotrauma, which would be likely to occur in a congested and therefore malfunctioning lung. It would seem that this fatality was, in the circumstances, quite unavoidable.

TRAINED. SOME EXPERIENCE. OVER WEIGHTED ON SEA FLOOR SO ORAL PARTLY INFLATED BUOYANCY VEST. BUDDY CLOSELY ASSISTED AND ACCOMPANIED ASCENT. SURFACE EXCESS FATIGUE SO BUDDY ASSISTANCE. WEIGHT BELT ENTANGLED ON BUOYANCY VEST STRAP BUT GOOD SUPPORT BY BUOYANCY VEST. VALIANT BUDDY ASSISTANCE. CARDIAC DEATH.

SC 86/8

There is no information concerning the training or diving experience of this man but it is known that he owned a regulator which had an "octopus" second demand valve, had three scuba tanks, and was known to obtain air fills from several dive shops so must have made a fair number of dives. It is unknown whether he always dived solo or with others but this evening he was alone when last seen going back to the water after exchanging an empty tank for a full one he had left in his car. The fresh tank had only 26 cu ft capacity. He spoke to a bystander and it is therefore believed he was either intending to catch crayfish or spear fish, although the correctness of these suppositions is unknown. He failed to return home that night and the matter was reported the next morning. His health was described as being poor as he had weakness of his left side following a stroke, was obese, and became breathless even when walking on the level. An intensive search, from the air and by the police divers, failed to locate his body, which was washed ashore 7 days later still wearing the tank and weight belt. His scuba tank was empty and the LP hose intended for connection to his buoyancy vest (which was incorporated in his wet suit) was not connected.

The weights on his belt were rather forwardly placed such that though they did not impede closing the belt buckle they were preventing the easy operation of the quick release. It is thought likely that he ran out of air rapidly, having forgotten he was now wearing a small capacity cylinder, was naturally unable to inflate his buoyancy vest or ditch his weight belt, so drowned.

SOLO SCUBA. TRAINING NOT STATED. EXPERIENCE NOT STATED. SMALL CAPACITY CYLINDER. L.P. INFLATION HOSE NOT CONNECTED TO VEST. WEIGHTS OBSTRUCTED BELT QUICK RE-

LEASE. OUT OF AIR. DELAY IN NOTIFICATION OF HIS ABSENCE. ILL HEALTH, OBESE, POST CVA (STROKE) WEAKNESS, EASILY BREATHLESS ON EXERTION

SC 86/9

Because he was older than either of his two companions it was agreed that he could leave them and return to the shore if he decided to abort the dive. Their plan was to snorkel out to rocks which were about 150 metres offshore, then to scuba dive. He was a trained diver with 2 years' experience, his companions having 1 and 6 years respectively. There was some swell but the water was calm inshore of these rocks, though it was rougher between them. On the outward swim they swam in line, the victim being in the rear. Both the other two divers swam through the rough water then waited for the victim to join them, which he failed to do. Being a little bit worried by this one of this pair allowed a wave to wash him up on a rock from which vantage point he was able to observe the victim floating quietly about 30 feet away and facing him. After he made an "OK?" signal he received a "Come and Help" signal so he removed his back pack, inflated its buoyancy vest, and gave it to his buddy before quickly swimming to the victim.

When the victim had made his signal requesting assistance he was holding his regulator in one hand as if intending to start using it. When reached he was floating face down, unconscious, with wavelets covering his face. The buddy turned him face up, put some more air in his buoyancy vest, ditched his weight belt, and made an attempt at in-water EAR despite the froth coming out of the mouth of the victim. Two nearby divers came to assist, responding to his calls for help, so he was able to continue his resuscitation while they towed the victim towards the shore. No signs of any response were observed. The autopsy showed an apparently healthy heart and signs of drowning. The description of the incident however is not such as to support simple drowning as being the cause of death as cause was not identified. The sea was described as calm and while the buoyancy aid allowed an unconscious wearer to float in rather a dangerous face-forward position this would almost certainly not occur while the wearer was conscious. Possibly he suffered from a sudden cardiac arrhythmia but there is no evidence to support any such a suggestion except for his mode of dying. His regulator was said to require more than the correct effort to activate it, which would have increased the effort necessary to keep up with his two companions.

