INCIDENT REPORT AND
RESULTS OF SUBSEQUENT INVESTIGATIONS.

AIR/SEA RESCUE

SOUTH/NORTH STACKS, ANGLESEY.

1ST MAY 1988.

CONTENTS.

1. INTRODUCTION.

On 1st May 1988 a canoeist had to be rescued in extremely difficult conditions off South Stack, Anglesey by helicopter. To anyone who knows the kayak involved, a Sea Tiger, it was immediately obvious that a most unusual incident had occurred since it defied all the tests carried out on it over the years and also the report issued in the canoeing press did not add up. The first purpose of this report is to treat this incident with the respect it deserves, to analyse the detail of the incident itself together with the period before, to state why the problems occurred, to show how the problem could occur to anyone at any time, to compare what would happen if a similar problem were to happen in a conventionally fitted kayak and to draw some conclusions which would help all to gain from the traumatic experiences and findings of this extremely serious incident. The second purpose is to correct the totally misleading situation which surrounds the reporting of the incident to date.

Any rescue which gets to a serious stage is in need of thorough investigation in as an objective manner as possible in order that lessons can be learned, not only by those concerned, but also by canoeists in general and also manufacturers and distributors of equipment. There was only one report made in the canoeing press immediately after the event. It unfortunately took the manufacturer of the kayak and the paddler some time before they were able to meet, to get the necessary official documentation relating to the rescue and to thoroughly investigate the case in order that a full, detailed and accurate report could be produced.

On the other hand, Frank Goodman chose to write a report on the incident which was published in the July edition of the Canoeist. The relavent paragraph read as follows:-

> "Not so happy, though, were the two canoeists who set had out from Treaddur Bay where the surf conditions were easier. One boat, in theory very safe with a cockpit pod fitted, developed a small leak. The big seas bent and twisted the boat, causing it to act like a giant pair of bellows, alternately sucking in water and pushing out air. Before long, water was pouring from end to end of the boat as the swell passed under, lifting first bow and then stern. Luckily Nigel Dennis, the Director of the School, knowing the two paddlers were inexperienced on the sea, had already asked the Coastguards to keep an eye out for the them. The helicopter winched the hapless canoeist clear and, luckily for him, Nigel was on the scene soon afterwards as the lifeboat had been called out to a yacht in distress and he was able to retrieve the waterlogged kayak. It took four lifeboatmen to lift the kayak from the water!"

In anybody's book this incident is, to say the very least, extremely serious. This report was written to read like "an everyone lived happy ever after" bedtime story with the villains being the paddler and the kayak. And yet it was written with minimal investigation as to what happened, with no investigation as to the extent of the cause of the incident, without any discussion with the paddler concerned, without

reference to timescale, without reference to the conditions at the time or, in other words, almost without any background information which would represent a true picture. As a result he was totally unaware of the fact that if the same problem had occurred in a conventionally fitted kayak the paddler would be more than lucky to be alive today.

The report is in two main parts. The first is written by the paddler concerned and the second by the Manufacturer of the Sea Tiger. Every attempt has been made to present the details accurately and without bias.

SECTION 2. The paddlers report covering the incident and its background.

2.1 INTRODUCTION.

The purpose of this part of the report is to look at the events leading up to the request for an air/sea rescue off South Stack, Holyhead, to establish what safety proceedures were adopted or ignored before setting off, to see what procedures were taken upon the incident occurring and to see what procedures could be adopted in order that an incident of this type need not repeat itself.

2.2 PREVIOUS EXPERIENCE.

I have gained reasonable experience in white water paddling on various rivers including many weirs on the Thames, Holmpierre Point, the Dart, Wye, Usk, Treweryn, to name but a few. I have also put in a large number of hours canoe surfing locally, from the West Country and West Wales often under extreme conditions. My experiences in sea paddling are narrower and have been undertaken in more passive conditions - locally on the South Coast with some under more strenuous conditions around the Isle of Wight.

