Also by the same author:
SURVIVE THE SAVAGE SEA

Sea Survival

A Manual

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D. R.

LIST OF ILLUSTRATIONS

Drawings by Pam Littlewood

1 PREFACE

Disaster at sea seldom strikes in the same way twice. The circumstances and consequences of catastrophe are so variable that no hard and fast rules can be formulated to cope with the unknown factors of the situation. Safety routines carried out in the safe environs of an undamaged craft, while adequate for checking the working efficiency of materials and their usage, may be quite impracticable in disaster conditions. It is therefore of first importance that safety equipment should be either self-operating in the nature of their release mechanism or should at least be operable with a minimum of manual work by uninformed and unpractical people.

It is not, however, the purpose of this manual to investigate safety practices or appliances, a subject which should be dealt with quite adequately in the official publications of the relevant authorities. Its purpose is to provide survivors with enough information to enable them to cope with the life-and-death circumstances in which they find themselves immediately after their parent craft has sunk, and during the subsequent period of time which has to elapse before they reach safety either by rescue or by their own efforts, or, as is more usual, by a combination of both.

Information is a major factor in successful survival, and although survivors can learn much from their own mistakes, death may intervene before the learning can be applied to a second chance. Absence of, or bad, information can be as deadly as any other factor which may threaten the lives of castaways, so that those who find themselves in a survival craft and isolated from outside help should immediately study the information in this manual and their position on the charts contained in the back pocket, before deciding on any long-term course of action.

The information contained in this manual has been gathered mainly from three sources: the expertise which has been acquired and contributed by generations of seamen and scientists to contemporary nautical knowledge; the extensive and valuable research of practical survival institutes; and personal survival experience. The first two sources are self-explanatory and I would like to express here my deep appreciation for the encouragement and special help given to me by the Institute of Naval Medicine, Portsmouth, the staff of the Meteorological Office, Bracknell, and of Leith Nautical College.

The third source perhaps requires a little more explanation, for my main survival experience was thrust upon me in the Pacific Ocean when an attack by killer whales upon my schooner resulted in her sinking in 60 seconds, a thousand miles from the nearest practicable landfall. The story of the subsequent 37-day ordeal by six castaways, with emergency water and rations for only three days, is told in *Survive the Savage Sea* (Elek, 1973). It was this experience which brought home to me the importance of having available a manual which contains the information which castaways need to know, not only to survive the immediate emergency after the disaster but also to provide the data and advice which are necessary to their continued survival in long ordeals. My experience as a Master Mariner, as a hill farmer, and as an ocean yachtsman, has possibly made it easier for me to concentrate more readily on the issues at stake than if the subject was approached from a more academic standpoint. If I have dwelt on the basic principles of survival practice to the seeming exclusion of the more sophisticated aids provided by modern medicine and technology it is because these aids are not usually available in survival conditions.

I have no words to offer which may comfort the reader who is also a castaway, except that rescue may come at any time but not necessarily when you expect it; and that even if you give up hope, you must never give up trying, for, as the result

of your efforts, hope may well return and with justification. You can expect good and bad luck, but good or bad judgment is your prerogative as is good or bad management, and it is in the exercise of the last two qualities that this book is designed to assist, and in assisting, influence the first in your favour.

2 URGENCY NOTES

The following is a summary of the survival action to be taken after the decision to abandon ship has been made.

(1) Abandoning Ship

Release survival craft. Send radio SOS to include position. Dress warmly to include waterproof outer clothing with lifejacket over. Collect additional water supplies. Try to enter survival craft without getting wet, especially in cold weather. Take supplementary fishing equipment/food/buoyancy. Keep survival craft clear of sinking ship and dangerous wreckage.

(2) Action in Cold Water

(*a*) *For survivors*

(i) Enter cold water fully clothed with waterproof outer garment and lifejacket, with whistle if possible.

(ii) When immersed in cold water remain as still as possible until rescuers come to you. Initial discomfort will decrease quickly.

(iii) Do not exercise to keep warm. Increased circulation will only accelerate loss of heat from your body.

(iv) Exhaustion will immobilise you very quickly in cold water; secure yourself to any necessary material or reserve flotation before this happens.

(v) Cold injury will not affect you before hypothermia. There is no need to take priority measures to counteract this form of injury.

(vi) If you have no lifejacket, secure yourself to other reserve buoyancy if possible.

(b) For rescuers

(i) If survivor is unconscious and not breathing. Note probability of drowning from posture in the water. Apply mouth-to-mouth respiration. Do not stimulate circulation by rubbing or by applied warmth, particularly if the casualty is very cold. Allow recovery to take place slowly in normal temperatures.

(ii) If survivor is unconscious and breathing slowly. Do *not* apply mouth-to-mouth respiration. Strip off wet clothes by cutting. Place survivor in unwarmed but dry insulating bag. Leave to recover without further assistance or interference (except if 'buddy warming' technique described on page 16 is implemented) unless breathing stops. The survivor may be assisted to rewarm only after consciousness is regained. It is of the utmost importance that very cold and unconscious survivors should be disturbed as little as possible. *Clinical assistance should only be given where expert care is available.*

(3) Action in All Waters

Bind wounds and look out for sharks and other dangerous fish. Strike them if they come near enough but do not splash the surface of the sea in an attempt to frighten them away as this is more likely to be interpreted as a distress signal, which will stimulate attack. Maintain contact with other survivors and secure yourself to any useful flotsam which will assist the survival of others or which may be used to ward off predators.

(4) Action on Boarding Survival Craft

Assist other survivors to board and secure useful flotsam. Attend to injuries, and if in cold areas, guard against onset of illness or injury from cold; examine inflatable raft for leaks and guard against excessive leakage of carbon dioxide gas into an unventilated raft. If there is more than one raft, secure them to each other. In rough weather, fit tension buffers to sea-anchor lines and also to lines joining rafts; this should be done with the minimum of delay to avoid damage to flotation chambers. Post lookouts to guard against dangerous wreckage. Anti-seasickness pills should be administered before seasickness starts, to avoid loss of body fluid. If castaways are already seasick administer suppositories if available.

Assess further action only after very careful consideration of all the factors involved. These must include the likelihood of search and rescue, position with reference to ocean currents and proximity to shipping lanes. The decision you are faced with at this time is the most important in your life; it should be taken only after full consultation with all the survivors and with the help of the best available information.

3 DISTRESS SIGNALS

INTERNATIONAL REGULATIONS FOR PREVENTING COLLISIONS AT SEA

Rule 31

Distress Signals

When a vessel or seaplane on the water is in distress and requires assistance from other vessels or from the shore, the following shall be the signals to be used or displayed by her, either together or separately, namely:

(i) A gun or other explosive signal fired at intervals of about a minute.
(ii) A continuous sounding with any fog-signal apparatus.
(iii) Rockets or shells, throwing red stars fired one at a time at short intervals.
(iv) A signal made by radiotelegraphy or by any other signalling method consisting of the group ... ——— ... (SOS) in the Morse Code.
(v) A signal sent by radio-telephony consisting of the spoken word 'Mayday'.
(vi) The International Code Signal of distress indicated by NC.
(vii) A signal consisting of a square flag having above or below it a ball or anything resembling a ball.
(viii) Flames on the vessel (as from a burning tar barrel, oil barrel, etc.).
(ix) A rocket parachute flare showing a red light.
(x) A smoke signal giving off a volume of orange-coloured smoke.
(xi) Slowly and repeatedly raising and lowering arms outstretched to each side.

NOTE. Vessels in distress may use the radio-telegraph alarm signal or the radio-telephone alarm signal to secure attention to distress calls and messages. The radio-telegraph alarm signal, which is designed to actuate the radio-telegraph auto alarms of vessels so fitted, consists of a series of twelve dashes, sent in 1 minute, the duration of each dash being 4 seconds, and the duration of the interval between two consecutive dashes being 1 second. The radio-telephone alarm signal consists of two tones transmitted alternately over periods of from 30 seconds to 1 minute.

The use of the foregoing signals, except for the purpose of indicating that a vessel or a seaplane is in distress, and the use of any signals which may be confused with any of the above signals, is prohibited.

Visual distress signals call the attention of passing ships, aircraft or coastal watchers to the plight of the survivors. A great deal of expertise has gone into the manufacture of pyrotechnic signals of distinctive and easily detectable pattern so that they will function efficiently in severe weather conditions with a minimum of effort, but no amount of skill on the part of the manufacturers can make a visual signal effective if nobody is looking. Modern ships have autopilots for helmsmen, radar scanners for lookouts and if it is the castaway's misfortune to encounter a vessel that has no proper lookout the chances are that his distress signal will burn out unseen.

(1) In the Day

It is of some use, therefore, to try to attract attention in daytime by a *heliograph*, or by making black smoke, so that a casual onlooker may be watching when the distress signal is actually fired. For the same reason, it is better for a hand flare to be fired before the discharge of a rocket flare, especially at night. The orange smoke of distress flares is sometimes difficult to see from a distance, especially in quick dispersal conditions, but a source of black smoke is usually investigated by a watchkeeping officer or perhaps an off-watch crew member with binoculars. Thus, in addition to the regulation distress flares, emergency kits should contain a means of making *black smoke* as well. A small bottle of paraffin sprinkled over surplus rubber material, tied to a paddle, lighted, and held to leeward of a raft may suffice. This also makes an effective night distress signal (except in areas such as the China coast, where this is a customary

method used by junks to warn ships of their presence). *Water dyes* are very useful for attracting the attention of searching aircraft, but are not included in many survival packs.

(2) At Night

Attracting attention at night is easier because flares can be seen over much greater distances. Distress rockets and hand flares can be visible in excess of 20 miles and torch signalling at 5 miles. When using the Morse SOS, due regard should be given to the height of the swell and whether the signal can be seen from a passing vessel when the survival craft is in the trough. Such signals should be slow and regular in calm weather, but in heavy seas an attempt should be made to transmit the full SOS while on the crest of the wave, otherwise the light may be mistaken for a small boat's navigation light dipping behind the waves.

Some form of *sound apparatus* (a whistle or horn) should be available to enable the castaway to attract the attention of unseeing ships on their close approach. The shouts of dry-mouthed weakened castaways do not carry very far but even so, these have been responsible for rescue being effected when all visual means had failed.

Many types of *radio apparatus*, in the form of beacons, or small radio-telephones, are now available in survival packs. *Radio-telephones,* though more expensive, have the advantage of providing two-way communication over longer distances than *beacons*, which have a very limited range (about 20 miles) to searchers at sea level but up to 200 miles to searching aircraft. Both beacons and radio-telephones are made to function automatically on distress frequencies and in the case of radio-telephones, transmission may be interrupted to broadcast a distress message and receive acknowledgement if communication is established.

Radio transmissions are usually limited by reserves of electrical energy, which, particularly on radio-telephones, is

quickly exhausted if continuous transmission is maintained. Some energy should be kept in reserve to assist search and rescue craft to 'home' in on an RDF bearing.

4 PROCEDURE ON ABANDONING SHIP

While it is vital that survivors suffering from injury, near-drowning, immersion hypothermia or cold injury be brought aboard the survival craft as quickly as possible and given immediate care (see pp. 10–19), it is also of paramount importance that any debris floating nearby should be scrutinised and, if of the slightest possible use and not dangerous to the survival craft, be secured alongside or brought aboard, depending on the permeability of the material. The lives of the uninjured as well as the injured can sometimes depend on pieces of flotsam saved at this time. Materials to avoid are those with sharp edges, which could be dangerous to inflatable craft; heavy materials (spars, etc.) should not be tied alongside rigid survival craft where they could cause hull damage but may be secured to the sea anchor by a separate line to float clear of the survival craft. Foresight at this stage is all important, for damage sustained as the result of a thoughtless action may shorten the effective life of the survival craft and this can mean the difference between life and death.

Any buoyant materials should be secured in a safe place regardless of their apparent uselessness at the time; reserve buoyancy and waterproof container space are the castaway's two most precious assets, followed by shelter and warm clothing in cold areas, shade in tropical zones. Additional water reserves are vital in all climates.

Painters should not be secured to any part of the parent craft which is strong enough to allow the raft or boat to be dragged down with the sinking vessel before survivors have time to cut free. Additional stores should be secured to rafts

or survivors by lines until they can be brought inboard. If the choice is available, it is better to lie to leeward of a sinking vessel, where some shelter may be gained while picking up survivors and where useful flotsam will drift down wind after the vessel has sunk. The danger of a wind-driven hulk drifting down on a survival craft can be met by fending off. If you have to enter the water without the prospect of reaching a survival craft it is better to go over the weather side where the hulk will not drift down on top of a swimmer.

If the parent craft is sinking rapidly, survival craft should be moved far enough away to ensure their safety. Safe distances depend on the nature of the disaster: for instance, there may be a danger of explosion or burning embers may cause damage to inflatable craft. Waves caused by capsize and suction from large vessels present a hazard to a survival craft as do buoyant materials breaking free from the sunken vessel and moving swiftly to the surface. Damage to inflatables can result from severe abrasions from the barnacled side of the parent craft and all survival craft are in danger, on the weather side of a ship, of being smashed or punctured beyond repair.

Wind-driven survival craft travel faster than burning oil unless they are well sea-anchored, but if it is necessary to swim through burning oil, swim to windward, using the breast stroke to sweep the flames aside. In intense heat it may be necessary to swim underwater, rising to the surface only to breathe, in which case a lifejacket and bulky clothing cannot be worn.

5 SURVIVAL IN WATER

(1) Drowning

Drowning is the most common cause of death at sea, and the most effective resuscitation treatment in survival conditions

is the mouth-to-mouth method of artificial respiration (see diagram below). If the breathing has stopped, the casualty should be laid flat, face upwards with the head tilted back. Remove any obstructions from inside the mouth (such as false teeth) with as little disturbance as possible. If the throat is obstructed by mucus clear this by sucking or blowing if possible. Open the casualty's mouth, pinch his nostrils and

Mouth-to-mouth artificial ventilation (the position of the right hand is important)

placing your mouth over his lips, blow air into his lungs, noting the effect of this by the expansion of the chest. (If the mouth is injured, air may be blown through the nostrils while the mouth is covered.) Then allow the patient's lungs to exhale. Repeat this routine two or three times in quick succession, then continue at a steady rate of one breath every 6 seconds, but more slowly if the body is very cold.

The patient may try to vomit. If so, turn him face down immediately to prevent the vomit from entering the lungs, then resume mouth-to-mouth respiration until breathing is restarted. He should then be placed in the coma position, on his side, head to one side, one knee and one elbow at right angles (see diagram, below) to support him until recovery is assured.

The mouth-to-mouth method of artificial respiration does not interfere unduly with the slow recovery treatment for hypothermia (see below), although if the patient is very cold he should be disturbed as little as possible while being treated for drowning. When the patient regains consciousness his recovery can be assisted by giving him warm glucose drinks (the fluid should be warmed against another survivor's body if no other way is possible). Tolerable quantities of bicarbonate of soda in tepid water can be usefully drunk at this time.

(2) Hypothermia

The danger to life from cold, both in the acute form experienced from immersion in cold water, and the more prolonged

Coma position (the head should be lower than the feet)

type resulting from exposure and exhaustion in cold climates, is one of the greatest the castaway has to overcome.