SURFACE SNORKEL SWIM WEARING SCUBA. SEPARATION. CALM WATER. BUOYANCY VEST PART INFLATED BY VICTIM. FLOATING FACE DOWN. WAVELETS OVER HIS FACE. QUIET RAPID DEATH AT SURFACE. IN-WATER EAR ATTEMPT CONTINUED WHILE TOWED BACK TO SHORE.

H 86/1

This was a day when everything seemed to go wrong,

TABLE 1

PROVISIONAL REPORT ON AUSTRALIAN DIVING-RELATED FATALITIES 1986

CASE	AGE	DIVE SKILL LEVEL		DIVE GROUP	DIVE BASE	DIVE PURPOSE	WATER DEPTH	INCIDENCE DEPTH
		VICTIM	BUDDY					
BH 1	35	Not Trained Inexperienced	Not Applicable	Solo	Beach	Shellfish	4'	Surface
BH 2	35	Not Stated	Not Stated	Separation	Boat	Recreation	40'	Surface
SC 1	31	Trained Experienced	Not Applicable	Solo	Rocks	Recreation	10'	Not Stated
SC 2	34	Trained Inexperienced	Trained Experienced	Group	Rocks	Recreation	10'	Surface
SC 3	24	Trained Inexperienced	Trained Inexperienced	Group Separation	Jetty	Recreation	Not Stated	Surface
SC 4	40	Some Training Inexperienced	Trained Experienced	Buddy	Boat	Class	70'	70'
SC 5	28	Trained Some Experience	Trained Some Experience	Buddy	Boat	Recreation	90'	12'
SC 6	40	Not Trained Some Experience	Trained Moderate Experience	Buddy	Boat	Recreation	45'	Surface
SC 7	50	Trained Experienced	Trained Experienced	Buddy	Boat	Recreation	90'	Surface
SC 8	37	Not Stated	Not Available	Solo	Beach	Recreation	50'	Not Stated
SC 9	59	Trained Experienced	Trained Experienced	Trio Separation	Beach	Recreation	Not Stated	Surface

TABLE 1

PROVISIONAL REPORT ON AUSTRALIAN DIVING-RELATED FATALITIES 1986

WEIGHT LBS.	BELT ON?	CONTENTS GAUGE	BUOYANCY VEST	REMAINING AIR	EQUIPMENT CHECK	OWNER	WET SUIT	SIGNIFICANT FACTORS
Not Applicable	No	Not	No Applicable	Not	Not Applicable	Own Applicable	No	Poor swimmer. Solo 1st use of a snorkel.
Not Stated but near	Not Stated	Not Applicable	Not Stated	Not	Not Applicable	Not Applicable	Not Stated	Acute Gastric Ulcer Stated bleed. Alone others.
18	On	Yes	Yes	>1/2	Yes	Hired	Yes	Acute Illness. Solo. Calm sea. Toxoplasmodia Myocarditis.
Not Stated	On	Yes	Yes Used	>1/2	Yes	Hired	Yes	Knocked over by waves previde. Vest inflated, but drowned.
22	On	Yes	Buddy Inflated	>1/2	Some Adverse	Instructor	Yes	Tight wetsuit. Rough Sea. Night. Lost fins. Hard-breathing regulator. Separation/ solo x 3. Vest inflated.
36	Buddy dropped	Yes	Yes Used	>1/4	Yes	Instructor	Yes	Several health problems. Acute Illness Underwater. Cardiac. Valiant buddies. Weight belt!!
Not Stated	On	Yes	Yes Fail	Nil	No	Hired	Yes	Low-air descent. Out- of-air ascent, air embolism. Current No Air = useless buoyancy vest.
Not Stated	On	Yes	Yes	Low	Yes	Hired	Yes	Post swim surface unconscious (possibly) Air Embolism.
21	Off Entangled	Yes	Slightly Inflated	Low	Yes	Club Instructor	Yes	Underwater onset feel- ing ill? Surface breath- lessness before. Acute Cardiac Failure.
35	On	Yes	Not Inflated	Nil	Some Adverse	Own	Yes	26 cu ft tank. LP Hose to suit vest not connected. Out-of-air.
Not Stated	Buddy dropped	Yes	Slightly Inflated	>1/2	Some Adverse	Own	Yes	Surface separation, calm sea. Buoyancy vest inflation support, unconscious face down.?? Cardiac.