I was quite new to the boat that I was using (a Sea Tiger) but had paddled it in quite hard surf (e.g.force 6 in up to 5 ft. breaking waves) and for approximately 50 hours including solo around the Isle of Wight. I have found this boat to be most versatile, easy to roll, exit and re-enter at sea and easy to paddle under a wide variety of conditions. One important aspect of my paddling is that my stamina is good and, even on a poor day, I will happily endure two sessions of 3-4 hours white water or surf.

This was my first visit to the area where this incident occurred. The day before the incident was spent paddling from just East of Holyhead Breakwater to Trearddur Bay and we had gained reasonable first hand knowledge of the escape routes that were on offer should the need arise.

2.3 EQUIPMENT AND SAFETY ORGANISATION FOR THE DAY.

I was quite aware on setting out of the strengths and limitations of the equipment I was using. On the plus side the paddles were strong and were attached securely to the wrist with a quick release buckle. I was attached securely to the side of the boat with a quick release harness around the waist. I had found on rolling practise the previous day that clothing was more than adequate, with a spare neoprene balaclava and gloves being carried. I was well protected against heat loss. I was paddling with a very strong and most competent paddler with whom I had built up a very good understanding over the years and with whom there was an excellent mutual confidence.

With respect to the limitations of the Sea Tiger, there had been a minor leak around the skeg which had been dealt with (and was still satisfactory after the incident) and there was another small leak which had remained elusive. All told, however, the kayak had not taken on board more than a gallon of water maximun over a period of five hours and including rolling and exit/re-entry exercises.

Flares and charts were not carried on the trip. Notice was given to both our immediate paddling colleagues and the local coastguard. Chats were not necessary as the details of tides were remembered from charts before leaving and escape routes had been noted from the previous day. Our liaison with a fixed shore party was made in very loose terms. I was aware that myself and my colleague were to be the only people leaving Trearddur Bay. A group of about 10 paddlers was due to leave from Porth Dufrach at 10.00am. Before departure I checked the weather board, made enquiries about the forecast and confirmed as to when and at which point the second party of canoeists would be meeting us. On asking what would happen should we not manage to liaise with the others the expected and received reply was "they would stand and wave from the cliffs" as we shot through the standing waves at Penrhyn Mawr. Many a true word said in jest!

2.4 THE OBJECTIVE OF THE DAYS PADDLE AND WEATHER CONDITIONS.

The day's objective was to paddle the standing waves off Penrhyn Mawr. Weather conditions were South Easterly winds with force 6-7 with accompanying squalls.

2.5 THE PADDLE AND RESCUE.

After leaving Trearddur Bay we were met by Mr. Nigel Dennis, the Canoe Centre leader, in a power boat who informed us that we would not be met by the second group of canoeists at Porth Dyfrach as they could not get out through the break which was developing. On pressing to seek the advise of Mr. Dennis and appreciating his local knowledge we were informed that, although the sea conditions were severe, they were not beyond the reach of a strong and competent canoeist. On reaching Penrhyn Mawr we realised we had missed the standing waves. From this point we decided to paddle to South Stack and enjoyed the interesting sea conditions and marvellous scenery.

Despite the heavy (10ft. plus) break that was occuring at the time, sea conditions a mile out were reasonable with a 3-5ft. swell and a constant wind direction. We were aware, however, that the heavy break reduced our escape route to Holyhead, in one direction, and Trearddur Bay in the other.

Upon reaching a position halfway between the South and North Stacks we decided to paddle on towards Holyhead and get a lift back from there. However, we calculated that the tide may have turned which was proved correct since we made no progress in the following 1/4 hour. We decided to return to Trearddur Bay. This is where my problem started. After 1/4 hr. this also proved impossible for myself and we decided to paddle towards land and about 1/2 mile offshore and pick up a different flow of current. On reaching this point I realised that I could not go East or West and by this time another 3/4 hr. had passed. My colleague had retained manoeuvrability and was able to go in either direction. On realising my predicament we decided to separate with my coleague to paddle to Holyhead to raise the alarm whilst I stayed put. During the next half an hour I had drifted to 2 1/2 miles off land. I had not noticed the extent of my drift for two reasons. One was because I was situated equally between two headlands and, hence, the slow rate of change was deceiving. The second was because of a bout of sea sickness caused by not paddling. I had decided that there was no point in paddling unless conditions became worse since I was perfectly stable.