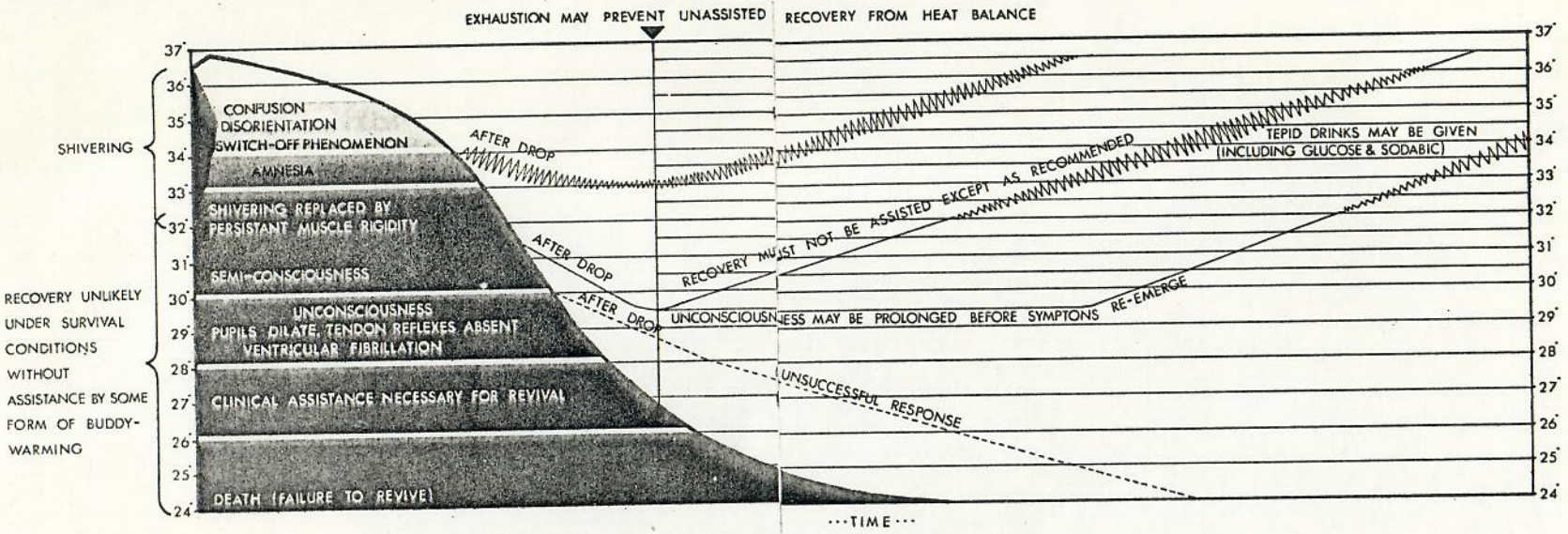
If the disaster has taken place in an area where sea temperatures are below 20°C (68°F), the survivor faces the risk of becoming disabled due to a drop in deep body temperature and of dying from cold (hypothermia). The probability increases as the water temperature drops and the immersion period lengthens. There are ways in which human resistance to cold can be encouraged and the survivor's life prolonged, both by correct action of the survivor and the correct after care given to him by his rescuers. Instinctive first aid action of applied warmth or the stimulation of blood circulation in both situations is usually inappropriate and hastens the onset of unconsciousness and eventual death.

If time allows before abandoning the parent craft, survivors should try to dress as warmly as possible, preferably with an outer garment which is waterproof, before putting on their lifejackets and entering the water. If time is short, the waterproof garment should be first choice, with lifejacket over. If a survival craft is nearby, swim to it and get out of the water as quickly as possible. If there is no survival craft within reach, swim only far enough to clear the disaster area and then lie still; this has the twofold advantage of keeping blood circulation to a minimum (thereby preventing heat loss from the centre of one's body) and also of preserving the layer of warmer water inside one's clothing next the skin. The distance which people can swim in very cold water decreases sharply as temperature drops, so that in cold conditions they should keep as still as possible until the survival craft comes to them. Those not wearing lifejackets should avoid swimming in very cold water (less than 10°C) by clinging to some form of support, ie flotsam of any description, until rescued. It is important to remember that even expert swimmers quickly become exhausted and drown after a few minutes of swimming in very cold water. Survivors in cold water seeing rescue close at hand have left the safety of floating wreckage

and have failed to swim to rescue craft, resulting in their deaths while trying to cover distances under 100 yards.

When survivors are rescued from cold water the action taken by the rescuers is vital to the life of the survivor.

SYMPTOMS AND SIGNS IN ACUTE HYPOTHERMIA



The curve represents the behaviour of body temperature during cold water immersion with the associated signs and symptoms encountered at the various body temperatures. When exhaustion is present in hypothermia (likely in prolonged ordeals or when vigorous exercise was necessary for survival), the victim's energy reserves may be so depleted that shivering will not resume on recovery, even when the indicated deep body temperature has been reached through assistance by buddy warming. If consciousness is regained without the resumption of shivering, buddy warming should be continued until energy reserves can be replenished by drinks. It is, however, important to remember that buddy warming in cases of deep hypothermia should be very minor, aimed at stopping further heat loss rather than promoting rapid heat exchange which may be harmful. Treatment

Generalisations are difficult to apply to the treatment of hypothermia but, if no civilised amenities are available, it is best to insulate the survivor from further heat loss and allow him to recover slowly, aided only by his own body

should also aim at eliminating further heat loss from wind chill, from contact with wet clothing, or by conduction to the floor.

APPROXIMATE TIME SCALE FOR SURVIVORS OF AVERAGE BODY BUILD

Temp. of water		Clothed	Unclothed
5°C	Survivor remains able for	60 mins	20-30 mins
10°C	Survivor remains able for	3 hours	1 hour
15°C	Survivor remains able for	5 hours	2 hours
20°C	Survivor remains able for	8 hours	4 hours

Thin survivors become helpless in a shorter time than those quoted; fat survivors, if warmly clad, remain able over much longer periods

warmth. Any artificial stimulation of blood circulation, either by exercise or applied warmth, to an unconscious survivor, far from helping, is more likely to kill him by assisting the cold blood near the surface of the body to return too quickly to the heart, thus causing a further steep drop in deep body temperature. This further or after drop often results in hypothermic survivors losing consciousness after they have been rescued. The symptoms displayed by survivors suffering from hypothermia become more acute with increase in time, succeeding each other more quickly as the water becomes colder, and are as follows: shivering, accompanied by confusion and loss of awareness, followed by amnesia. (see diagram, p. 14). As the survivor becomes semi-conscious, shivering lessens and is replaced by muscular rigidity. The final lapse into unconsciousness is accompanied by eye pupil dilation and generalised muscular relaxation simulating death very closely. If the heat loss is not stopped and reversed before this stage, recovery is further impeded by changes in blood chemistry; the survivor's heart-beat becomes erratic and death results from cardiac arrest due to the body's inability to function properly rather than from any particular injury due to cold. For this reason, where expert hospital care is quickly available, attempts at revival are successful in those who appear to be dead.

In a survival craft, however, no such assistance is available and expert opinion differs on the best recommended treatment. It would appear that the casualty who has gone beyond the shivering stage will, in all probability, die anyway unless some positive action is taken and the practice of 'buddy warming' would appear to be the only practical way of rendering assistance in such circumstances. The loss of body temperature in a semi-conscious or unconscious casualty may be counteracted to a certain degree by this method, which consists of a close approximation of two or more bodies hugging the victim, thereby increasing and assisting the available recovery powers, and at the same time reducing

the overall area from which heat may be lost. As soon as the casualty has stopped losing heat, he should be allowed to rewarm without further assistance from buddies.

When such a technique is used aboard a survival craft care has to be taken that the buddies of the casualty do not themselves become cold to a dangerous degree and a close watch should be kept on them to guard against this. For the same reason, it is advisable for buddies to retain their clothing (apart from any outer insulating layers) rather than to try to promote rapid heat exchange by naked contact, which while helpful in preventing the onset of hypothermia in others, may have adverse consequences on those who are already hypothermic (see p. 16). If buddy warming is not practicable, then insulate the patient's body in a polythene bag if available, and place him in the coma position with the head lower than the feet. Guard against choking on fluid, and keep the temperature under the raft canopy or around the exposed area of the patient's body at an ordinary comfortable temperature. (In crowded rafts with enclosed canopies, quite high temperatures can be attained, even in cold climates, which would endanger the life of an unconscious hypothermic survivor.) Do not give any alcohol. Glucose in tepid water could assist recovery if the patient regains consciousness, and at this stage tolerable quantities of bicarbonate of soda may also be helpful. Warm drinks (from self-warming-type tins) would help, but make no attempt to administer such drinks to an unconscious survivor since this could result in death from heart failure, apart from the obvious risk of choking.

In conditions where survivors have to endure continuous exposure to cold wet weather over long periods in an open boat, the weaker and/or thinner castaways will be the first to show signs of chronic hypothermia. This may take the form of diminished shivering, accompanied by withdrawal or dissent, followed by, as in the more advanced stages of hypothermia, cessation of shivering and collapse. In such weather conditions, survivors should huddle together as

much as possible, the boat should be 'hove to' under a sea anchor, and all energy conserved until weather conditions improve. Survival rations will not allow the most willing of castaways to expend energy needlessly, and the husbanding of strength and prevention of hypothermia or cold injury in such conditions are the most important acts of survival.

(3) Drowning or Hypothermia?

Although the most frequent cause of death at sea is undoubtedly drowning it should not be assumed that anyone rescued from the water in an unconscious or apparently dead state has in fact drowned.

Deep hypothermia can have symptoms of death and is difficult to diagnose even when clinical facilities and professional opinion is available. As the relatively inactive treatment advocated for hypothermia contrasts with the positive treatment for drowning, general guidelines only can be laid down to help the prescribed treatment.

(i) Lifejacketed casualties, semi-conscious, unconscious or apprently dead, should be assumed to be suffering from hypothermia and treated accordingly.

(ii) All others in an immersion state should be treated for drowning.

It is also probable that survivors who have been immersed in cold water (under 10°C) for over an hour or in not so cold water (10°C to 20°C) for several hours, and are unconscious, will be suffering from some degree of hypothermia, even if drowning is apparently the main cause of collapse; resuscitation should take into account treatment for both conditions. If an apparently drowning person loses consciousness after rescue and is also very cold, treat for hypothermia immediately while checking other symptoms.

Rescuers should bear in mind that the time spent on administering artificial respiration to a casualty suffering only from hypothermia could mean a fatal delay in the administration of the correct clinical treatment, if it was available. Drowning should therefore be correctly diagnosed in cold water immersion, and the length of time the casualty has been exposed to cold will be a significant factor.

It therefore follows that:

(i) Dangerous hypothermia is unlikely to be present in short periods of immersion.

(ii) Drowning takes place quickly with non-swimmers.

(iii) Good swimmers quickly become exhausted in very cold water, if they do not lie still, and may drown before becoming hypothermic.

(iv) Good swimmers falling unexpectedly into very cold water may inadvertently inhale a large quantity of water and drown immediately.

(v) The practice of taking several deep breaths immediately before an underwater swim can result in the instant drowning of a good swimmer.

On the other hand, drowning as the result of exhaustion or unconsciousness from hypothermia occurs after a much longer period and then usually to people supported by lifejackets or on wreckage. Only immediate hospital treatment can offer hope of resuscitation in such cases, but artificial respiration should be tried if death is not firmly established.

(4) Non-Freezing Cold Injury

Constant cold, associated usually with wet or immersion conditions in holed rafts or boats, results in cold injuries to limbs which can cause lasting damage to the limbs involved. The criteria for cold injury are as follows: (i) temperature less than 11°C; (ii) inadequate circulation due to cold, an inability to move, constriction of clothing, or any combination of these; (iii) wetness from any cause. The onset of cold injury may be detected by a feeling of numbness in the part affected later followed by a general swelling of the limb and discoloration. While in a raft or boat, in cold weather, the castaway

should carry out exercises of the limbs, particularly the toes, at frequent intervals to maintain circulation, especially when numbness is felt, for prevention is the only effective cure in survival conditions. Do not use massage to stimulate circulation where numbness exists in cold injury.

There is no danger that this type of cold injury will develop in the relatively short space of time required to produce immersion hypothermia so that keeping still to delay the onset of hypothermia will not result in cold injury.

(5) Freezing Cold Injury

Cold injury from freezing, well known as frostbite, is recognised by the dead, white, frozen appearance of the part affected. Those most vulnerable to frostbite are lookouts on rafts and lookouts and helmsmen on boats, especially when low environmental temperatures are combined with air movement. The parts of the body most likely to be affected are nose, cheeks and fingers. In severe conditions, unprotected skin (hands, feet, etc.) will also be affected. Like its non-freezing counterpart prevention by early recognition is the best treatment. Lookouts should be warned of the danger and told to wrinkle nose and cheeks frequently and if sensation is lost, treatment should be begun immediately. Once frostbite is incurred, the part affected should be rewarmed as quickly as possible and then kept covered to avoid refreezing. Rewarming should take place by placing warm hands, or breathing, on the frostbitten part and not by rubbing; it should then be left to recover on its own.

Immersion in seawater below —1°C (seawater freezes at —1·9°C) can cause freezing injury if the part is uncovered, so that head, hands and feet should be clothed if possible to provide the slight rise in the next-the-skin temperature necessary to avoid freezing in icy conditions.

In flooded rafts, or holed boats supported by buoyancy tanks, a close watch has to be kept on exhausted castaways

while at rest, for they may inadvertently slip into unconsciousness and drown in the water in the bottom of the survival craft. If it is not possible to keep the craft bailed, keep a separate watch on sleeping survivors to ensure that they maintain a safe posture, particularly during heavy weather or in cold conditions when the onset of hypothermic confusion may make them more vulnerable.

(6) Tropical Immersion

A type of immersion injury which has no connection with cold may be experienced by survivors who are forced to have parts of their bodies soaked in seawater for long periods. Swelling and tenderness on the tips of fingers and toes are particularly painful but this can be alleviated by making determined efforts to keep the affected parts from remaining saturated. Apply a barrier cream or oil if available, although this will quickly be rubbed off the skin if it is exposed, as in tropical conditions.

Other types of skin eruptions result from long periods of seawater immersion in the form of a rash and boils, appearing first, usually, on areas of most frequent contact, ie hands, elbows, buttocks and knees and then spreading gradually to other parts of the body. Once incurred, the sores take quite a long time to heal and the pain from them is considerable and often demoralising. Try to avoid wearing wet clothing on the area of sores and if rain showers permit, wash the salt from the affected parts. Although healing takes a long time, the inflammation and pain (except through direct contact) are quickly alleviated if a 48-hour period of salt-free exposure can be achieved. Much care is necessary to avoid the onset of seawater boils and this is often not possible if survival obligations intervene. If so, a determination to endure, and an infinite sympathy for your fellows in avoiding inflicting pain when moving around, can help to compensate for and assist suffering. Established boils should be left strictly

alone; any attempt to squeeze the pus from them should be resisted strongly as this results in further damage to tissue and prolongs the healing period.

(7) Other Miscellaneous Dangers

Shark attack can vary a great deal in the determination with which it is pressed home, depending on the type of shark and the condition of the survivor. It is always to the survivor's advantage to adopt an attitude of quiet aggression as most sharks will test the survivor's vulnerability by approaching closely and 'bumping' (ie hitting with nose, body or tail) before actually attacking. If a shark is struck (with the feet or fist if no wreckage is to hand), it will retreat to a safe distance and wait or find an easier prey. It is useless and dangerous to try to swim hurriedly away from a shark, for its speed through the water is far in excess of anything a swimmer can achieve. Progress should be made quietly and warily, stopping to strike if the shark approaches closely again. If the survivor is bleeding, the wound should be covered and the bleeding stopped; the survivor should then try to leave the immediate area where the blood was released as predators tend to strike at any form of life in that area, but this should be done quietly and watchfully, as already described.