CASE	AGE	DIVE SKILL LEVEL		DIVE GROUP	DIVE BASE	DIVE PURPOSE	WATER DEPTH	INCIDENCE DEPTH
		VICTIM	BUDDY					
H 1	26	Not Trained Some Experience	Not Trained Experienced	Separation	Rocks	Shellfish	10'	10'
H 2	31	Not Trained Some Experience	Not Trained Inexperienced	Separation	Boat	Crayfish	12'	5'
H 3	34	Trained Experienced	Not Available	Solo	Wharf	Work	37'	25'

first a delay in the getting together of those involved, then faults which caused both outboard engines of their boat to fail. But they both held licences to catch crayfish and were determined to go diving. So they took their compressor and other diving equipment in a car down the coast in search of a suitable place for a dive using hookah. The car became bogged on the coastal track but nearby they found a place where their compressor could be located close to the water. The buddy was untrained but had experience of many years of diving. He had trained the victim and the third one in the group, the person deputed to remain with the compressor. The victim was said to have made 15 dives in the previous two years.

They were careful to site the compressor correctly before connecting their hoses and entering the water. After about thirty minutes the buddy came ashore to sort his catch for correct sizes and about 5 minutes later the victim surfaced 15-20 metres out. He showed no signs of having any problems, and he soon resubmerged and his bubbles showed he was swimming towards the shore. He surfaced again a short time later, however, and signalled to them to pull on the air hose to assist his return. They had arranged to give this help on request when planning the dive so the two who were ashore started to pull in his hose. They saw him submerge and noticed an increased resistance to their efforts, then he came to the surface again and seemed to be in some kind of trouble and was calling to them for help, but the compressor was so noisy they could not make out what he was saying. He seemed to be struggling rather than to be panicking. The buddy thought that he might be entangled by the kelp and rapidly donned his mask, fins and weight belt and grabbed his regulator, then jumped into the water. He was brought up short by inhaling water, having omitted to put the demand valve into his mouth before entering the water, then lost a fin and while placing it back on was inconvenienced when his companion turned off their noisy compressor in order to hear what the victim was calling. It was soon ordered restarted!

When the buddy reached where the victim had been, he found him lying on the sea bed, the water depth here was only 10 feet, with his regulator free flowing nearby. He was in a clear area and not entangled when found. The buddy managed to remove his weight belt with some difficulty due to the quick release having been pulled, possibly by their hose traction, to lie at his back (and therefore out of the victim's reach). After he had surfaced with the victim he signalled to be pulled ashore by his hose but the person there mistakenly pulled in the victim's hose. This one, ditched in order to make it easier to raise the victim, was composed of two lengths and the junction parted during this time of pulling, an event that had no adverse influence on this occasion but highlights the real danger of pulling too hard on a hose junction. Realising what was happening, the buddy towed the victim back to the rocks. Their EAR efforts were unavailing. The cause of death was drowning with no explanation for the observed events. It is supposed that his hose became snagged round kelp or some other obstruction and he became tethered, sank, let the regulator fall from his mouth, was unable to recover it or to reach the quick release of his weight belt so he drowned despite the shallowness of the water. Aid was summoned using the radio on a boat which came to the scene during the rescue.

UNTRAINED. SOME EXPERIENCE. SEPARATION/SOLO. HOOKAH. SHALLOW CALM SEA. NO BUOYANCY VEST. WEIGHT BELT TURNED SO QUICK RELEASE OUT OF REACH FAILED/UNABLE TO DROP WEIGHT BELT. PROBABLY HOSE ENTANGLED BY KELP. AIR HOSE SEPARATION ON TRACTION. DIFFICULT ACCESS FOR AMBULANCE.