I did not see my colleague again until I was returned to Trearddur Bay. I subsequently discovered that he had not been able to make Holyhead and was forced to return to Trearddur Bay where he was kindly intercepted by the RNLI Inland Rescue Service.

After about 1/2 hr. of being alone I saw a rescue helicopter scanning the cliffs between North and South Stacks. After about another 20 min. of searching the helicopter came out to within half a mile of me on the North side, looked, missed his objective and returned. The pilot repeated this proceedure on the South Stack side of me five or so minutes later and still missed me although, on both occasions, he was within half a mile, I was broadside on to him and giving a distress signal with my paddle. Some five minutes after this the helicopter was guided towards me from a radio contact passed from a lookout on the cliffs via the Coastguard. My position was fixed by means of an orange smoke flare and the winchman was lowered. As he reached the water I was out of my boat and ready for winching up. I was most surprised and grateful for the fact that the helicopter stayed in the air for a further 10 minutes firstly to mark out my boat and, secondly, my paddles for the RNLI Lifeboat to pick up.

The lifeboatmen noted that the boat was about 1/2 full of water but no damage that would have allowed such a leak was found until a detailed inspection a week later. A hole large enough to put a fist through was caused by a gentle pressure. The interior and exterior gelcoat had fallen away to reveal a "dry" resin free patch of glass fibre underneath.

SECTION 3. Technical Aspects relating to this incident and the Safety of the kayak design.

3.1 INTRODUCTION.

The purpose of this section of the report is to establish what happened to cause this incident and why it happened. It demonstrates how the safety built into the kayak enabled a successful rescue to be accomplished which would have been most unlikely for any other conventionally fitted kayak faced with the same problem. To assist in this some details are included of the tests made during the development period of the kayak to ensure that such success was possible.

3.2 THE CAUSE.

The cause of the problem encountered in this incident was Fibreglass Osmosis. This is a phenomenon based upon the relative properties fibreglass and water. It can occur in any vessel made of fibreglass whether it be a minesweeper, a luxury cruiser, a yacht, a dinghy or a kayak. It is much more prevalent in vessels which are continuously in water. It is common in leisure craft but fortunately is a rare, although significant, problem with kayaks. I have seen this problem with several kayaks of which I recall two Nordkapps, one and possibly two Iceflows, an Anus Acuta and possibly an Islander. I must confess that, at the time, I was not as aware as I am now of the cause. The problem with one of the Noordkapps was of a similar magnitude as this one but fortunately it was spotted before putting to sea. At the time I put it down to isolated manufacturing problems, although I now appreciate this was not correct. When it reaches an advanced stage it appears like faulty manufacture whereas it relates to the post manufacture history of the craft. The problem usually occurs in older craft since it can often take some considerable time to develop. The kayak concerned in this case was four to five years old.

What is Fibreglass Osmosis? A fibreglass product is laid up by coating a mould with a gelcoat and then bonding to this one or more layers of a fibreglass matt or cloth with resin. Great care has to be taken to ensure that the bonding is complete and without air bubbles being present between the various layers. If this combination suffers a knock the materials are subjected to a stress situation which can disturb this bonding by cracking the resin under an area of gelcoat or the gelcoat or both. Sometimes, dependent upon the form the knock takes, disturbance can take place behind the gelcoat in one place and stress lines can run to a point away from the main area to a chip, deep scratch or crack in the gelcoat. The latter may be caused at the same time, been there before or be created later by another blow. Once this situation exists osmosis commences. Initially water is sucked in, as distinct from leaking in, via such a minute chip, crack or hole in the gelcoat due to natural forces/pressures/surface tension etc. and the properties of the resin/glass fibres and creeps behind the gelcoat and along the glass strands and cracks in the resin often some considerable way from its point of entry. It can then spread in the previously disturbed area. Over a period of time the water destroys the resin

to glass bonding causing a weakness of considerable size behind gelcoat which outwardly looks in perfect order. In the ultimate the material behind the gelcoat is reduced to no more than the cloth which resembles a sieve without any ablilty to stop water passing through it. If the gelcoat is then knocked at this weak point a hole, which may outwardly appear as no more than a stress line, will appear with nothing behind it to prevent a virtually frictionless free flow of water out of all proportion to the immediately apparent damage.