Jellyfish, especially of the Portuguese man-of-war type, can cause very painful and crippling stings if inadvertently swum into, another good reason for moving carefully through the water.

Barracuda may attack live survivors although they, and other forms of scavenger fish, will strike much more boldly if their first advances to a weakening swimmer are not forcefully repulsed. Generally, the rule governing survival against attack is that those who prove able to defend themselves will be left alone, except in an attack by extremely large predators, against which normal weapons would be useless anyway.

This is a primary law of savage survival, which holds good for all time.

Cramp, although painful, is not a common cause of drowning, for this is usually associated with tired muscles. Swimmers who suffer from cramp can usefully allow the affected parts to remain idle, for this is also the way to resist the speedy onset of hypothermia. Cramp does not prevent a swimmer from floating on the surface of the water in the normal 'at rest' posture.

6 ASSESSMENT OF COURSE OF ACTION

One of the most difficult decisions has to be taken once the initial work of reviving casualties and collecting useful debris has been completed: whether to stay in the area of the sunken parent craft (as much as is allowed by wind and current) and hope for rescue; or whether to strike out immediately for the likeliest landfall.

The decision is made easier by a careful assessment of probabilities. Waiting time limits can be variously estimated if there is the probability of a search and rescue party being launched towards the scene of the disaster. Thus:

(a) If radio contact has been made through distress channels, and your plight acknowledged, try to stay as near the scene of disaster as possible. Allowances will be made by rescuers for your likely drift.

(b) If radio distress signals have been sent, at the correct time on the international wave-lengths, even if no acknowledgement has been received, a certain amount of time must be allowed for response before leaving the disaster area. This length of time can only be assessed in relation to the accuracy of the disaster position being known to the rescuers and the likelihood of a search being launched. If no search aircraft or ships are sighted within three days, alternative action should be put into effect.

(c) If portable radio beacons are carried it should be remembered that they have a very limited range (about 25 miles at sea level) but may be received by aircraft at longer distances. As in section (b), if no response is observed within three days alternative action should be taken.
(d) If no radio signal has been made, the probability of search and rescue will diminish in proportion to the size of the disaster, its commercial significance and the distance from search and rescue services. Aircraft are tracked fairly accurately and a successful search is possible if the disaster has occurred along the established route. Larger vessels are similarly well reported and investigated but smaller fishing boats and yachts cannot expect assistance until well overdue at their destination and often not then. In such cases there is little point in remaining at the site of the disaster any longer than is necessary to recover useful debris and survivors. The decision now has to be made as to the direction in which to travel. There are four major considerations to take into account, and I place these in order of importance to survival: (1) water; (2) ease of progress; (3) landfall; (4) rescue.

(1) Water

If the disaster has taken place in an area where there is little rain it is essential that the survival craft should be directed with all possible speed to the nearest area of rainfall. Consultation of the survival chart (appropriate to the time of year) in conjunction with ocean winds and currents is vital for this decision. *A wrong decision in this matter could be fatal.*

(2) Ease of Progress

This can certainly be associated with, primarily, favourable currents and/or favourable winds. Once again consultation with the chart is essential before a decision is made. In terms

of effort, a survival craft can travel down wind at 40 miles a day while the occupants rest and conserve their strength. The same occupants can exhaust their lives from their bodies in an attempt to travel up wind and current without gaining a yard. Thus survivors could successfully make a landfall 2000 miles to leeward, or die in the attempt to make land 200 miles to windward against the set of current. The decision to turn away from the nearest, but unfavourably situated, land is a very difficult one to make in survival conditions but it is often the right one.

The problem of direction having been settled, the whole concept of survival takes on different values. There is no greater morale booster than a positive course of action which can be seen to be working to the castaway's advantage.

(3) Landfall

The ultimate aim of the castaway, who should bear in mind that the land aimed for must be able to support life (and therefore probably be inhabited) and that it must be large enough to allow for errors in navigation commensurate with distance run. To travel 200 miles and hope to sight a low-lying island a mile in diameter would be stretching dead reckoning beyond the bounds of credulity. The actual sighting of the island after such a run in a survival craft would be a matter of good luck rather than good judgment. The landfall aimed for should be the largest chunk of land in the general direction of travel and survival time estimates for stores should be based on the distance of this land from the scene of the disaster.

(4) Rescue

Rescue comes regrettably last in the prospects for the castaway, not so much because the chances of sighting a ship are so remote, but rather because the chances of

sighting a ship which will pass close enough to see or hear the signals of the survivors are a matter of coincidence rather than design. A raft may lie in a busy shipping lane for many days and be passed by several ships without being sighted. Or survivors may meet a solitary ship in mid-ocean and be picked up. This is particularly so since the advent of auto-pilot and radar and the castaway should be careful not to exhaust his store of flares in frustrated anguish at a ship's passing.

7 CARE OF SURVIVAL CRAFT

(1) Inflatable

Modern inflatable survival craft of approved makes are constructed from proofed fabric of sufficient strength and durability to satisfy the high standards laid down by the Safety of Life at Sea Convention (1960).

It does happen, however, that because of damage incurred during the disaster (to which inflatables are particularly vulnerable) and subsequent leakage, or because of changes in temperature, that pressure is lost from the flotation chambers. Pressure should be replaced frequently to keep the chambers rigid and so prevent the fabric from flexing in the seaway; flexing accelerates the rate of wear and, while the fabric is designed to withstand a minimum of 30 days' exposure in all sea conditions, the craft may have to last considerably longer. Care taken to preserve the fabric in the initial stages of the ordeal will therefore have a pertinent bearing on this. Any damage to the fabric should be made good as soon as possible. Usually external damage can be more easily repaired with the use of plugs than by trying to apply adhesive solution to wet fabric. Internal damage is more readily repaired with patches. Spars or paddles should not be used to support canopies on inflatable craft unless special provision is made by way of reinforcement and protection to avoid chafing by both the spars and their lashings. *Continuous chafing of this nature can destroy the fabric in a week.* Extreme care should be taken to ensure that grab lines, trip lines, towing appliances, sea anchor ropes, etc. do not foul and chafe the fabric; frequent inspections are necessary to ensure that the fabric remains chafe-free; prevention is the best repair.

The consequences of overlooking an area of chafe can result in long periods at the bellows to keep flotation chambers efficient. Often the bellows themselves are inefficient both in volume and construction. When this happens the castaways must then cut off the bellows tube and blow through it by mouth. This is an exhausting routine but it may be the only way to keep the fabric rigid until the site of the pressure loss is located and repaired. Bellows tubes should be fitted with a small junction piece near the bellows chamber to allow for this emergency procedure.

Precautions must be taken in areas of ice to protect the fabric from sharp floe edges; small granules of slush ice may also wear the fabric quickly and any form of protection which can be afforded to the fabric is better than none.

Where there are a number of occupants in a raft, care should be taken to avoid excessive wear in the positions of greatest usage, particularly around doors where watch-keeping is carried out, and on central divisions where heavy strain is imposed by occupants attempting to stretch out. The area where the floor of the raft joins the side flotation pieces is also subject to heavy stress, and although wear here may not result in loss of air pressure, it does allow a flow of seawater on to the floor of the raft; severe discomfort, salt-water boils, and probably some form of immersion injury will follow, particularly in cold-water areas.

In areas where there is much evidence of surface marine life and particularly where sharks or turtles are numerous, the fabric of the inflatable is under stress from bites and from contact with the harsh skins of these creatures; they should

be warded off at every opportunity with paddles or improvised spears unless they are required for food. In rafts with canopies, in warm weather areas, holes can be made in the side of the canopy through which the occupants can strike at fish or turtles rubbing on the sides of the flotation chambers.

If game fish and sharks strike frequently at the edges of the raft, as they will in areas where there is a high dorado (or dolphin-fish) population, they may be diverted by trailing a 'skirt' of any sort of material around the edges of the raft to create an area of shadow beyond the flotation chambers (see diagram, p. 29).

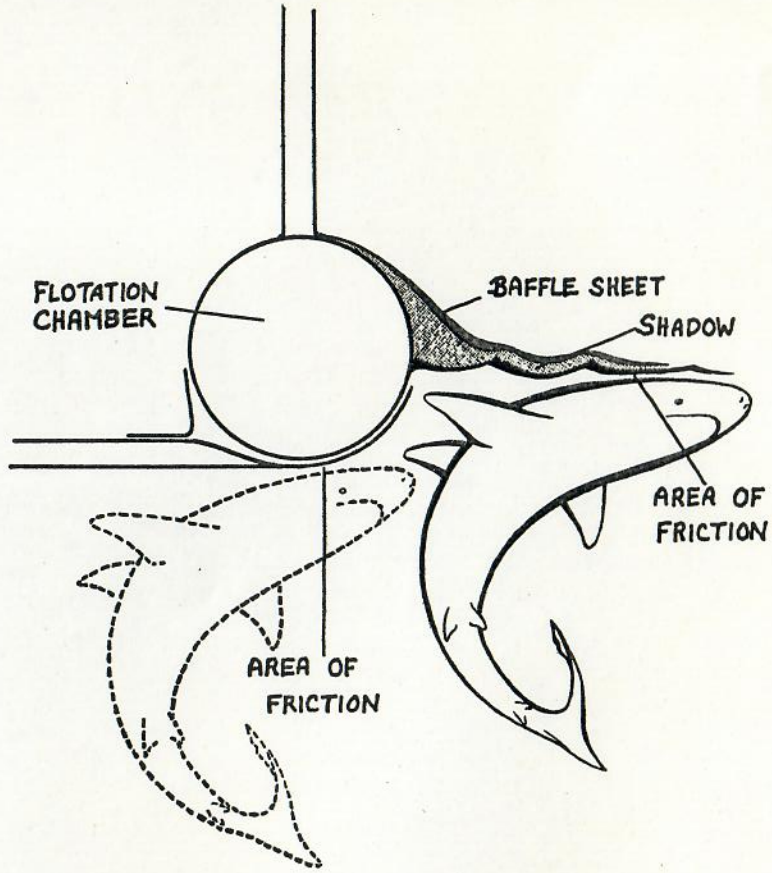
When repairing worn areas the weakness of the surrounding fabric should be taken into consideration, and if repair solution or patches are in short supply, then it may be more effective to use a plug, round which the weak fabric may be gathered and then bound airtight, saving the patches for the smaller holes which will appear later (see diagram, p. 30).

When propelling inflatables by oars or paddles over long periods, take extreme care to ensure that the points of contact between fabric and oar are well protected from wear and that too much strain is not put on the fabric by an excess of zeal, especially in dual-purpose inflatables where carrying handles are used as rowlocks. It is therefore better practice to lie to the sea anchor in adverse winds than to attempt to row against them.

(2) Rigid Craft

Whereas the delicacy of inflatable fabric is fairly obvious to castaways, it is not so readily understood that in rigid craft the seams of wooden and metal boats are vulnerable to shock; fibreglass and plastic may split or shatter under severe impact; and the danger of capsize or swamping is much increased if manned by inexperienced seamen, especially in high seas. Heavy debris should be carefully warded off and heavy bumping by large sharks is readily discouraged

by striking at them with oar or paddle on their close approach. Turtles are best discouraged by grasping their hind flippers and holding them captive for long enough (half a minute should be enough) to make them realise that the survival craft is not the mate they were seeking. Striking them on the head or shell takes longer and needs more energy but this

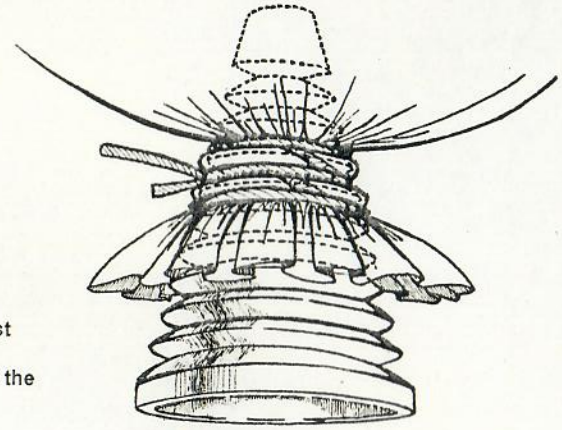


Attacks on flotation chambers may be reduced by a baffle sheet to extend area of shadow

may be the only way to deter the really big ones from bumping.

Excessive strain through attempting to beat against a short steep sea, especially with a jury rig, can cause extensive damage to small craft, to say nothing of the extreme discomfort to their crews. It is wiser to lose 20 miles in leeway than to damage the craft by trying to maintain position in adverse weather, and consequently be unable to make further progress.

Rigid craft are more stable if the occupants sit in the bottom of the boat rather than on the thwarts. Buoyancy tanks and spaces should be filled with impervious buoyant material and the risk of capsize is reduced if such buoyancy areas are close to the gunwales and away from the bottom of the boat. (This also makes it easier to right the craft if it does capsize.) A conscious awareness of the elementary principles of stability should be taught to survivors who are unused to boats at the earliest opportunity, so that they can assess the effect of their own movements on the safety of the boat. Simple practical demonstrations of how movement affects both stability and trim in favourable sea conditions can avert the need for unpleasant preventive action in times of danger.



A plug is the most effective way of stopping leaks on the outside of a raft

Rigid craft have the advantage of being more easily propelled through the water by oars or paddles in calm or adverse weather but where a cutaway stern has to be presented to an unfavourable following sea, serious consideration should be given to proceeding stern first, with the bow presented to the oncoming waves; some form of drogue or sea anchor streamed from the bow is essential to allow the craft to ride easily without yawing.

Rigid craft are much less comfortable, and if no canopy is fitted, provide less protection against cold. Spars may be used to rig awnings in tropical zones, or canopies in cold weather and if few materials are to hand, efficient windbreaks can make life more tolerable than in a strictly open boat. Pressure sores on buttocks or limbs are more likely in rigid craft, especially if there is very little room to move around, and survivors should take every opportunity of changing position within the compass of the space allowed to them to prevent such sores developing.

Survival craft of all types should be kept as dry as possible to prevent the onset of skin eruptions from continuous wetting by seawater. If it is possible to prevent seawater from entering the craft by rigging canopies or effecting repairs, this should be done in preference to bailing, which is exhausting and unproductive work. The amount of care taken in handling the craft can be a major factor in the length of time it remains serviceable, and it is as well to recognise this fact from the outset, rather than suffer damage from stress and strain which might have been mitigated by reefing sail or by a judicious use of the sea anchor.

8 METHODS OF PROGRESS

(1) Inflatable Craft

In inflatable craft fitted with solid keelsons, mast and sail

may be jury rigged with less fear of chafing than in other types. Only favourable winds should be used for sailing as any attempt to beat against the wind will be nullified by excessive leeway. If adverse winds are slight, paddles may be used but, otherwise, the sea anchor should be streamed until a change of wind allows further progress. In warm climates where the standard type of inflatable survival craft is fitted with a permanent canopy, better progress can be achieved by turning the open canopy door towards the wind (provided seas are not too rough) and maintaining this position by streaming a half-tripped sea anchor made fast to the towing fixtures at the doorway. If in stronger winds the sea slops into the raft the door may be closed, or turned to the lee side of the raft by transferring the sea anchor fastening to the opposite side of the raft. Progress of up to 35 miles a day can be achieved in this way. In adverse winds leeway should be restricted as much as possible by a fully opened sea anchor but in heavy seas, too much drag results in heavy buffeting and severe jerking on the raft fixtures, resulting in damage to the fabric. *This should be avoided at all costs,* either by lengthening the sea anchor lines, or fastening a weight between sea anchor and raft to act as a tension buffer (see diagram, p. 33). If oil has been collected from sun-dried bird or turtle fat, this can be used to smooth breaking seas. This is best done by placing the fat, or oil-impregnated rope fibre, in a cloth bag and streaming it on the windward side of the craft. Oil will spread to windward as the craft makes leeway.

