Middle Articles

Isafjordur Trawler Disaster: Medical Aspects*

L. G. C. PUGH,† M.A., B.M., B.CH.

Brit. med. J., 1968, 1, 826-829

Shortly before midnight on 4 February 1968 the 659-ton trawler *Ross Cleveland* capsized in hurricane-force winds off Isafjordur, in North-west Iceland (Fig. 1). The wind direction was NNE, velocity 70 knots gusting to over 100 knots (see Table). Air temperature was -7 to -8° C. and water temperature $+2^{\circ}$ C. The storm was one of the worst in living memory. Only one of the crew of 19 men survived. Another trawler, the *Notts County*, ran aground near by at about the same time. The crew were rescued next day, demoralized and suffering from exposure. One man was lost, and both the captain and the mate sustained injuries. A small Icelandic trawler with six men on board was also lost in the area; there were no survivors.

Weather Forecast and Weather Report from Iceland

Weather Forecasts Obtained from Icelandic Meteorological Office at Reykjavik

Saturday 3 February

11.30 a.m. North-west Banks: Strong easterly winds today, north-east gale during the night. Snow.
4.30 p.m. North-west Banks: Increasing north-east winds with snow. Fresh gale by morning.
11.30 p.m. North-west Banks: North-easterly gale force winds and snow.

Sunday 4 February

4.30 a.m. North-west Banks: North-easterly storm with snow.
11.30 a.m. North-west Banks: Violent north-easterly storm—hurricane force. Winds 70 knots steady.
The Meteorological Office states that temperature was from -7 to -10° C. during this period. Winds were up to 100 knots in gusts.

Weather Report Obtained from the Meteorological Office, Ministry of Defence, London, on Tuesday, 5 February 1968
From Galtarviti Lighthouse near Isafjordur.

1968	Day	Time	Wind	Temperature (°C.)
3 February	Saturday	Morning	Calm	—
4 "	Sunday	12.00 hr.	60 Kts. N.E.	-11
5 "	Monday	00.00 hr.	50 Kts. E.N.E.	-8
		12.00 hr.	30 Kts. E.N.E.	-7

Circumstances

The storm began on the evening of Saturday, 3 February. About 30 trawlers took shelter in Isafjordur Deep and adjacent fjords. Three put into Isafjordur harbour.

It is common practice for trawlers fishing off North-west Iceland to put into Isafjordur Deep in north-easterly gales, as they cannot otherwise control the formation of ice on their superstructure when steaming into the wind. North-easterly gales are accompanied by temperatures down to -12° C. Southerly and westerly gales bring temperatures near freezing-point and there is no danger of ice formation. Snow greatly accelerates the formation of ice. In Isafjordur Deep trawlers may anchor off Graenahlid (Ritr) if the gale is not too strong. In extreme weather they steam to and fro. The usual method is to steam towards the land, heading into the wind, then to drop back under reduced power, and so on. The crew clear ice with axes from the ship's deck and superstructure under shelter of the land. Steam hoses are also used.

The storm continued all Sunday, and increased in violence on Sunday night.

The *Notts County*, which was badly iced up, ran aground opposite Isafjordur at about 23.40 hours owing to difficulty

with her radar. The Icelandic fishery protection vessel *Odin* was having similar trouble and headed off up Jokulfirdur to clear their radar scanner. When she returned the *Notts County* was aground, and she ordered the crew to remain aboard pending rescue next day. According to one of her officers, the wind was much stronger and more turbulent in this area than off Graenahlid. Just before midnight several ships reported that the *Ross Cleveland's* lights had disappeared and she had gone off their radar screens. The exact position was $66^{\circ}08.5' N. 23^{\circ}03' W.$ A., who was the only survivor, takes up the tale.

The *Ross Cleveland* had finished fishing and was about to return to England. She was making for the land opposite Isafjordur in order to find shelter to enable the crew to put the net into the hold. It never entered his head that the ship was in danger. He was one of three men on watch, and had twice been out to clear the radar scanner. Before going on watch he had cleared the three 12-man inflatable rafts. He had just got back to the bridge after clearing the radar scanner when the ship broached to and "lay down." They could not get her into wind again, and several seas came aboard. Within seconds (perhaps 7 to 30 seconds) she rolled over and sank. A., B., and C. managed to release a raft and get it inflated. The next thing he remembered was being in the raft with B. and C. A was warmly dressed and was wearing a "duck-suit," which is a two-piece plastic-covered fabric suit, and thigh boots. B. was also fully dressed but did not have on waterproof outer garments. C. was in his underclothes. They were all wet through. The canopy of the raft was correctly erected, but a wave came in through one of the entrances and swamped the raft, washing out the bailer and other survival gear.