The first signs of Osmosis are often an apparent sweating or very small amounts of water which seem to come from nowhere and with no reason. I have often heard it referred to as condensation - not an uncommon problem. Later a damp patch may be noticed and more water may become apparent as the affected area grows. Any boats kept outside or with water still in them will be subject to a quite rapid development of the problem. In the case of one of the Noordkapps mentioned above there was a very small chip in the gelcoat and the affected area was immediately around the chip. Obviously the boat had hit something sharp which had caused the disturbed area to be around the point of contact. The point had been reached where about a mug of water entered the boat in approximately two hours. Filling the compartment with water and looking for seepage externally yielded nothing. However, a damp patch was noticed of about 1 1/2 in. diameter inside the hull. A bit of pressure and my thumb was straight through - a massive hole. Prior to this occasion this was is worst case I can recall although at the time I did not recognise it for what it was.

For the Sea Tiger in question the situation was different in that a piece approximately 3 ins. in diameter came away. This was a week later and when the materials had had time to dry out. The centre 2 ins. diameter section was in perfect order and the remainder of the hull was also satisfactory except for a lead off from the affected area to the tell tale crack an inch or so away. The glass cloth was being held in position by the good remaining resin of the hull and that in the centre of the plug. It had the strength of the glass fibres to hold it there but had little, if any, water resistance behind the gelcoat. Prior to the incident the kayak appeared externally in good order. The area of the affected materials was approximately equivalent to a sieve of 4 sq. ins. Originally the problem must have been caused by the boat hitting a rounded object quite hard to cause this form of disturbance. Whether the gelcoat damage at the crack was caused at the same time is not known.

What happened to cause the rupture of the gelcoat in front of the affected area is not known. It could have been a bump on launching, hitting a piece of driftwood, flexing of the weakened area in the heavy seas, a combination of these or whatever. It does not take much of crack in any gelcoat to allow a great deal of water to pass through if there is nothing behind to stop it. Also a cursory inspection did not reveal the true extent of the damage since the piece appeared well fitted in position until pressurised from the outside. This is why the extent of the problem was not appreciated until a close inspection was made.

It is difficult to estimate the equivalent size of the hole at the time of the incident, but to suggest that it was up to the order of a square inch would not be out of court. In all events it was an

exceptionally large one which could not have been in a worse position - on the waterline at a point just forward of the front of the cockpit liner. Couple this with the conditions described earlier and one begins to see the enormity of the situation faced by both the paddler and the boat. And yet, it will be noticed that whilst the kayak had had a leak previously the point of leakage could not be detected.

3.3 THE EFFECT AND A COMPARISON.

In the heavy seas the boat did not take on more than 1/2 full of water and yet the paddler was in this state, alone, for over an hour. He was perfectly stable and was even able to raise his paddle in the air to assist location. He did not have to leave the boat until requested by the helicopter crew and then he was able to do so in a normally controlled manner. This performance is exactly as would have expected from all the trials conducted during development even though it was a greater problem than we had reasonably allowed for.

Now imagine what would have happened in a conventional kayak fitted with bulkheads. If the hole had been in front of the front bulkhead the front end would have tended to sink. With this problem these boats tend to become unstable and similarly uncontrollable. The chances of the paddler remaining in the boat in these conditions would have been slim, particularly when on his own. The same would have been the case if it had been behind the rear bulkhead except worse since the volume behind the rear hatch is much greater. In both these cases the opposite end of the boat would have taken a tremendous pounding from the sea making stability problems worse. If it had occurred in the cockpit area a hand pump, even if operated by someone else, would have been useless, no electric pump could have possibly kept up with the water flow for any significant length of time, there would have been no stability and the chances of staying in the boat would have been nil. Bearing in mind the problem the trauma for the paddler was far less than it would have been in any other boat and his life could well have been lost without the cockpit and with bulkheads. A terrifying thought.