(2) Rigid Craft

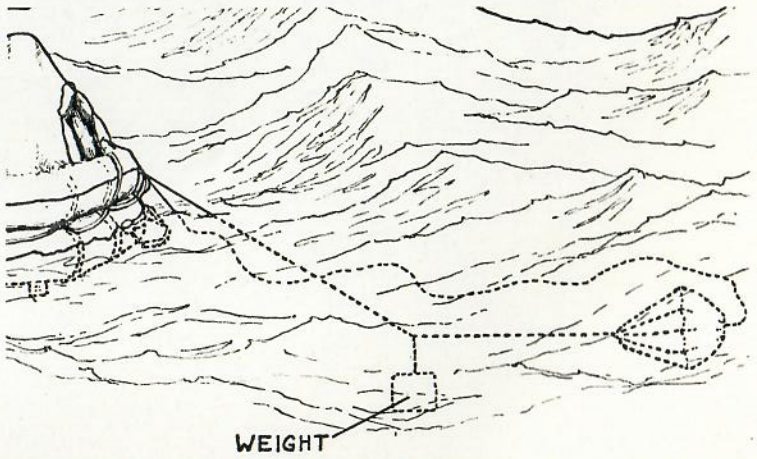
Only boats with keels may successfully beat to windward in ocean conditions where adverse seas add to leeway in reducing windward progress. Persevering in this method of progress in shallow-draft boats only exhausts the occupants, as well as subjecting the boat to undue strain and possible damage. In survival conditions it is good seamanship to

sacrifice 30° of direction for the added comfort and reduced stress which this achieves. It is also good seamanship to lower the sail and ride to the sea anchor rather than risk swamping in heavy seas. The boat may be steered by an oar in place of a rudder or, if proceeding stern first with the sea anchor half tripped, by pulling down on the square sail edge on the side of the desired direction of travel (see diagram, p. 35).

In calm weather, good progress may be made by rowing, especially in an area of fairly frequent rainfall. A good water supply is essential to this form of continued progress and to exhaust survivors unnecessarily when no reasonable objective is within reach is bad seamanship and bad husbandry. In tropical zones, it is better to row at night and for the oarsmen to rest during the heat of the day.

9 STORES

When planning the distribution of survival rations the longest period of deprivation should be anticipated. Survival rations



A tension buffer on a sea anchor line; it should also be attached to a line joining rafts

are not maintenance rations, which recognise the body's needs over long periods of time. Until rations can be supplemented by the survivor's own efforts, or by local conditions, the initial survival ration should be the minimum which the body requires for coherent function. This allowance will vary with climate and the individual, and the following are only general guidelines established by survivors in the first two weeks after being castaway.

(1) Fresh Water

BOARD OF TRADE

MERCHANT SHIPPING NOTICE No. M.500

DRINKING OF SEA WATER BY CASTAWAYS

Seafarers are reminded that if castaway they should NEVER UNDER ANY CIRCUMSTANCES DRINK SEA WATER which has not been through a distillation plant, or de-salinated by chemical means.

A belief has arisen recently that it is possible to replace or supplement fresh water rations by drinking sea water in small amounts. This belief is wrong and DANGEROUS. Drinking untreated sea water does a thirsty man no good at all. It will lead to increased dehydration and thirst and may kill him.

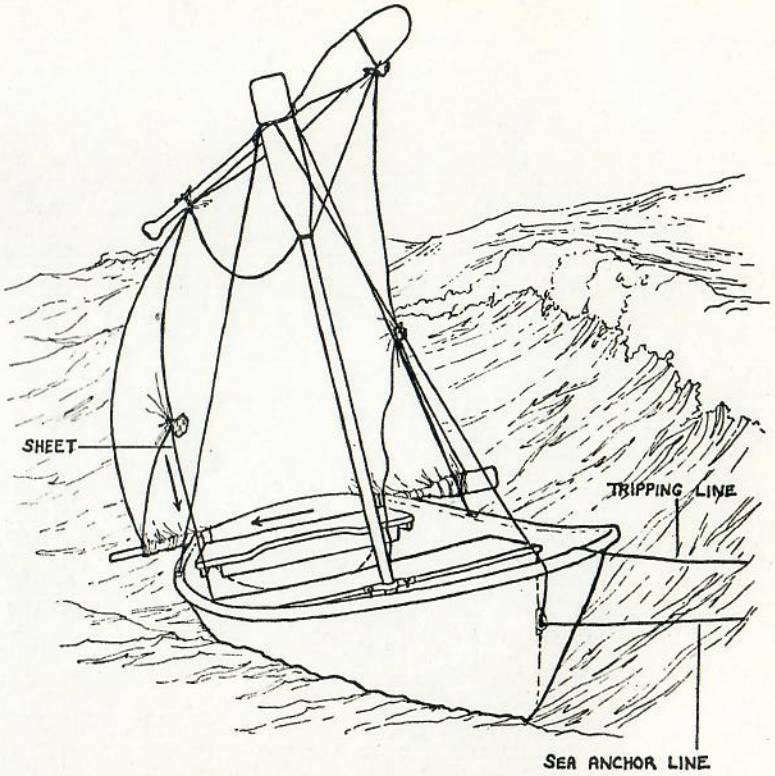
Even if there is no fresh water at all it should be remembered that men have lived for many days with nothing to drink, and therefore the temptation to drink untreated sea water must be strongly resisted.

MC 54/09

Board of Trade
Marine Division, London
November 1965

Reprinted March 1968

In tropical areas with shade, after an initial period of 24 hours without water in order to bring the body to a low level of hydration, coherent action can be maintained for a week on as little as one third of a pint of water per day. Much more water than this is required to maintain life and after seven days, dehydration may begin to impair judgment. More substantial amounts of fluid are then required and must be obtained from other sources if rainwater is not available (see p. 39). Although the initial effects of dehydration cause much



A jury rig for a yacht tender proceeding stern first. Tension of the sheet indicated pulls the stern away from a breaking crest

discomfort (foul taste, absence of saliva, weakness of legs, cracking of lips) it does not incapacitate the sufferer, but if delirium becomes established in any of the survivors, the water ration should be increased if possible to prevent the others being affected, since coherent action then becomes difficult.

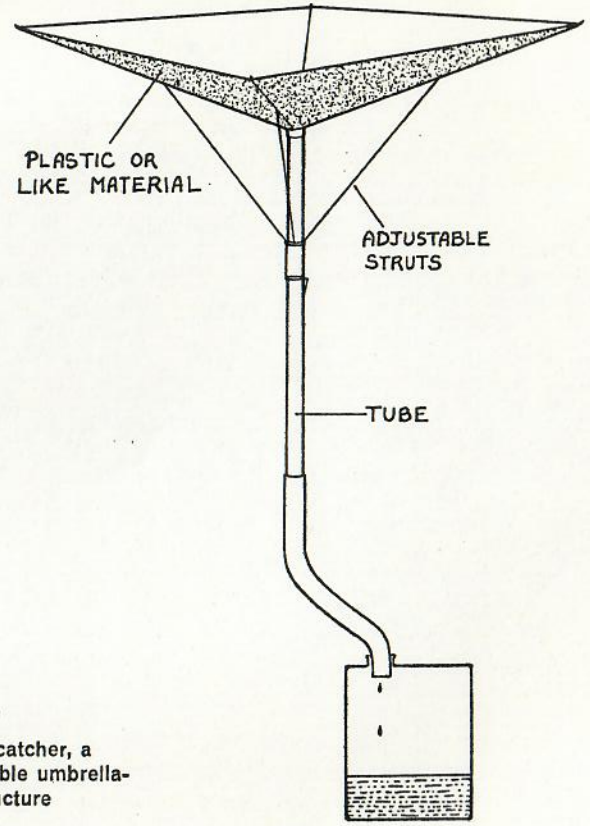
If circumstances allow, the voluntary rationing of water as a self-imposed discipline is much more effective in conserving water supplies than compulsory rationing. It is, of course, essential that all the survivors join in the spirit of self-denial and do so by visual means, such as drinking from a transparent jar, but the feeling of need for water, and the desire to drink, is much lessened by the principle of self-rationing. It should not be regarded as a heinous crime if one castaway takes more than his due, but if he does so consistently, then he should be issued a ration to ensure equality.

When rain showers of short duration pass over, it often happens that water of varying salt content is collected from the catchment area, because of the need for an initial washing off period. The less salty water should be kept in reserve to use in place of good fresh water when this is needed for cleaning fabric around leaks before solution is applied, for moistening lips or any such auxiliary needs.

Foul water which is not poisonous but may cause vomiting can be absorbed rectally by means of a water retention enema. In rain storms, when all containers have been filled, additional water may also be taken in this way not only in order speedily to relieve dehydration but also as an additional method of conserving surplus water, for when the stomach shrinks in survival conditions, it is unable to hold much water. Up to a pint of water may be taken and absorbed through the rectal membrane, but it must be remembered that salt water taken in this way is equally as dangerous as if taken by mouth.

Rain should be caught and collected by means of an impervious sheet (for example, plastic) to reduce any washing

off period to a minimum (see also, p. 38). Rubberised fabrics taint water, but although unpalatable, it is drinkable. Extreme care should be taken, especially in crowded rafts, to put full containers where they will not spill or suffer damage; careless handling of containers is a common cause of wastage. When opening tins of water, a very small hole should be pierced on each side of one end of the tin and the water decanted into a clear drinking jar with a lid. When the tins are to be refilled from rain, one of the holes should be enlarged so that the tin may be filled without waste. Plugs should be made ready to use immediately the can is full.

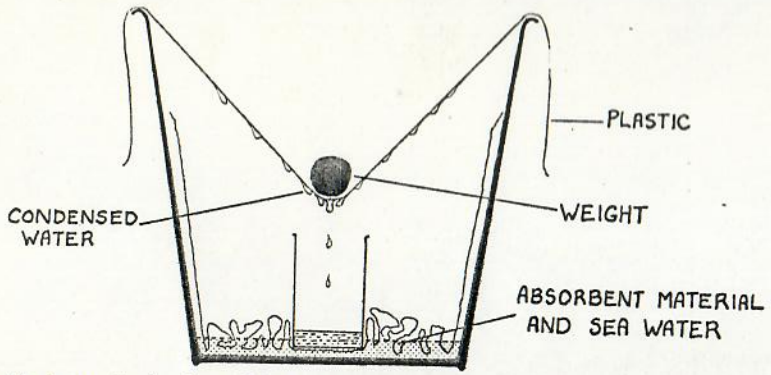


A rain catcher, a collapsible umbrella-like structure

When using these refills, freshly collected water should be set aside for use in rotation after that previously collected, for it sometimes happens that taint develops (from many sources) in rainwater which is stored over long periods. In storing tins with plugs which do not fit exactly, when the plugged end is uppermost, the tops of the tins must be protected, preferably by a snap plastic top, against the intrusion of seawater from spray. It is often these small, relatively simple points of care and maintenance which are overlooked by survivors under stress and which if neglected cause loss of vital food supplies.

Condensation can sometimes be collected from surfaces which are salt-free. An example of this form of water collection is a solar still, which can give up to two pints of water a day—survival ration for six people—to span the gap until rain is collected. Makeshift condensation units can be rigged with useful results if the right materials are available and conditions are suitable, as they sometimes are in areas of water shortage (see diagram, below). Care has to be taken to avoid upsetting makeshift equipment and this can be a major factor limiting the use of stills in a rough sea.

It helps to conserve body fluids in tropical zones if clothes are soaked in sea water frequently to keep body temperatures



An improvised solar still for calm weather

down by surface evaporation. Bathing in these zones, apart from wasting energy, is not usually possible owing to the presence of sharks, particularly if fish are being caught and their offal discarded. However, much relief can be obtained by simply pouring water over yourself or your companions and bailing the surplus overboard.

In ice regions, old sea ice is salt-free. Icebergs contain fresh water ice, but the current year's ice is contaminated by salt and should not be used. Old sea ice is recognised by its smoothness and clarity, and the way it splinters easily. New ice, by comparison, is opaque, tough, and angular. Ice should be melted before tasting it for salinity, as cold tends to numb the palate.

Note. It is agreed by all competent authorities, including people who have experimented with drinking sea water in small quantities, that the drinking of sea water by anyone who is suffering some degree of dehydration will only result in increased dehydration, followed by deterioration into delirium and death. It is not possible to prevent dehydration by drinking sea water and early drinking of sea water before dehydration sets in merely reduces moral resistance to reject it when faculties are impaired.

Food in any dehydrated form need not be eaten (it will not be wanted) when water is very short, but the fluid in marine life should be taken immediately it is caught so that the full benefit of the moisture it contains may be gained. Surplus marine food should be dried and saved to eat when more water is available. Vivid dreams of fresh fruit and such delicacies are not to be mistaken for hallucinations or delirium, but are a natural reaction to the need for moisture. Delirium sometimes requires the need for physical restraint to prevent injury to the sufferer or to others.

(2) Supplementary Water Supplies

Tropical areas, where maximum dehydration conditions

exist, are fortunately populated by a large variety of marine life which, if caught and killed in the correct way, can be used to sustain the life of the castaway for long periods.

Apart from fish, the turtle is one of the most useful marine creatures which the castaway may encounter. Some species are fairly easy to catch, for they often bump the survival craft (looking for a mate) and may be hauled aboard by the hind flippers taking care to guard its beak and lacerating claws from damaging castaways or craft. Although it is difficult to kill and cut up this armoured reptile without the proper equipment, a good enough job can be done with a sharp pointed knife and perseverance. The turtle should be laid on its back, beak and claws held, and the point of the knife inserted into the neck to cut the arteries and veins close to each side of the vertebrae. The spurting blood vessel may be directed into a receptacle and three or four pints can be expected from a 75 lb turtle; the blood is not salt to taste, and is best drunk immediately while warm, as it coagulates on cooling (in about a minute) and is then difficult to drink. If the castaways are very weak, or the turtles particularly large and unmanageable, it may be found more convenient to secure the turtle alongside and drown it, rather than bring it aboard the survival craft to kill it; but if this method is used, the blood will not be so readily available for drinking, and the meat will have a much poorer keeping quality through not being bled properly. The cooler blood will very quickly coagulate but if it is distasteful to the castaway to eat this jelly, it can be cut up to release the serum which can then be drained off for drinking. The meat from the turtle which is not to be eaten immediately should be kept in a waterproof bag for an hour or so; the juice which drains from the meat can then be collected and mixed with turtle egg yolks to make a delicious sauce in which pieces of dried meat and fish can be dipped.

Fresh-tasting fluid can be obtained from the cavities in the backbones of fish, and may be sucked out after the vertebrae have been separated (see diagram, p. 41). The vertebrae of

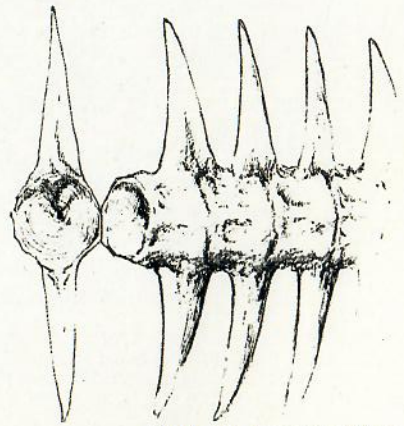
sharks, however, contain no fluid. Some species of fish have large eyes which may be sucked to obtain the fluid they contain.