H 86/2

This man was untrained but had been diving for many years and had instructed his friend in the art and science of using the hookah apparatus about 5 months prior to this incident. That they both regarded 25 fsw as deeper than they

WEIGHT LBS.	BELT ON?	CONTENTS GAUGE	BUOYANCY VEST	REMAINING AIR	EQUIPMENT CHECK	WET SUIT	SIGNIFICANT FACTORS
21	Buddy dropped	Not Available	No	Not Available	Some Adverse	Borrowed Yes	? pulled underwater as air hose around kelp. Unable ditch weights.
23	Buddy dropped	Not Available	No	Not Available	Faulty	Borrowed Yes	Repeated diving after repeat hookah failures. Hose snagged.
27	On	Not Available	No	Not Available	Yes	Employer Yes	Aware danger, used scrubber. Emergency so cut own airhose. Failed operate get-home tank.

were experienced to dive indicates a cautious and limited approach. The weather had lately been unsuitable but this day the sea was calm. Then the buddy found his boat was not working and his hookah was bolted to it. However he had a friend with a compressor designed for diving though till then it had only been used to inflate car tyres and spray paint. The friend had however loaned it recently to a diver who was an engineer and he had overhauled it before returning it. So it was said to be now in perfect working order. The hookah owner was a trained scuba diver and brought his wife along on this trip intending to teach her to scuba dive while the others were hookah diving from his boat.

They declined the first dive location because of the poor visibility, they hit the sea bed before they could see it. A shallower location was then tried. The visibility here was also far from good. The victim and buddy descended but soon had to surface as the compressor motor cut out. It was easily restarted but soon again failed. Again they surfaced but descended once more when the owner, the scuba diver, restarted it. He had thought that would abandon their attempts to dive after this and did not notice them dive again as he was busy handing a scuba tank out of the boat to his wife, who had been snorkeling around the boat while the engine problem was occurring. Then the engine failed again but on this occasion it refused to restart. This time the buddy alone surfaced.

When he surfaced the buddy called out that the victim was trapped, prevented from surfacing by his air hose. He had tried to pull him free but failed. The victim could be seen 5 feet beneath the surface, his hose passing under a rock ledge and tethering him about a similar distance from the sea bed. The buddy realised the necessity of setting him free and breath hold dived again, on this occasion managing to release the weight belt and bring him to the surface. He was still alive at this time with frothy blood coming from his mouth. The buddy and the scuba diver commenced EAR

while towing him back to the boat and continued this during their 10 to 15 minute trip back to the harbour. There he was pronounced dead.

The compressor was attached to a single air hose and this ended at a "T" junction from which ran two 15 feet long hoses, one to each diver's regulator. The hose section running to the victim had caught under a ledge and unfortunately it failed to pull free when he ascended. He probably responded by struggling against the restraint it imposed instead of ditching his weight belt, too late realising his mistake. Although the scuba diver member later said he had noticed that the victim had the air hose covering the belt quick-release, the buddy reported that the only problem he noticed in releasing the weight belt arose from him wearing rubber gloves, to protect his hands while catching crayfish, as these made his attempts to operate the quick-release clumsy.

Examination of the compressor's engine revealed that the carburettor drain tube had been incorrectly connected. It was upside down and therefore permitted the carburettor to over-fill. When this was corrected the engine worked properly. It was lucky for the buddy that the water depth was not any greater or he also might have found himself tethered. The inexperience of the victim was tragically demonstrated by his failure to respond by dropping his weight when snagged so close to the surface. As the hose and the regulators were ditched during the rescue and were stolen before their recovery was arranged, this equipment was unavailable for checking but there is nothing to suggest that it was faulty.

UNTRAINED. INEXPERIENCED DESPITE MANY HOOKAH DIVES. SHALLOW WATER. CALM SEA. CONTINUED DIVING DESPITE REPEATED COMPRESSOR FAILURES. SINGLE AIR HOSE TO "T" JOIN THEN TWO SHORT HOSES TO REGULATORS.

HOSE TRAPPED BENEATH ROCK LEDGE. TETHERED VICTIM UNABLE TO SURFACE FAILED TO DITCH WEIGHT BELT. SCUBA DIVER TEACHING NOVICE TO DIVE IN OPEN SEA. SEPARATION/SOLO DIVE.