3.4 TESTS DURING DEVELOPMENT.

It must have been in about 1975 when the very first cockpit liners ever to be produced were inserted into two KW7s that the question arose as to what would happen if the hull area became holed. No reliable information was then available and this lead to a very extensive investigation.

Initially, tests were carried out to establish what happened when small amounts of water were swilling about in the open hull area and the quantities were steadily increased until the boat was over half full. We were amazed to discover that the stability of the kayak did not change significantly although it did tend to wallow from bow to stern as it rode the water undulations. Naturally the boat rode lower in the water and directional control was impared. It was also decided that buoyancy blocks should be placed in the bow and stern as an additional safety feature and it was noticed that this considerably reduced the wallowing effect. This was due to much less weight of water being allowed to go to the extremities of the kayak as it flowed from end to end which in

turn reduced the depth to which the bow and stern went in the sea. The hull/deck shape and the amount of buoyancy at these points is important.

Instability is caused by water swilling from side to side particularly at the centre of the kayak where it is widest. This was the problem with the Zebrugga Ferry. The safety cockpit liner touches the bottom of the hull and is situated amidships. As a result water is prevented from setting up a side to side motion which is the problem that occurs in any conventionally fitted kayak. In addition, since the water is not trapped in a confined area but can travel from end to end this movement also prevents such a motion being set up. In this way the Safety Cockpit provides a major advantage over any other design of cockpit. In passing, the other advantage is that since water was not trapped at one end or the other by bulkheads neither end tended to sink (with the attendant problems of stability, control and general paddling ability) or in the cockpit area (with the major stability problem).

The next and longest stage of investigation related to what happened when the hull was holed. Here the most important thing to remember is that if air cannot get out then water cannot get in - at least in any significant quantity. However, when a sealed vessel is holed different pressure forces come into play. The pressure inside the vessel will always be greater than or equal to atmospheric. When an equilibrium is reached, which is dependant on many factors, water flow into the vessel ceases. Holes were made in the hull in all manner of positions and of different sizes and the kayaks were paddled in all types of conditions. Since it was considered that the likelyhood of unknown major leaks suddenly appearing were very unlikely and occurred very infrequently unless close to shore, when it would be known that something had happened and emergency repairs made. The investigation was carried out using 1/4 in. holes as a maximum. If the hole was permanently beneath the waterline relatively little water entered the hull. The closer to the waterline the hole was situated and for a distance above the waterline the more water entered. This could be expected since with immersion a little water would get in and then some air would get out, etc. For a given height position relative to the waterline, the nearer the bow or stern the hole was positioned the less water would be admitted simply because the water in the hull would prevent more water coming in as, say, the bow became submerged and the water inside rushed to that end blocking the entry. At no time did we have any more than about 1/3rd of the kayak full of water even in rough conditions. The kayak was controllable although with more difficulty, but it was not tested with wind conditions as high as in this incident.

The initial tests were carried out in the KW7s but all were repeated and all later tests were done using my original Sea Tiger. With this and other development work this poor old kayak became more like a sieve than a boat. It is difficult to explain the strange feeling that the paddler in the Anglesey incident felt when he began to realise that he was unable to control the kayak as he would have liked. To all intents and purposes the boat feels as though it is behaving normally and yet it is not. When I took my Advanced Sea Proficiency Test I attempted to make sure that all points of surgery had been suitably repaired. To this day neither of the assessors know that I had a 3/8in. hole right at the tip of the bow even though we had been paddling through 4-6ft.

standing waves. I had a tough ride and found considerable difficulty in keeping up due to the weight of water I shipped, but I was stable, controllable and able to complete the trip prior to emptying the kayak which was about 1/4 full. In a conventional kayak a forced stop would have been necessary, which in the circumstances could have jeopardised the party.