The flesh of fish and turtles, as well as that of barnacles and similar shellfish which cling to ropes trailed in the sea, contains a large percentage of fresh fluid and small quantities may be eaten immediately. They may also be eaten at varying stages of drying but extra water must be taken to compensate for this. All unknown food should be taken with caution at first, to see that it does not contain harmful substances like, for instance, the stings of jellyfish in plankton.

While it is obviously not possible to lay down conditions in which the fluid contained in marine life may be consumed, in times of acute water shortage it should be assumed that if the taste is bland and unsalty, try it; if it tastes bitter or salty, reject it.

(3) Food

Many responsible authorities state that protein food should not be eaten on any day when less than two pints of water are also available. This advice may be based on the fact that an intake of two pints of water is needed to supply the body's demands for the necessary gastric juices and for the ultimate disposal of the waste products of protein matter. But it must be recognised that there is a considerable difference in the amount of water which needs to be taken



Fluid can be sucked from the spinal cavities of fish

with wet protein, such as freshly caught fish or turtle, and the same protein after it has been dried. It is also possible for the body to tolerate a build-up of waste over a period of several days, to be disposed of later by a flush of water when rain becomes available. Over long periods of survival-level living, the castaway needs to adjust his intake of food from marine life to cope with his long-term needs and to prevent his body tissue from wasting away through starvation. It has been suggested that whereas a man may live only 10 days without water, he may live 30 days without food; but during the latter stages of both periods the castaway will certainly be disabled to the extent of being incapable of self-help or of attracting the attention of a rescue vessel.

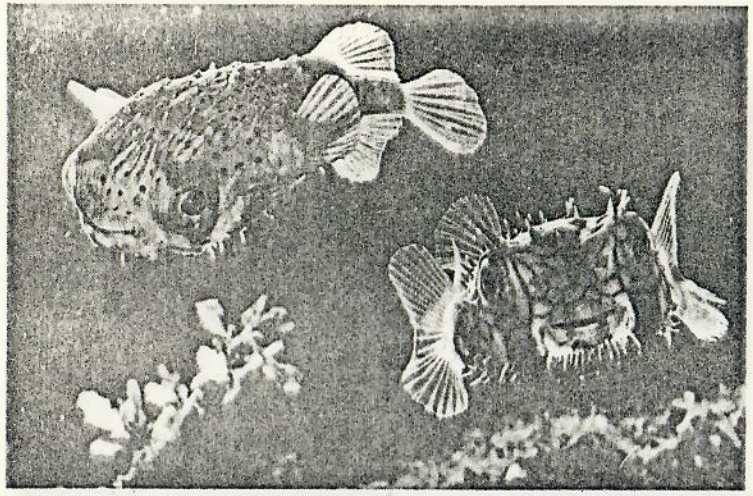
It is a first principle of survival that the castaway should try to remain coherent and able, and to this end many practical examples may be cited of castaways who, over long periods, have consumed marine food with considerably less water than two pints a day, and have remained healthy and able with no subsequent ill effects. Indeed had this rule been rigidly observed, the same castaways would undoubtedly have become severely disabled by starvation with a different conclusion to their ordeal.

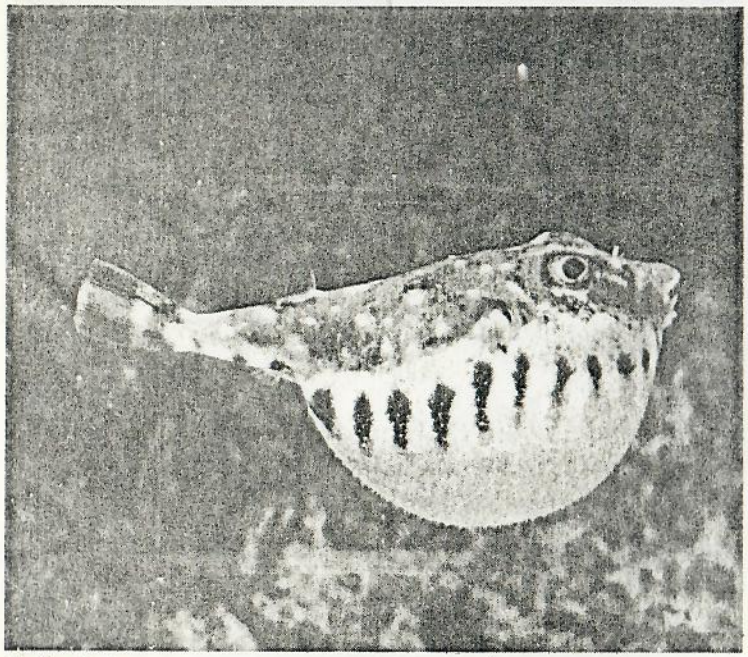
It should be remembered that while caution is praiseworthy in matters of choice, the hunting savage, which the castaway has now become, has little opportunity to pick and choose in the selection or rejection of food. He may be able to reduce or increase his intake of food as available water allows, using his dried stores when water is plentiful and restricting himself to small quantities of wet, fresh food when it is scarce but such is the plight of the castaway that caution cannot be practised to the exclusion of survival demands. The adjustment to primitive eating practice should be made before desperation robs the castaway of basic good judgment of the difference between what is harmful and what is simply disagreeable. It is better to live dangerously than to die cautiously.

The flesh of most types of *marine life* may be sun-dried and stored against the time when rain will provide the castaway with enough water to use it. If there is the prospect of a relatively dry period of three days, the fish, turtle flesh, etc. may be cut into strips an inch thick and hung in the open air to dry. For quicker drying, the flesh may be shredded into much smaller strips and either laid on thwarts or canopies and turned frequently, or hung in rows fastened to lengths of small line. More fluid is leached from the flesh in this way but the drying period is reduced by half. The food may be eaten at any stage during drying, water permitting, so it is better to start the drying process immediately for marine food quickly goes bad if kept damp in hot weather.

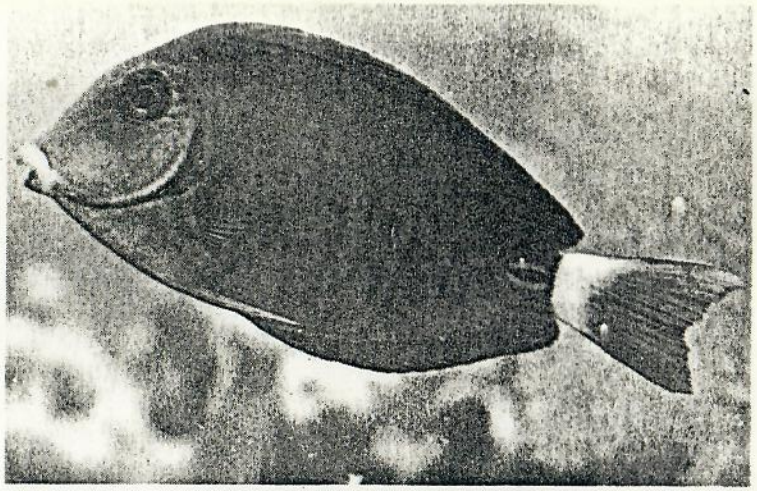
Generally speaking, ocean and offshore fish make good eating, scavengers or not, but the offal and flesh of scavengers should be discarded if the castaway has any misgivings that the fish may be poisonous or may have fed in polluted waters. Fish livers, hearts and roes, taken in small quantities make tasty variations to diet. Large quantities of fish and turtle liver should be avoided to prevent too high an intake of liver oil which can cause illness. The liver may be pulped, and the oil strained off and used for other purposes. Several inshore varieties of fish have stings, or are poisonous to eat, and may be distinguished by their spiny appearance, their puff-up defence mechanism, or coral-eating characteristics (see pp. 44–5). Some older barracuda feed on coral-eating fish and themselves become poisonous. Inshore shellfish such as lobsters, crabs, crayfish, conch, clams, mussels, cockles, etc. make good eating and are often easier to trap than fish, but they should not be eaten if from polluted areas nor should shellfish with conical shells be handled because many are venomous.

Sea birds may provide a useful addition to diet although they are difficult to catch from a canopied raft. The wide-ranging birds, such as albatross, petrels, or frigate birds (see p. 102), seldom approach close enough to be caught by hand, but





Puffer fish



Top: Reef trigger fish *Bottom*: Stone fish

gulls, boobies and the like will perch on the boat, raft or sometimes on the castaways themselves. It is easier and better to skin the bird (if eating it raw) than to pluck it. Useful oil may be obtained from the fat which attaches to the skin.

The fat from birds and turtles should be collected in a plastic bag and hung in the sun. Oil is secreted from the fat and forms a very useful lubricant, protects areas of tender skin and may be used to smooth breaking seas (see p. 89). Residual fat tissue may be chewed and is very sweet-tasting, especially in colder weather.

Bones of birds and turtle bones have a very tasty marrow, which is best extracted by chewing the knuckle end and then poking it out with a pointed instrument. If a castaway's teeth are strong, turtle bones can be splintered and the marrow then licked out; many a happy hour may be passed in this manner.

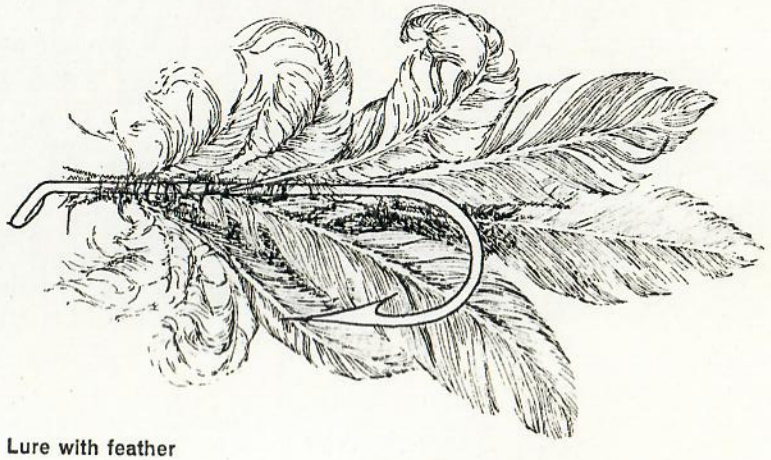
Sense of smell is not a very good guide to the quality of food (either wet or dry) since the castaway quickly becomes accustomed to the disagreeable odours which emanate from drying fish, turtle or bird flesh. Quality can often be determined by examining the folds of the dried meat. If they are green or slimy and have a very disagreeable taste, then the slough should be scraped off and the food thoroughly re-dried. If the fibres of the flesh have disintegrated, as is likely in continuous wet weather, it should be thrown away.

If any *emergency rations* have been saved from the disaster, these should be husbanded with great care and used only when sea food is not available, or for special occasions when stress of weather or action stretch the castaways' resources to the limit. Some of the survivors may be less able to assimilate raw food than others (although reluctance to try it should not be confused with this inability); if so, the emergency rations could be better used to supplement the diet of the weakest.

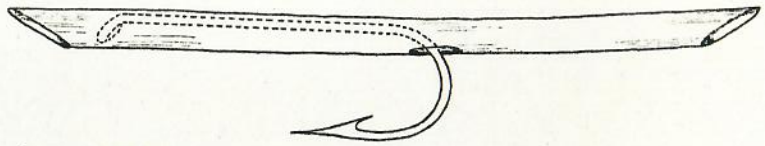
10 METHODS OF CATCHING FOOD

(1) Fish

In temperate zones or cold water areas, line fishing may be the most practical method of catching fish. The strongest tackle should always be tried first, at all depths to the full extent of the line. If bait is taken from large hooks without a successful strike, small hooks, down to the size of very small trout hooks, should be tried. The best bait for deep-sea fishing is usually a small fish, or a piece of fish with tinsel (the small fish in the vicinity of the survival craft may be caught by net or trap — see diagram, p. 52). Surface fishing by spoon, spinner, feather or straw (see diagrams, below) should be tried at varying depths and by skimming the surface at



Lure with feather



Lure with straw

speed to simulate leaping fry or flying fish. Attracting fish by lure or bait is largely a matter of trial and error, but the strongest tackle should always be tried first since large fish are reluctant to return after breaking weaker tackle, but small fish become bolder if they have cleaned bait from a large hook.

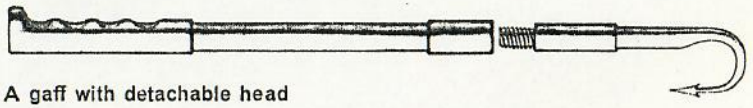
When fishing is in progress, the line must always be held ready for a strike, even if it is also secured to the craft, for valuable time may be wasted if the bait is eaten from the hook unobserved, or, even worse, a small fish caught unnoticed is then taken by a large predator, resulting in the loss of valuable equipment as well as the catch. When casting away from the craft as in trolling, the end of the line should be fastened to the craft or held by a helper, otherwise the whole may be lost in a careless cast. If fastened to an inflatable raft, the line should be secured to external grab lines or at a point where it will not foul or cut the raft fabric.

In areas like the Atlantic trades, dorado or dolphin fish of average size (up to 20 lb or so) are fairly easily caught by skimming the surface with a captured flying fish, which also abound in these areas. In some tropical zones, however, particularly in areas where shark and large game fish are numerous, fishing becomes more difficult, for the hooking of one of these larger fish must result in the loss of valuable tackle. The castaways must therefore select suitable fish by other means than line fishing, and to do so they must become hunters. Infinite patience to await the right moment to strike the right fish, combined with an ability to strike instantly when that moment arrives, is an art which has to be learned by much practice and at the cost of exhausting muscular tension, but perseverance improves performance out of all recognition and the rewards are very tangible.

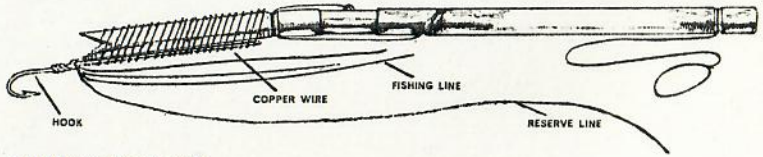
The two most common methods of hunting fish are by *spear* or *gaff* (see diagrams, p. 49). Spearing may be most effective if the fish is close to the surface so that force of the thrust is not absorbed by water drag. (This of course will diminish if more sophisticated spears are available.) It is

better not to strike at a doubtful prey, rather than to strike without killing, for fish quickly learn to keep a respectful distance. Wounded fish also attract larger predators, which may not only be dangerous to the craft but will drive the more eligible fish away. Ground bait by day or a flashlight (if batteries are to spare) by night help to attract fish close enough to enable a strike to be made. A gaff is a safer instrument for use on an inflatable and also provides a more reliable way of securing the desired fish, especially if it is designed with hunting in mind, rather than merely as an aid to line fishing. The shaft should be 6 feet long, elliptical in shape, slender, and capable of being moved swiftly through the water horizontally as well as vertically. The hook must be very sharp and barbed and should measure 1½ inches across the curve of the shank. Both spear and gaff should be secured by a line (such as the rescue quoit line). When striking with a gaff, the barb should be inserted in the belly just behind the head so that the fish will be swimming in the direction of pull if the strike is successful (see diagram, p. 50). Game fish are powerful enough to break all but the strongest equipment if the initial thrust is misplaced and the escape dash is away from the line of pull. For this reason, an improvised gaff (see

A spearhead, interchangeable on the gaff



A gaff with detachable head



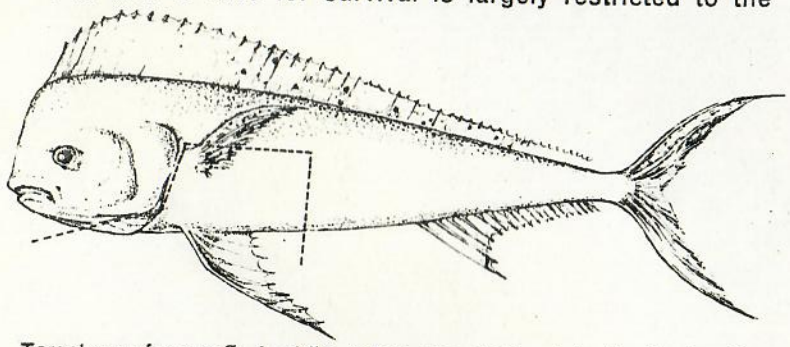
An improvised gaff

diagram, p. 49) must have the hook fastened so that it is rigid for striking but free to swivel immediately afterwards. If mono-filament (single strand) nylon line is used it must be checked frequently for cracks and replaced if suspect.