H 86/3

After leaving the navy this diver took up commercial work and was involved in tasks such as scrubbing the hulls of vessels. He was regarded as being safety conscious and on this occasion he was using a hired hull-scrubber to work on a ship in harbour. The machine was known to have gobbled up a diver's umbilical at least on one previous occasion when used by his team but the installing of an emergency cut-out switch for the diver to use was quoted at so high a price that it was not installed. A simpler, and cheaper, remedy of binding the umbilical to the power cable, at least close to the machine, was suggested but never implemented on this job.

The diver had voice communication with topside, one person to monitor the communications, one as tender, and a third to ensure the hose did not snag as the diver worked fore and aft under this ship close to the wharf, this last being the stand-by diver. After a short time underwater the communications failed so while it was being repaired the diver was brought out of the water. After this the victim, the boss, decided that he would take a turn working the scrubber and exchanged tasks with the first diver. The wharf crew became alarmed when communications ceased abruptly and the tender noticed the hose was suddenly taut. They immediately cut power to the scrubber and the stand-by diver descended along the umbilical to find out what was wrong. He found the hose led to the scrubber and entered it but there was no sign of the victim. The visibility was nil but he noted that the hose had been cut. A search was now organised and his body was located five hours later. His fullface mask was full of water but the back-up bottle he was wearing soon blew this out. It is believed he cut his hose in order to prevent himself from being drawn inexorably into the scrubber but did not have time to turn on his reserve air bottle to establish positive pressure in his helmet before it filled with water and he drowned as water entered through the cut hose. The hose was of a floating type and under the hull would be likely to be near the intake for the scrubber.

COMMERCIAL DIVER. SCRUBBER KNOWN RISK INGESTING HOSE. FAILED TO TIE HOSE UMBILICAL TO POWER LINE OF SCRUBBER. UNDER HULL WITH FLOATING TYPE HOSE. GET-HOME CYLINDER BUT DROWNED WHEN CUT HOSE TO STOP BEING PULLED INTO MACHINE. MACHINE DANGEROUS IF USING HOSE SUPPLY.

DISCUSSION

Examination of these cases reveals many matters which are of importance in the context of diving safety but major attention is warranted to two matters in particular, the

fact that a medical factor was so frequently present and the number of cases where a buoyancy vest failed to save its wearer. In the first group there is no suggestion that the victims were necessarily aware, or could have been aware, of their precarious health condition. Certainly a medical examination would not have predicted these disasters. The situation may be that the number of people diving is now so great that a statistical expectation arises that illness-related deaths will occur in sufficient numbers to invite comment. There must be many unfit persons undertaking all types of activities and only a small number will become fatally ill. It would be helpful in this context if an increased attention were given to investigating the medical history of victims, but there is a high probability that a person undertaking diving or other potentially strenuous activity will be unlikely to tell others of any symptoms he suspects might lead them to advise him to refrain. Case BH 86/3 may serve as an example of a person who probably had some symptoms of indigestion but in whom it is unlikely anyone would have predicted that there would be an acute gastric haemorrhage, and his medical history was not ascertained. The "cardiac deaths" noted in Cases SC 86/1, 86/4 and 86/7 (and possibly in SC 86/9) were all probably "unavoidable deaths" and would have occurred even had the victims been at home, but there is no way such a proposition can be tested. Although it was obvious that the victim in Case SC 86/4 was considered unfit, so received special attention, nobody suspected that his heart was his danger factor, his hypertension being considered not requiring medication. This case also serves to remind us "even Homer nods", that the dicta of experts may be suspect. The pathologist was too ready to regard all in-water deaths as necessarily resulting from drowning, although in this case he was tactfully persuaded to look at the evidence again and reconsider his diagnosis.

Of greater importance is the finding that an unconscious person may drown despite wearing an inflated buoyancy vest, a fact which is disquieting and deserves urgent attention. There is also a fact noted previously, that an empty tank makes scuba-feed vests virtually useless in time of need. Obvious, but nonetheless having real significance and likely to be overlooked by wearers until an emergency situation occurs.