Frank Goodmans report states that "...The big seas bent and twisted the boat, causing it to act like a giant pair of bellows...". The Safety Cockpit forms a box section with the deck which is, in turn, joined in an extremely rigid seam with the hull. A box section is the one of the most rigid sections devised by man. The bottom of the liner is so situated that it prevents any bellows action to any significant degree as we were able to discover during development trials or has come to light at any time since.

The design of the kayak was not just sticking a cockpit in a boat and letting it go. All the dimensions and shapes are inter-related to give the performance and safety features to the best advantage when the kayak is in normal operation and with water in either the hull section or the cockpit. There is no reason why bulkheads should not be added as well except that it reduces the safety as described above. In exactly the same way the hull, deck shapes are integrated with the size and position of the skeg to give the remarkable directional control which the Sea Tiger has. The sad thing is that the kayak does not have the sleek lines of many of the conventional kayaks, but to get these would immediately loose these essential performance characteristics.

SECTION 4. Conclusions.

4.1 GENERAL OVERVIEW.

In this incident the magnitude of the problem could scarcely have been worse. It should be remembered that, for reasons rightly or wrongly, the paddler was alone in heavy seas, fast tidestreams and winds of between force 5 and 7 for an hour after the problem had become critical without any form of assistance or company. His kayak had a breach of very large proportions in about the worst possible spot for which the cause was a previously undetected case of Fibreglass Osmosis. This type of problem could happen in any type of fibreglass vessel although the chances with kayaks are fortunately rare and would be even more so if owners are aware of this problem. There is no doubt whatsoever that if this had happened to a paddler in a conventionally fitted kayak his trauma would have been far worse, the chance of a successful rescue, even by helicopter, would have been minimal and it could well be that he would not be here today to tell the story.

4.2 THE PADDLERS' CONCLUSIONS.

The problem occurred solely due to the kayak developing a substantial leak. Without this the rescue would not have been necessary. The other salient points are;-

a. The arrangements with the shore party should have been much more formal, although they should not have been relied upon.

b. Under the sea conditions of the day the visibility was reasonable. Even so, a boat with a yellow deck and a canoeist in bright red and yellow clothing could not be seen from the air.

c. Mini flares, although they might have helped raise the alarm would not have been otherwise useful. Parachute and orange smoke flares should be carried, the latter to help air/sea rescue.

d. The boat proved so stable on being filled with water that I was not aware for quite some time as to the cause of the problem. The boat's stability almost certainly prevented a serious situation from becoming even more threatening.

e. The original leak had remained a mystery even though it caused such a major problem later. The reason did not become apparent until the detailed investigation took place.

4.3 THE TECHNICAL CONCLUSIONS.

To report on an incident is one thing. To report in such a glib manner on an incident as serious as this and without full knowledge is a disgrace. To make assumptions, develop a sequence of events and, by implication, to condemn equipment and personnel without investigation, to still make no enquiry of anyone, investigate anything, not consider what the consequences would have been if another type of kayak had been in the same situation, then to advise others of the unsuitability of equipment and to set in motion an amendment of British Standards Institute Document BSMA91, which covers canoe and kayak construction and design features regarding safety, by stating that "cockpit liners or pods are unsuitable", as a direct result of this incident only, shows a lack of integrity which almost defies belief. The whole post incident episode as presented to date totally lacks any professionalism, is inaccurate and misleading to both the public and industry. It is to be deplored. However, it must be admitted that this is an exceptional case but a simple telephone call would have established this even though the final findings may not have been available at the time. Here are some brief comments to correct any misunderstandings created by the initial report:-

a. "...developed a small leak". A hole equivalent in size to up to one square inch - what is a large one?

b. "...where the surf conditions were easier". Does this give the impression of heavy tidestreams, force 5 - 7 winds, breaking seas or a gentle mornings paddle?

c. "...bent and twisted the boat, causing it to act like a giant pair of bellows ...". The Sea Tiger with its cockpit forms a box section which is one of the most rigid construction techniques known to man. The position of the cockpit liner in relation to the hull is such that all tests carried out over the years show that this action does not take place to any significant degree.