Improvised spears may be made by lashing a sharply pointed knife to a paddle handle but this method is risky in that a careless thrust could result in the loss of the knife, the most valuable tool in the castaway's kit, which should not be risked except as a last resort. Single scissor blades (if these are provided with the first aid kit) may be more suitable, but these should be attached to a shorter handle and used against smaller fish, tempted close to the craft by the distribution of ground bait (flying fish offal or pieces of skin, cloth, tinsel, etc.). A swift and sudden stab, followed through in an arc to propel the fish into the survival craft so that it is secured even if, in its struggles, it slides off the blade, is the most effective method of spearing small fish.

Small sharks may come close enough to survival craft (especially at night) to strike it with their tails. The alert castaway may catch such a fish by hand, for the skin is rough and gives a good grip; the tail should be secured while the fish is held and killed. Larger sharks should be beaten off with paddles or oars, especially from inflatables.

The use of nets for survival is largely restricted to the



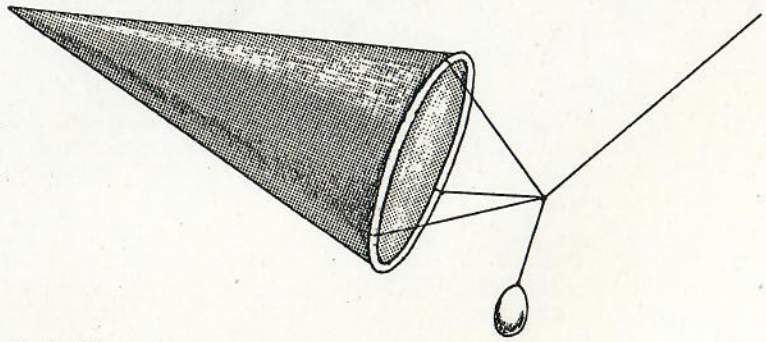
Target area for a gaff. A strike in the area enclosed by the broken line ensures the least resistance from the fish

collection of planktonic material, but the small fish which gather around to feed on offal or lie in the shade of the survival craft may also be caught by these nets (see diagram, below).

Seaweed and *grass* is mostly edible but is best collected when rainwater is available to wash out the salt. These plants contain trace elements valuable to the castaway's continued health if he is adrift for a long period of time.

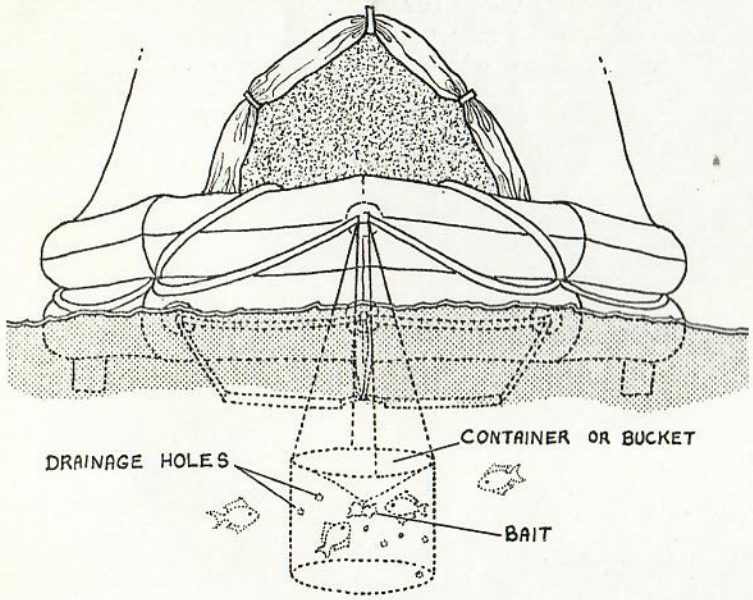
If a stingray is caught, the fish should be stunned before it is brought aboard and the tail, where the sting is housed, cut off at the earliest opportunity; the 'wings' of the ray make quite good eating. Generally, fish with single spines projecting from dorsal or pectoral fins have these for protection but a painful wound can be received if they are handled carelessly.

The catching of turtles, already described on page 40, and of some types of seabird (p. 46) need not be repeated here. Birds are quickly and easily killed by placing the thumb on the back of its head and with fingers cupped under its beak give a quick backward leverage to break its neck. Some offshore birds, such as gulls, may be attracted by bait to a position in which they may be caught by hand, but others approach closely out of curiosity and this is encouraged if the castaways keep very still and quiet.



A plankton net

Many types of reef fish are poisonous, others venomous. *Poisonous fish* are usually of the coral-eating variety and have large protruding teeth or, like the parrot fish, have developed a beak suitable for grazing coral. Scavengers of reef areas may also be poisonous from feeding on the poisoned flesh of coral-eaters, and for this reason fish which puff up like balloons when caught, and reef predators, especially the older varieties, should be treated as poisonous. *Venomous reef fish* are usually distinguishable by their spiny appearance or by their veil-like appendages which can inflict very injurious stings. While these forms of fish are to be avoided (and if in doubt, don't!), there are many other forms of reef fish which are edible. An infinite variety of good eating fish, ranging from snappers, jacks, grouper, mackerel of various types, down to angel fish and large shoals of 'fry', make the rejection of the poisonous or venomous fish an easy matter to decide



An improvised fish trap

upon in terms of food, if somewhat more difficult in terms of actual disengagement after they have been caught.

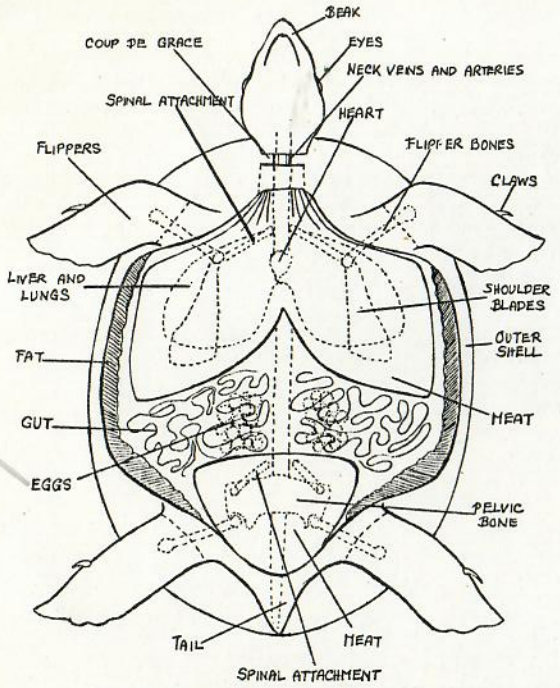
(2) How to Kill Marine Food

Most small fish in temperate zones are harmless and may be killed by a sharp blow with a stick on the back of the head or by putting a thumb in its mouth and bending the head backwards to break its neck. In tropical zones, small fish usually have a spiky projection at the dorsal fin, and sometimes on pectoral fins too, so these, and venomous fish with stings, have to be identified before being brought aboard, especially an inflatable. They should be first stunned and then made safe by cutting out stings or spikes before being brought inboard to be gutted. On inflatable rafts they should be landed on the canopy or in a thick wad of cloth while being rendered safe. Such fish should not be handled until they are safe, but should be held by gaff or spear clear of vulnerable material (including the other castaways!). Hooks should be extracted with the help of artery forceps if the fish is too dangerous to touch and the fish then thrown back.

Larger game fish may be killed by severing the head, holding them still by pressing on the eyes with thumb and middle finger, which induces a temporary paralysis in the fish. Sharks are not to be handled in this way, however, and should by held by the tail while they are killed or paralysed by stabbing it through the eye; the head is then cut off. I am told that a shark's attack may be repulsed by striking at the nerve centre on top of its head. This nerve centre behind the eyes is identified by taking the line between the eyes as the base of an equilateral triangle and striking the third angle where the sensitive area is located.

Turtles, like all animals with a copious blood supply, should be bled to death in order to improve the keeping quality of the meat. This prevents it taking on the unattractive dark colour which may be observed in bruised or badly killed

meat, which goes bad quickly and is more difficult to dry in the sun. When dressing a turtle (see diagram, below), the knife should be inserted in the soft leathery skin at the head end of the belly shell and the edge of the belly shell then followed by sawing movements of the knife until the shell has been cut right around. The head end of the belly shell must then be undercut, for valuable layers of meat adhere to it as well as to the shoulder bones, the joints of which may be reached by cutting out from the centre, with the blade lying flat, close under the belly shell. The shell may then be lifted off, and the meat extracted (in four main pieces if you are experienced, in many smaller pieces if you aren't!) and the eggs harvested



The anatomy of a female turtle (in the stag the tail protrudes beyond the shell)

if it is a female. The heart may be eaten but the offal should be discarded as suspect, especially in older turtles. The meat should then be treated as described on page 43.

Conch are best removed from their shells by breaking the pointed end of the shell where the shellfish anchors itself to the shell. A slower method is to hang the shellfish from a hook, allowing the weight of its shell to extract the fish from its protection; this is not so effective and it is better to learn to break the shell at the spot where it anchors itself.

11 NAVIGATION

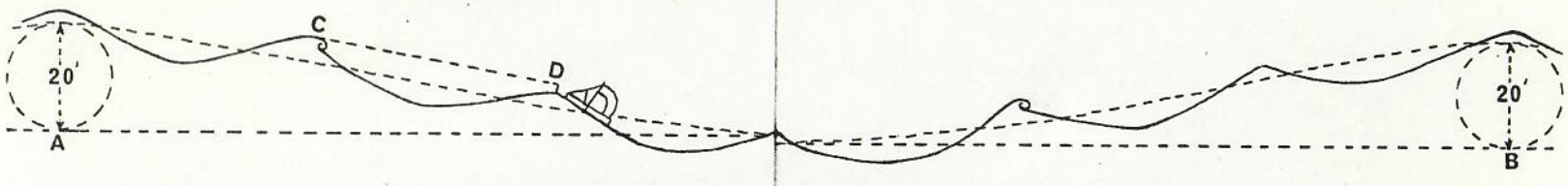
Navigation in survival craft is, of necessity, the sort of rough and ready reckoning adopted by seamen before the present era of scientific calculation. The modern castaway has certain navigational knowledge at his command, however, which will help him, not only to arrive at a more accurate estimate of progress, but also to determine the direction in which he will be most likely to reach safety. The accuracy of his calculations may be of considerable importance in assessing the period of time that stores must be made to last, and his estimates should always take into account the unhappy consequences of raising false hopes in the minds of his fellow castaways. Moral stamina can be seriously undermined by a succession of disappointments over estimated times of arrival, so that it is better to err on the side of caution when you cannot confirm your progress by positive land identification.

Survival craft navigation is largely a matter of estimating the effect of the various forces of wind and current upon the craft during each twenty-four hour period and applying the set and drift to any sailing or rowing progress achieved during the period to find the day's run. A careful study of the ocean charts is necessary and, if possible, each day's run, mean course and estimated position should be noted in a

log book even if no progress is made, so that the navigator should keep in close touch with the craft's position if the chart should be lost or ruined. If a compass is supplied with the emergency kit, amplitudes (bearings of rising and setting bodies) of sun and planets should be carefully recorded so that, if the compass is later lost, the recorded bearings, which only change substantially with alteration of latitude or time of year, can give subsequent guidance. The moon changes declination rapidly and is not suitable for this purpose. The compass should be checked on the Pole Star, or the Southern Cross at its zenith, at intervals to ensure that it is functioning correctly, and care must be taken to see that no metal is near enough to the compass to cause deviation when checking the course run. In order to determine this course more accurately, a small line should be streamed, its direction noted, and the reciprocal used. Magnetic variation should only be applied to a steering course if above half a point in quantity (ie 6°) since, in rough-and-ready reckoning, the finer adjustments of navigational accuracy can be ignored, for in rough-and-ready progress they cannot be implemented.

If no compass is available the course made good should be noted in relation to the direction of the primary swell and any steering carried out accordingly from this directional aid (see diagram, below). Sea swell, caused by winds from remote (as opposed to local) areas, is the one factor which is least likely to change direction without being noticed. The geographical direction of the primary (or dominant) swell should be noted at sunrise or sunset if possible, and also the direction of any cross swell which may become dominant during the period, before the opportunity to take another bearing presents itself. The wind and sea can change direction in an overcast sky without being noticed by the watchkeeper, and even in monsoon or trade wind areas, large local variations in wind direction can take place as atmospheric pressure fluctuates. The primary swell will remain constant in direction throughout these changes.

When a course is being steered, a light line should again



scale:– 0 30ft

Waves

AB: Swell (caused by distant winds)
One every 9 seconds
Height 20 feet
Length 300 feet

CD: Seas (caused by local winds)
One every 3-4 seconds
Height 5-10 feet
Length 50 feet

Swell in this case travels about three times faster than Seas

be streamed to indicate the craft's real direction of travel.

As soon as it is convenient for the navigator to do so, the position of the disaster should be determined as accurately as possible and marked on the survival charts supplied in the pocket. The first chart to be consulted when planning a route should be the chart showing drift and rainfall with ocean currents, for these will determine the only possible direction in which you will be able to travel in your survival craft. Rainwater and ease of travel are the two most vital features of the route, distance and the possibility of casual rescue being of secondary importance. It is worth repeating here that 1000 miles can be covered in 25 days, down current and wind in an inflatable raft with no paddles, while no progress at all would be made in the same craft in calm weather if paddling all the time against an unseen current. This is a hard fact to accept when habitable land lies only a hundred or so miles to windward, or up current, and the deliberate act of turning one's back on this apparent nearby salvation is one of the most difficult acts of practical survival. It is, nevertheless, the only course to take in many circumstances, for proximity to land does not, in itself, prevent death, and only an assessment of a favourable chance of rescue could justify the survivors remaining near the disaster position.

It will be immediately apparent to the castaways if the planned survival voyage will outlast their provisions and if so, they should start hunting for food without delay to establish as much as possible their independence of the emergency supplies, which should be saved for use in times of stress.