The death in Case BH 86/1 illustrates the effect of using unfamiliar equipment, in this case the victim would have survived if he had thrown away his snorkel and thought of himself again as a swimmer rather than some breathing through a tube. The other breath-hold fatality underlines the sad fact that one is alone in a crowd, that supervision of an unregulated group is not possible. It is for such a reason that the instructor and pupil ratio has to be kept low, particularly in the open water phase of teaching scuba.

Fatalities among hookah users usually result from failure of the compressor portion of the apparatus or from a hose problem of some sort. In these cases there was hose entanglement and hose separation as well as a cut hose and

compressor engine failure. A sad collection of reminders of the critical factors deserving the keenest attention by hookah users.

Readers are invited to consider what further lessons they can discover from a careful consideration of these case histories so that such events never confront them or their buddies.

ACKNOWLEDGEMENTS

The production of this report would not be possible without the interest and support of the Departments of Attorney General/Law/Justice in every State. The willing assistance of the Police in cases where the Coroner has considered it not necessary to hold any Inquest is noted with appreciation. Thanks are also due to those in the Diving Organisations, as well as those who correspond directly, for their support.

PROJECT STICKYBEAK

The objective of this project is to collect reports on all types of diving-related misadventures which range from the fatal to those so well managed that there was no "incident" to report. Medial Confidentiality is at all times afforded such reports, and there is a firm policy that this is a NON PUNITIVE REPORTING SCHEME. This means that the reporting of asthma or diabetes, etc., will NOT result in the affected diver losing his or her diving certification. Remember, it is only through having accurate, adequate, and up-to-date information that diving and hyperbaric activities are able to reach and maintain acceptable levels of safety. Reports are urgently required to enlarge the scope of the project.

Reports should be sent to:-

Dr Douglas WALKER,
P.O. Box 120,
NARRABEEN,
NEW SOUTH WALES 2101.

By Ed SPUMS J.

The following paper highlights the unknown, and unknowable, factor in all calculations about the risks of diving, the denominator. Diving trainees can be counted but not the number actually diving during any weekend, nor the total of divers and dives made during a year.

The situation in Australia is little different. The various diver training organisations know how many certifications they have issued each year, and there are estimates of the number of dives a week out of Cairns. But the dropout

figures are not known nor is the number of dives a year by "active divers" known.

We have reprinted the paper to encourage all diving organisations, dive training bodies, diving clubs, and individual divers to keep records of who dives when, and to encourage them and dive charter boats, who presumably keep records of divers taken out and their dives, to supply Project Stickybeak with annual figures. As with all Project Stickybeak information it will be confidential and all identifying items will be removed before the information is used for publication.

Of interest is the total number of dives in the year and each diver's total, or in the case of charter boats the number of dives by each diver on the charter. With this information for Australia our statistics would no longer only be guesses as we would have a minimum number of dives a year, and with luck, an estimate of dives per diver.

THE RISKS OF SPORT DIVING

Robert Monaghan

JUST HOW MANY DIVERS ARE THERE ? 3.5 Million or 700,000?

INTRODUCTION (By the Editor of "Undercurrent")

Diving is purported to be a very safe sport, especially when compared to other sports. The truth is, comparatively speaking, it may be among the least safe because the number of active divers may be far fewer than popular industry statistics would have us believe.

Diving fatality and accident rates are determined by the National Underwater Accident Data Center (NUADC), which is housed at the University of Rhode Island. It is essentially a one-man operation, which John McAniff has dutifully compiled and reported data since 1970. Historically it has been underfunded by the federal government, and now barely survives on a budget of less than \$60,000 per year, mainly through large contributions from the Diving Equipment Manufacturers Association, PADI and small contributions from others, Undercurrent included.

Although NUADC reaches out to a number of sources for information about diving deaths, according to its own statistics about 75% of the deaths it discovers comes from newspaper clippings provided by a clipping service. John McAniff has told Undercurrent that the NUADC has never received complete data nor complete cooperation from the training agencies or other industry sources to develop a statistical base. Essentially, McAniff labors alone