d. "... water was pouring from end to end...". This is intended. It aids stability and gets over the worse problem of trapping water at one end or another behind a bulkhead causing the end to tend to sink and giving greater problems of stability and loss of control or, alternatively, of keeping it in the cockpit area where it totally jeopardises stability in any serious situation with a conventionally fitted kayak. Bulkheads could be fitted but their presence would cause more problems to safety than they would solve. With the problem in the position and of the magnitude it was in this instance bulkheads in any boat would have spelt almost certain disaster.

e. "...the two paddlers were inexperienced on the sea...". Their experience of heavy sea conditions was limited, however, their experience in heavy white water and surf was much greater. The conditions and their limited sea experience were not responsible for the incident since no rescue would have been necessary without the problem.

f. Timescale. There is no reference. It took an hour for the problem to develop and once it had become critical at least another hour before rescue. In the circumstances that is superb for both man and kayak.

g. "...four lifeboatmen to lift the kayak.....!". This is made to sound a big deal - with an exclamation mark as well. The weight. Why worry. With all the problems and the timescale is it surprising or the least bit significant?

h. "...One boat, in theory very safe with a cockpit pod fitted...". Until any manufacturer can demonstrate that a kayak they supply as a standard can successfully master an experience of this nature bearing in mind the size of the problem, the prevailing conditions and the timescale and can also provide the other safety facilities, not mentioned in this report, delete "in theory" and substitute "in practise". The peace of mind created by stability in terrifying circumstances should not be forgotten.

To turn to other conclusions not covered above it is well to remember that Osmosis can occur at any time. If you are aware of a leaking problem and cannot find where it is keep a wary look out for tell tale chips, cracks and scratches and look inside for possible water tracks or larger porous areas developing behind the gelcoat. If your boat leaks and even if you know where it is leaking be sure to empty it before storing to prevent a similar problem from developing from the inside. Try to ensure your boat does not leak before

putting to sea. With inland paddling a leaky boat can be used, although not recommended, because landings are easy for emptying. That is not the case for the sea where one is continuously committed.

No kayak has been designed yet specifically to combat a situation like this. The Sea Tiger had undergone considerable tests of this nature but not to this gravity, which is exceptional. The fact that this one came through thanks to the Safety Cockpit and its other integrated design facilities, not to mention the very considerable level headedness and courage of the paddler is gratifying. What this incident demonstrates is that, with the latest knowledge, the basic design of the conventionally fitted sea kayak needs a thorough review. Is it becoming a part of history?

Finally, as always in these situations our thanks go to The Coastguard, The Lifeboat Service, the Helicopter Crew and in this particular instance to Nigel Dennis. We trust that they will appreciate that their efforts are more than valued and that those who could be considered in any way involved have not been prepared to drop the case without a very thorough investigation and to ensure its findings are made known thereby helping to reduce the possibility of a similar incident.

FOOTNOTE FROM SEA TIGER.

Nothing is perfect and there is always room for improvement. This incident has lead to a thorough reappraisal of all aspects of the kayak. It took the Sea Tiger into a dimension of danger that is beyond the worst we expected and for which any kayak is designed. Yet it came out on top - battered but back in service again. We are not complacent. As was the case during the long development period constructive criticism, comment and ideas are always welcome and if these lead to viable improvements then every effort would be made to incorporate them. It is of great credit to Mark Atkinson that he had the mental ability and skill to ride this appalling situation for so long and, at the same time, to extend the proof of this kayak's performance and the value of the Safety Cockpit concept. Until proved otherwise we have no hesitation in believing that the kayak remains "The safest and most versatile sea kayak afloat". As soon as evidence comes to hand that this is not the case we shall withdraw this claim.

This does not mean that problems will not occur - they will. It is the nature of the sport and the elements can be unrelenting. However, it does mean that if a problem does occur there will be more chance of a very speedy and successful rescue operation. This is particularly in relation to the more regularly met situations where outside assistance is not required. These facilities should also reduce the need to call on outside asistance.