Progress need not be marked daily on the maps (which should be carefully protected from damage) but only when distinct progress is made or when it is necessary to demonstrate progress visually to the others. When further routing is necessary the position and course should then be noted on the route map, estimates made as to when shipping lanes

will be approached or crossed, and more careful lookouts kept on the horizon at these periods. If entering an area of high-density shipping, serious consideration should be given to streaming the sea anchor to hold the craft in the area, but this decision will be strictly governed by the available supplies, condition of survivors, and proximity to land. *The sure successful conclusion to the voyage should always be given priority over the random chance of rescue.*

Transit from one ocean current into another may often be noted by the change in seawater temperature. The marginal areas between ocean currents of differing temperatures are often marked by distinctive up-wellings and changes in weather conditions, especially visibility, but even though the temperature change may be quite noticeable to the touch, it does not seem to make any appreciable difference to the quantity of marine life available. I have noticed that the same fish will accompany a survival raft across a temperature rise of 10°C without change of habitual behaviour.

It is not practicable to steer an inflatable survival craft directly across the wind, and this fact should be taken into account early enough in trade-wind areas so that lesser adjustments to cross wind navigation can still be made to angle the craft towards a destined landfall. Destruction of the canopy to create a sail to propel the raft is only justifiable if known habitable land is within reach by means of a jury rig which, it must be remembered, could also destroy the flotation chambers by spar or line chafing if used over longer periods of time.

Speed through the water is more easily estimated if it is related to a patch of stationary fish oil or submerged weed. Speed should not be gauged by any object protruding above the surface which is also subject to leeway. It should be remembered that the average walking pace is about three knots and it is unlikely that a wind-driven inflatable will reach this speed except in very severe weather. Normal speed in Force 5 winds will vary from one to two knots depending on

the amount of drag used to keep the raft stable. It could be that the tripping of the forward stability pockets under the raft in conjunction with a half-tripped sea anchor could increase speed by a half knot while in no way detracting from the stability of the raft. Similar speeds are achieved by boats drifting to sea anchors. Careful timing of each change of wind direction over the 24-hour period is necessary to establish the distance run and mean course made good. Watchkeepers should be instructed to report these changes of wind as they occur.

Errors accumulated over a period of weeks can be quite large and it should be impressed on all survivors that, as time passes, a hundred miles' inaccuracy is a minor discrepancy over the total distance run. For this reason, it is better to err on the side of psychological advantage so that land is sighted before it is generally expected; this means establishing a dead-reckoning position astern of the estimated one.

It is very difficult to check positions with any degree of accuracy by observations of celestial bodies without instruments, especially in temperate zones. Large changes in latitude can however be detected by noting the change in the angular height of stars, low on the horizon at their zenith.

An accurate timepiece can assist the navigator to confirm longitude by the time differences in amplitudes and these signs, although vague, give support and encouragement to the survivors, who should be taught how to look for such signs in their watchkeeping routines to relieve boredom, maintain interest, and keep the final goal in mind.

Signs of bird life may also be used in loose support of the estimated position, but unless any significant phenomenon is observed, such as a seasonal migration flight, increasing bird numbers should not be taken as a sign of proximity to habitable land, especially if there are barren oceanic islands in the area. There are, however, quite distinctive patterns which, taken in conjunction with other signs, assist the navi-

gator to establish his line of progress. The general patterns of ocean bird migration are described in Appendix B on birds and illustrated on the route chart.

12 WATCHKEEPING

Watchkeeping is an important part of the navigational routine, and if possible the same periods of the day or night should be allocated to each watchkeeper so that he is in a position to notice the changing times of amplitudes, or the altitudes of sun and stars in relation to his particular period of watchkeeping. Familiar rising and setting stars are less likely to confuse accustomed eyes into imagining a ship has been sighted, thus avoiding the subsequent upheaval and disappointment that follows such a pronouncement. Watches should be of short duration, especially if there is physical work involved, such as blowing up flotation chambers, bailing, steering, or rowing.

In bad weather, the watchkeeper needs an assistant to help in conning and bailing the raft or boat. If numbers do not permit this doubling up, then the most experienced seaman should be on call all the time and therefore be relieved of the necessity to stand watch.

Note: In rough weather when the survival craft is pitching heavily in a seaway, great care has to be taken when changing watches to ensure that water cans remain upright and that polythene containers are not in a position to be damaged by people falling on them.

In tropical waters the other principal function of the watchkeeper is to ward off the undesirable attentions of sharks or other predators, which may damage the fabric of the raft or the structure of a small boat by heavy bumping. If these bumps are frequent, two watchkeepers should be posted, one at each end of the craft, to strike the offending creature with the best weapon to hand.

Particular care to avoid eyestrain from both direct and reflected sunlight can save castaways much pain from this affliction, for which rest is the only cure. Blindness lasting several days may result from too prolonged an exposure to brilliant sunlight or to snow or ice in an icebound craft; wearing protective glasses or eyeshades in such conditions is a wise precaution.

In survival craft, watchkeepers have the added responsibility of keeping a close surveillance on exhausted companions who may move in their sleep and adopt dangerous postures which could result in their falling overboard, or, in cold weather, of checking the condition of survivors in exposed positions, who may be in danger of becoming hypothermic. Watchkeepers should familiarise themselves with the early symptoms of hypothermia and cold injury for their own protection, as well as that of others, and should not hesitate, if in doubt, to summon help. Delay in reporting a condition of this nature may result in a debilitating cold injury or an inability to keep an efficient lookout; either disablement is contrary to good survival practice however heroic or unselfish the motive. Similarly, in areas where there is a risk of severe sunburn, it is necessary to see that other survivors do not fall asleep in exposed postures, or with limbs trailing in the water where they may be attacked by bold predatory fish.

Constant attention to the condition of sea anchor ropes, knots, fishing tackle, areas of chafe, topping up pressure, bailing and sponging, drying food, and the needs of injured companions, ensure that watchkeepers on survival craft are busy people.

13 GENERAL SURVIVAL NOTES

After a prolonged period at sea in survival conditions it is natural for castaways to wonder how long their bodies will stand up to ill treatment before deterioration resulting from

the many forms of deprivation will impair and finally destroy their health. Such worry is often needless, and the following information is an attempt to set out for castaways the time which needs to elapse before various bodily functions fail.

(1) Dehydration

Survival time, when no fresh water is available, varies with climate, but an estimate of ten days is considered probable in tropical conditions. When seawater is used in an attempt to sustain life, the kidneys are forced to extract extra fluid from the body to excrete the excess of salt, dehydration is accelerated and death occurs in a shorter time than if no water is taken at all.

Seasickness accelerates dehydration and exposes exhausted sufferers to the risk of hypothermia in cold weather. Injured and seasick survivors require extra rations of water to compensate for fluid losses.

Some authorities recommend that a full pint of water should be taken each day to keep survivors able; it is also stated that nothing is gained by taking a smaller ration than one pint daily since castaways who do so will quickly become enfeebled and survival time is thus shortened. However, survivors of varying bodily condition are known to have survived in a coherent and active state, in a tropical area, on as little as one-third of a pint of water per day for seven consecutive days. After a temporary respite from one heavy shower of rain, they resumed rationed supplies at the rate of half a pint per person per day for a further seven days, supplemented by an occasional intake of turtle blood. Small quantities of wet fish and turtle meat were also consumed during this period. Although a considerable amount of body condition was lost, all the survivors remained well, worked hard at watchkeeping routines of lookout duty, blowing by mouth to maintain pressure in flotation chambers, bailing, and practising hygiene.

They then went on to survive a further 23 days with

increased rainwater supplies, but often with less than one pint each per day, and, finally, after rescue they suffered no subsequent ill effects. Considerable quantities of protein in the form of fish and turtle were eaten, but during times of severe water shortage the quantities eaten were small and freshly caught. In times of plentiful rain both dried and fresh protein was eaten. Only in the first seven days were small quantities of the emergency rations (supplied in the survival craft) eaten by all the survivors. The four adults in the group then lived entirely from the sea, reserving the remaining emergency supplies for the two children. After 30 days of living entirely on raw seafood and rainwater, no physical infirmity was experienced apart from an inability to walk without support during the first day of rescue. Complete walking powers were restored 30 days after rescue and no subsequent kidney or physiological ill-effect developed.*

It would seem that there are fairly wide margins within which the castaway may take a calculated risk of disablement from renal failure due to eating raw seafood in preference to death by starvation.

Rough guidelines are that, when water intake is very low, try to restrict your diet to glucose, carbohydrates (biscuits) and fats, or to very small quantities of wet marine flesh (fresh caught, *not* dried and then reconstituted with seawater) accompanied by marine fluids such as turtle blood, spinal fluid from fish, fish eyes, or any bland-tasting (unsalty) fluid. Surplus flesh from fish and turtles should be hung up to dry; turtle fat tissues pulverised to release oil should also be hung up to dry afterwards.

When water intake increases enough to allow hunger to be felt, more wet fish may be eaten but the dried stores of fish should be saved for days when rainfall allows a fairly unrestricted ration of water. When castaways are cold from rain or other causes, increased quantities of fat or small quantities of liver oil help to maintain health and morale.

* See *Survive the Savage Sea*, Elek, 1973.

Rainwater may be absorbed through the bowel as well as by mouth to allow a more speedy recovery from dehydration, especially when a shrunken stomach does not allow much water to be drunk. A makeshift enema tube may be made from any small diameter rubber tube, such as the rubber sheathing on the ropes of the boarding ladder of rafts; this may be further tapered if a sharp knife is available. The finer end of the tube has to be inserted in the anus for about 3 inches then the outer end joined to a fairly long tube (the bellows tube will do). Water should be introduced through a funnel into the tube, held high to allow a gravity flow. Up to a pint of water can be absorbed in this way, but not too much so as to cause discomfort. The castaway so treated should lie face down, one leg bent (in a way similar to the coma position, illustrated on p. 12) and should stay in this position after the water has been introduced into the bowel for a few minutes. Only surplus fresh water which would otherwise be wasted should be used in this manner. If there is any ointment or oil to ease the entry of the tube into the anus, the patient will no doubt be suitably grateful, and 'gently' is the operative word.

When dehydration has been experienced, the volume of blood in circulation decreases, but when water again becomes plentiful, as in areas of frequent rainfall, and the volume of blood expands with rehydration, the castaway will be anaemic from this and other causes, such as imbalance of diet. Provided that varied food is available to help recovery, this condition could be helped by the taking of some form of iron supplement, which should be included in the survival kit. Anaemia causes castaways to feel lethargic and easily tired, an unwelcome addition to their troubles when rowing has to be carried out with possibly a difficult landing afterwards. In these conditions, it is unwise to continue arduous exercise, like rowing, over long periods, especially in hot weather. Frequent short spells at the oars are less harmful than allowing a castaway to become completely exhausted

before resting. Exhaustion can be as demoralising as severe pain, and leaves the castaway uncaring, incapable of action in an emergency and unable to prevent the onset of hypothermia in cold weather. This is bad survival practice.

(2) Vitamin Deficiency

After a prolonged period without vitamins, particularly the 'C' group, various distinctive deficiency diseases develop. *Scurvy* is the disease which springs to mind as the great killer in sailing-ship days. In experiments conducted to encourage the onset of scurvy by deliberate deprivation of vitamins the first signs of the disease developed after 42 days, when small red haemorrhagic pustules appeared; these were followed by pains in the joints and swelling; gums became red and sore with bleeding between the teeth. It was reported from sailing ship experience that an appearance of well-being and clearmindedness developed immediately before the final collapse. Also noteworthy is that members of Scott's Antarctic expedition survived eight months without vitamin C and without developing scurvy. It has been reported that vitamin C exists in plankton, in small fish which live off plankton-eating organisms and in the green weed which grows on surface material which has been afloat for long periods. So it could be worth securing any flotsam on which this weed is growing; however it should only be eaten if surplus fresh water is available to clean off the salt. The weed can, of course, be easily kept until rain showers make this possible, simply by securing the object to which it is attached by line to the raft. Do not detach the weed until vou are ready to use it.

The inclusion of multivitamin tablets in the emergency rations is therefore of some importance and in planned voyages of long duration 10 mg vitamin C per day is considered the necessary level of supply to prevent scurvy. Oranges and lemons contain twice as much vitamin C as limes, and they

usually last longer too. Varying lesser quantities of vitamin C are contained in fresh fruit and vegetables. Young coconuts are a good source of vitamin C and fluid, and are much easier to open with a knife than are the older ones.

(3) Morale

As time passes, the sea and sky become familiar environs to the castaways and it is easy for them to succumb to the feeling that they may never see land again. This feeling is extremely demoralising. Every effort must be made to keep the survival craft's position, progress, and distance run to the forefront of the conscious thoughts of the survivors so that they not only remain conversant with the length of time needed to reach safety but will seek to make a positive contribution to progress. They should be informed of the reasons for regarding any setbacks as temporary, and of how they merely interrupt the sure permanent progress towards safety. For this reason, an adverse day's run should not be concealed for it will only delay the inevitable discouragement when land or shipping is not sighted at the predicted time. It should be remembered that such a setback would come at a time when morale may be lower after a longer period adrift, with a consequent loss of individual determination to carry on by those who are relying on the knowledge of others to help them.

Anxiety is a constant companion of the castaway, and is increased by feelings of fear and loneliness, especially among younger, inexperienced people. This feeling tends to make them imagine their condition to be worse than it is, both physically and in terms of their ability to endure. As time goes by in long ordeals, fears of missing a passing ship, or sailing past an island which may be just over the horizon, result in an increasing number of false reports of ships or land. Each reported sighting must be treated as initially valid until investigation proves or disproves the report, but the raising of false hopes with subsequent disappointment can be bitter

blows to declining morale. It is therefore better for all concerned that an experienced person should be on call in the event of such sightings, especially at night when survivors are resting, before a general disturbance is caused with its consequent upheaval and distress, especially for any castaways suffering from seawater boils.

It is sometimes possible to hear sonic vibrations through the bottom of rafts and boats; these are mostly caused by the progress of large fish or whales, but the possibility that they come from a ship not yet sighted, or a submarine, should not be overlooked, and secondary visual distress signals, or a radio beacon, should be tried. Flares, however, should be saved until a more valid reason for firing them becomes evident.

It is as well also that an experienced person should be continuously available for consultation on such matters as craft maintenance and attack by predators, and for checking that watchkeepers are keeping an efficient lookout—with proper attention being given to sea anchor ropes, the likelihood of and readiness for rain showers, the inflation of flotation chambers—and that the craft is properly bailed out at all times to keep immersion troubles to a minimum. Sometimes instant action is necessary to avoid the loss of valuable equipment, and if a state of readiness is constantly maintained it could well mean the difference between survival and death. (For example, if a predatory shark attacks the sea anchor it can be tripped and brought close where it can be protected before it is damaged or lost.)

In rigid craft under sail, it is vital that experienced personnel should be instantly available in times of stress so that one such person, if not in charge of the steering, should be resting beside the steering position and ready for immediate action. If a castaway falls or throws himself into the sea for whatever reason, speedy action by a rescuer with a lifeline is necessary if he is to be saved before he drifts out of reach, or is attacked by predators. If the reason for the fall was mental derangement, the sufferer should be forcibly restrained in

order to avoid a repetition, not only to save the life of the person involved but to demonstrate to the others that survival must be practised to the limit of endurance for everyone, and that an admission of defeat by a deranged mind should not receive sympathetic tolerance from the others. Those who decide rationally to seek death in preference to a difficult survival will have plenty of opportunity to do so inconspicuously, but the spirit of comradeship will do far more to influence such people to accept life than will the rule of authority.