The men sat on the sides of the raft and bailed out the water with B's sea-boots. One entrance was torn, the other incompletely closed. C. was shivering violently and soon began to fail. A. rubbed and smacked his limbs to try to keep him warm, while B. went on bailing. At last there was only a little water left, perhaps 4 in. (10 cm.), slopping about. C. gradually lost consciousness and slipped down on to the floor of the raft. They laid him on the thwart, but he soon died. Death occurred within one to one and a half hours of boarding the raft. B. soon began to fail too. His speech was slurred and incoherent, and he gradually lost consciousness. He died one to two hours after C.

Some hours later A. felt the raft go aground. He got out and pulled it ashore. He does not remember shivering or feeling particularly cold. The raft had gone ashore in a small fjord called Seydisfjordur; it was getting light and he could see the lights of a farm on the opposite side of the fjord. The time must therefore have been between 07.00 and 08.00 hours. The raft had taken seven to eight hours to drift 17 km.

* Report prepared for the Medical Research Council.

† Laboratory for Field Physiology, National Institute for Medical Research, London N.W.3.

The delay is difficult to explain, as one would expect it to cover up to 10 km. in an hour in such a wind. It may have been due to the turbulence of the wind and the tide.

A. sat a while, and then set out for the head of the fjord towards the farm. Visibility was bad and it was snowing. He struggled all day along the boulder-strewn snow-covered foreshore. By evening he came to a holiday house. The house was shut, but as he was getting weaker and darkness was approaching he decided to stay there for the night. The time must have been about 17.00 hours. He had covered only 6 km. in about nine hours. He stood all night on the lee side of the hut, and did not sit down for fear of falling asleep. He remembered vigorous intermittent shivering. In the morning he managed to attract the attention of a boy driving sheep. The boy helped him to the farm about one hour away. A.'s legs were numb below the knees, and he said he could not have made it alone. At the farm he was given refreshment and dry clothing and put to bed. He slept soundly for four hours. A small search boat, the *Svanur*, arrived in the afternoon and took him back to Isafjordur, collecting the raft on the way. On admission to hospital he was seen by Dr. U. Gunnasson, who found him in good condition, except for his feet, which were swollen but not painful. In spite of the fact that he had not worn gloves his hands were uninjured.

On Monday morning, 5 February, the *Svanur* had found the body of D. in a small fjord next to the one in which A. landed. He was wearing a cork life-jacket but no waterproof outer garments. The *Svanur* had entered Seydisfjordur, but missed the raft on account of poor visibility.

At 13.30 hours on the same day the *Odin* took off the crew of the *Notts County*. An officer I interviewed on board the *Odin* said he had been shocked at the light clothing they were wearing. He also said they were suffering from varying degrees of exposure (probably mild, as they were not admitted to hospital). The officer went on to say that the ship was unheated, as the crew had let all the fires go out. On arrival at Isafjordur one and a half hours later the captain, whose hands were severely frost-bitten, and the mate, who had injured his foot, were admitted to hospital. They discharged themselves two days later against advice and I did not see them.

FIG. 1.—Chart of Isafjordur Deep and surroundings. Icelandic Hydrographic Service Reykjavik 1950 No. 41. Distance in nautical miles (1 nautical mile=1.8 kilometres). Pointers marked "raft aground" and "Notts County aground" are approximate.

One member of the crew of the *Notts County*, E., died of hypothermia on the night the ship went aground.

The story was said to be as follows: When the ship went aground this man and others launched a raft; he panicked and jumped into it. Some say he overturned it. Meanwhile the captain, having received instructions to stay aboard, ordered the raft to be got on board again. After a long struggle, during which the captain sustained severe injury to his hands from frost-bite, the raft was washed aboard by a wave. E. still refused to come out. Members of the crew said he had gone mad and was moving about and making animal noises. They were afraid to go in and get him out, and left him to quieten down. Later they pulled him out and got him on to the bridge. By this time he seemed to be dead, and they did not attempt to revive him.

The body of F. aboard the *Ross Cleveland* was found later. He was not wearing a life-jacket or waterproof clothing.

I visited the hospital at Isafjordur on Saturday, 10 February and saw A. of the *Ross Cleveland* and two other trawlermen, one of whom had jaundice, the other cold injury to his hands sustained while clearing ice during the storm.

A. was a man of muscular physique, height 5 ft. 6 in. (168 cm.), weight 12 st. 9 lb. (80.3 kg.). Skinfold thickness over the trunk was about 1.5 cm. He had sustained only a comparatively mild cold injury to his feet, which were flushed and swollen; but there was no sensory loss or impairment of movement, and he had never complained of any pain. His hands had escaped injury altogether.

On inspection of the five corpses, four showed brick-red discoloration of the face. The body of E. from the *Notts County*, which had been taken in out of the cold, did not show this change.