All survivors should be fully aware of any damage sustained and likely to affect the safety of the craft so that they can be on constant guard against further damage or wear. Morale is seldom helped by an ignorance of the facts, but it is often badly affected by a discovery of unforeseen difficulties, or misrepresentation by those who claim to possess knowledge and are found wanting.

All the castaways should have an interest in the survival routine and be made to feel that they are a necessary part of, and are manifestly contributing to, the corporate survival. This may be simply a social function such as controlling a word game, singing, telling stories (fictional or true, they are usually received with avid interest), or instructing others in their own field of expertise. Especially popular are those who are able to conjure up word pictures of food delicacies or drinks — in fact, descriptions of anything which make easy and desirable listening. Occupational therapy can take the form of teaching the uninitiated to steer, to tie knots, to prepare and tend food for drying, or to catch and kill food where this can be encouraged without the danger of losing valuable equipment through inexpert use. Offers by keen but clumsy volunteers to use equipment which cannot be replaced and which is necessary to survival should be strongly resisted by all the others, and not left to a protest from one authoritative source.

The whole function of survival, which involves living from

the sea and creating a positive way of life upon the sea in isolation from the rest of humanity, does not include a dependence on rescue as one of the primary objectives. Rescue will come as a welcome interruption of the projected successful outcome of the survival voyage, rather than as an end in itself. While there is a strong advocacy for survival craft to be made wholly dependent on rescue, this happy conclusion for the survivors cannot always be arranged by the rescuers. In bad weather search and rescue operations fail even when full electronic co-operation is functioning, and are often abandoned when one or both communication systems cease to function effectively, as happens sometimes in times of peace and surely does so in times of international hostility. It is therefore a wise precaution, even in larger vessels, to equip a survival craft for both eventualities and thus ensure some independence of action in the event of a radio communications failure.

The most enduring factor in the personality of a castaway must be the spirit of self-denial, for if circumstances deteriorate and human beings are pushed beyond the limits of physical tolerance only their basic philosophical reserve will prevent reversion to selfish or mutually destructive practices. The basis for this philosophical reserve may lie in religious belief, or in sympathy for one's fellow sufferers, or a simple acknowledgement that this is the best way to overcome physical distress, but however the attitude is achieved, the factors which allow it to be practised must be given full scope of expression. Any authoritative instruction or direction must be confined to the realm of practical behaviour and attempts at mental domination by any one person should be resisted strongly by all the others, if only because the loss or breakdown of that one personality should not result in the abrogation of the laws of survival.

It will be difficult in this respect for those in hitherto accepted authority to avoid having this authority reinvested in them by the other survivors as a matter of course, but it is the hall-

mark of good survival practice that those with the required experience in any particular field of knowledge should be recognised as the authority in that field, and that pre-selected leaders, or hearsay assumptions, must be regarded with sympathetic mistrust until they are proved in practice.

It has also been significantly and increasingly established that, in human experience, there are unscrupulous people who find that, by dominating others in whatever field of human relations (by simple force of personal impact, by physical superiority, by devious educational and often deliberately false intellectual claims), they acquire the support that is necessary to keep their ego and their moral credit-worthiness at the required degree of inflation. In normal society, such people are often accepted and respected as leaders, and their errors of judgment, personal shortcomings and deceptions, concealed and even tolerated by their fellows, especially when personal gain or status is involved. In survival conditions, such people are dangerous and must be instantly exposed by those with the knowledge to do so, for simple errors of judgment, dogmatic adherence to wrong teaching or instructions, deference to protocol and other such common acts of civilised behaviour suddenly become life-or-death characteristics under conditions where a second chance is neither expected nor given. Thus the initial decisions regarding policy, direction, survival techniques, and behaviour must not be taken lightly, must not be accepted without question and must not be followed slavishly, especially if they are products of an unsound mind and will ultimately result in self-destruction. Such, for instance, would be the cause and effect of adopting cannibalism as a means of survival; of an uninformed instruction to exercise in cold water in order to keep warm; of a dogmatic adherence to written instructions even in the face of death; of a suggestion that seawater may be used for drinking, or that life itself should be the prerogative of selected individuals.

In situations where the forces of nature combine to impose

the threat of death, whether by dehydration, starvation, exhaustion or whatever cause, it will lie with the castaways themselves to decide upon the most satisfactory solution to the problem. If, for instance, water reserves have dropped to a very low level and no relief is in sight, consideration should be given to allowing the most suitable person an extra ration of water at the expense of the others so that the person so elected would remain coherent over a longer period, and so capable of action to prevent the self-destruction of the others in their subsequent delirium, or to collect rain should it come, or to fire distress rockets in the event of a vessel being sighted. While this would entail willing self-sacrifice by the majority, the self-interest of all would be the motivating force.

Similarly, when survival depends on the strength of oarsmen, then due consideration must be given, in terms of water and energy-giving food, to those who have to work so that they may serve the interests of all. Never should a suggestion of cannibalism, to alleviate starvation, be considered in a similar light, for this practice is ultimately self-destructive.

Only by a commonsense application of civilised behaviour is it possible to ensure the longest period of savage survival.

14 WEATHER FORECASTING

Although castaways have little opportunity to avoid a weather pattern, even if they know it is going to be bad, it often helps if they are able to forecast the approach of rain, or more important, recognise that certain cloud formations are unlikely to yield any rain at all and thus not be tempted to indulge in an extra ration of water at the false prospect of rain. It could also be fatal to delay an attempted landing in the face of a deteriorating weather sequence, especially if beaching is inevitable.

(1) Cloud patterns

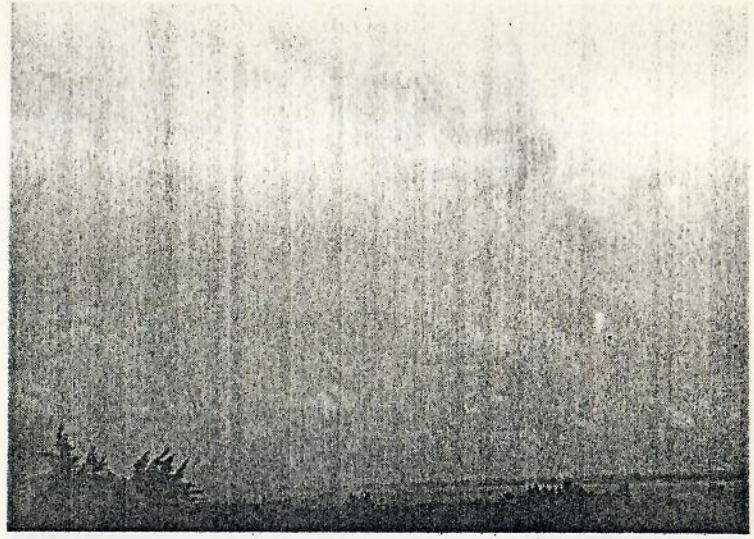
Weather forecasting in survival conditions is largely a matter of reading cloud signs, relating them to changes of wind force and direction, and associating both with an increase or an alteration in the swell pattern (see plates, pp. 74–78).

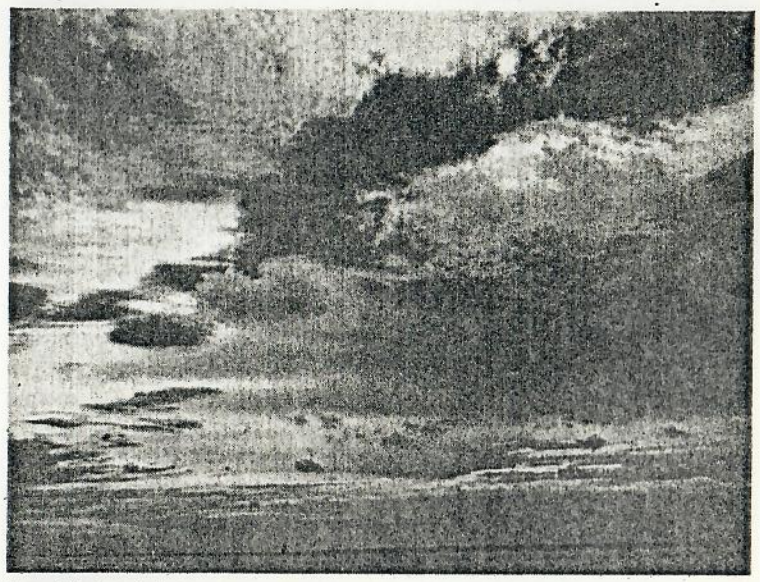
In *temperate zones and higher latitudes,* distinctive cloud patterns herald the onset of depressions or areas of low pressure, and a typical sequence is as follows. Cirrus clouds, high, white and wispy, are followed by cirrostratus, a continuous layer of ice crystals distinguished from lower layers of cloud by the formation of a halo around sun or moon. Clouds become lower as the depression centre approaches, thickening to altostratus, a continuous, even layer of cloud which almost obscures sun or moon. As altostratus cloud thickens to obscure the sun or moon completely, rain can be expected in small amounts, evenly distributed, but not in sufficient quantities to wash the accumulated salt from the catchment area of a raft canopy or sail.

Similarly, if the survival craft is outside the central rain area of the depression, rain may not fall in sufficient quantities to collect above a pint or two, making the distribution of extra rations at this stage a move to be avoided.

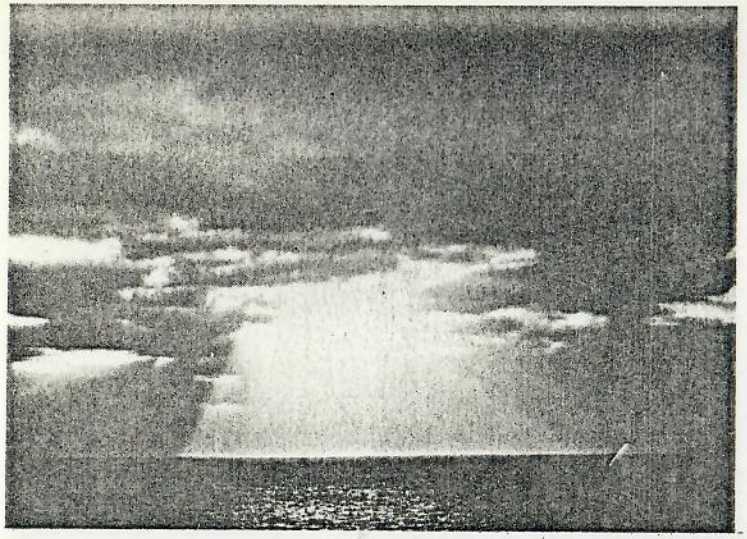
If the survival craft is closer to the centre of the depression, rain will increase significantly to a continuous downpour and extra water should be immediately issued so that the maximum container space is available for refilling with freshly caught supplies. The cloud will now be low overcast with wind-driven scud, but after the passage of the warm front, the wind will change direction quite suddenly, sometimes by as much as 90°, and the weather will become warm and drizzly with a heavy overcast. Then as the cold front passes the wind will alter again quite quickly, the clouds will break and after a while, high cauliflower-like cumulus will give the chance of heavy showers which may yield more rain volume in a few minutes than has fallen in the previous hours of drizzle or light rain. Weather will then become noticeably

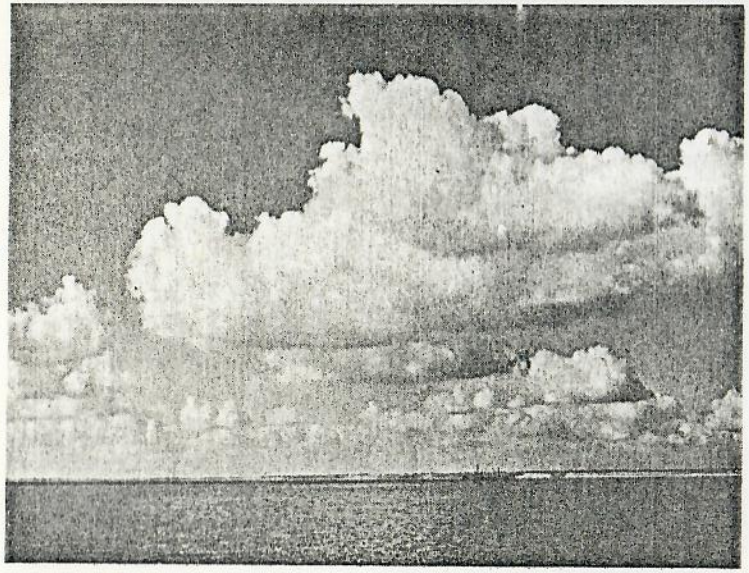
Top: Cirrus *Bottom:* Cirrostratus



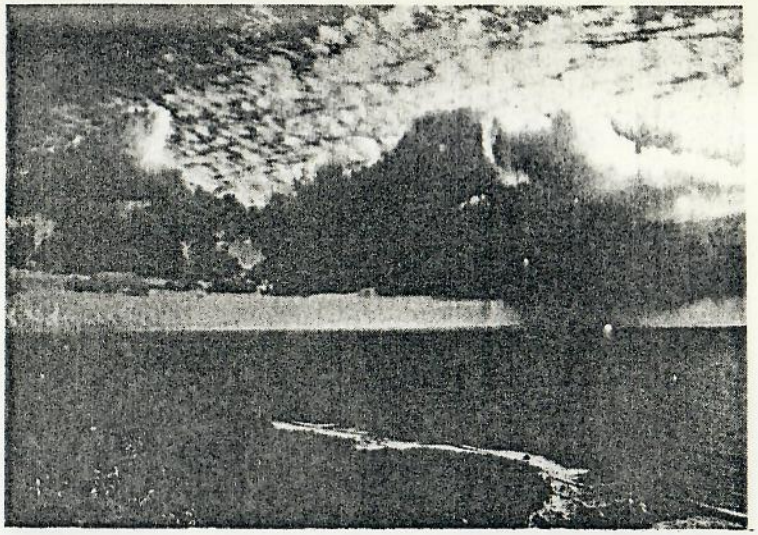


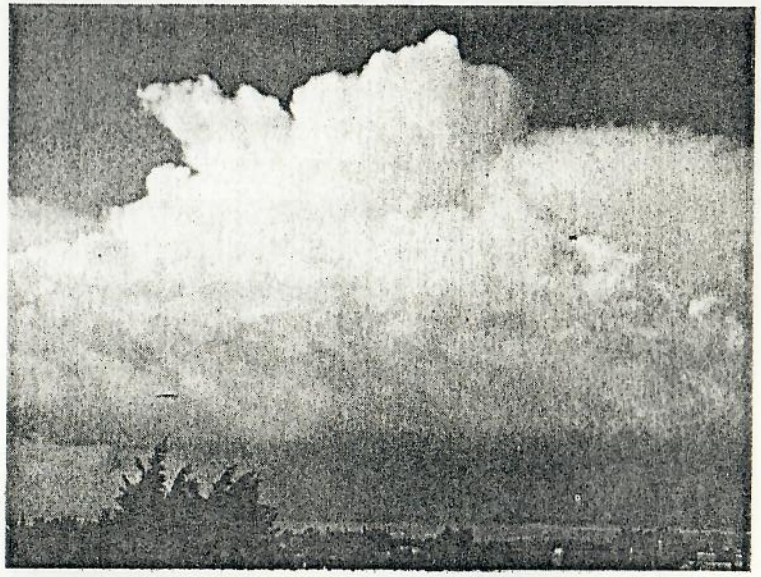
Top: Nimbostratus
Bottom: Increasing cloud at several levels





Top: Stratocumulus
Bottom: Fair-weather cumulus





Top: Large cumulus with a shower beneath it
Bottom: Cumulonimbus