The bodies were sent to Reykjavik, where necropsies were performed by Professor O. Bjarnason and his colleagues of the pathology department at the University Hospital. The findings will be available in due course. Notable points were the following:

(1) B., of the *Ross Cleveland*, aged 30, had mitral stenosis. The mitral orifice admitted one finger. Hypertrophy of the left atrium and both ventricles and pulmonary arteriosclerosis were found. The body was muscular; fat thickness over the abdomen was 1.2 cm.

(2) E., of the *Notts County* (aged 19), had gross deformity of the left thigh and widespread scarring from an old injury. One wonders whether the previous accident contributed to his state of panic when the *Notts County* went aground.

(3) D., of the *Ross Cleveland*, who was washed ashore wearing a life-jacket, had died of drowning, as had F. from the *Ross Cleveland*.

Clothing

A.'s clothing (excepting the outer garments) had been put in a bag and sent with him to hospital. It consisted of the following items: woollen vest, cotton shirt, heavy woollen sweater, thick closely woven cotton trousers (seamen's "moleskins"), long woollen drawers, thigh-length woollen stockings. His outer garments consisted of a smock and trousers of plastic-covered fabric, known as a "duck-suit." He was also wearing thigh-length rubber boots.

The bodies of his two companions in the raft were still dressed in the clothing in which they had been found. (1) C. had on a light-weight woollen vest, two pairs of short cotton drawers, one pair of long woollen drawers. Possibly he had been dressing hurriedly when the disaster happened. (2) B. had been about to go on watch, and was wearing a thick woollen sweater, a long-sleeved woollen vest, flannel-lined shirt, long woollen drawers, and "moleskins."

A. told me he had several sets of outer garments and several changes of undergarments, so that he always had dry clothes to wear. Lads coming on to trawlers nowadays wear

short cotton drawers, nylon socks, jeans, string vest, shirt, and jersey. They do not have a change of clothes. With increasing experience they dress more sensibly. They get a £25 tax-free allowance to buy clothing.

Mr. Cuthbertson, who had been sent to identify the bodies, and who had been in trawlers until three years ago, told me that only deck personnel had waterproof outer garments. Seven out of the crew of 19 in an average trawler would not have waterproofs.

Life-jackets

A. was wearing an inflatable life-jacket when he boarded the raft. D., whose body was recovered on Monday, 5 February, was wearing an old-fashioned cork life-jacket. None of the other three bodies had life-jackets on.

Other Information

According to Mr. Soegar and his son, who are the agents for British Trawlers in Iceland, men suffering from frost-bitten hands have been sent back to England for the first time for many years. There have been three or four cases this season.

There have been allegations of abuse of alcohol in some trawlers, and I was told that this had hindered rescue operations in the past. It should be pointed out, however, that the symptoms of hypothermia—namely, slurred speech, mental change, and staggering gait—are similar to those of alcoholic intoxication.

The British Consul in Reykjavik, Mr. B. Holt, informed me that he had returned 245 trawlermen to England on account of sickness or injury between 1 January and 31 December 1967.

From 2 to 31 January 1968 the following cases had been evacuated:

Trauma	Upper extremity	...	...	...	...	10
	Lower extremity	...	...	...	...	4
	Chest	...	...	...	...	1
Frost-bitten fingers	...	...	...	...	...	1
Stomach trouble	...	...	...	...	...	1
Blackout	...	...	...	...	...	1
Heart trouble	...	...	...	...	...	1
						19

Last year there were two deaths at sea—one from cardiac infarction, the other from lung abscess and bronchopneumonia.

Discussion

The sudden and completely unexpected capsizing of the *Ross Cleveland* explains why so few men escaped from the ship. Had danger been anticipated the normal emergency drill would have been put into operation and many more men might have been saved. Whether trawlers should carry some device to warn the bridge when the wind reaches a dangerous velocity is a matter for the Board of Inquiry. At present trawlers do not carry anemometers, and most trawlermen I consulted did not consider them necessary.

Under Schedule 9 of the L.S.A. Rules S.I. 1105 of 1965 British trawlers carry self-inflating rafts with self-erecting canopies. The *Ross Cleveland* had three 12-man self-inflating rafts. Each raft could, if necessary, have accommodated the entire crew. In both ships a raft was successfully released and inflated. Only three men managed to board the raft from the *Ross Cleveland*. They were unable to close the entrances properly; the wind in the tent would therefore have been considerable and the temperature similar to that of the outside air. These factors, as well as wetting, account for the rapid deaths of the two men not wearing waterproof outer garments. In experiments conducted for the Royal Navy by the R.N. Personnel Research Committee of the M.R.C. in 1950–1 it was found that in a properly closed raft full of people the air

temperature rose to 10 to 15° C. when the outside temperature was –0.5 to –9° C. (Glaser and McCance, 1950; Glaser and Hervey, 1951).

Breckenbridge and Woodcock (1949) measured the effect of wind on thermal insulation value of military cold-weather uniforms, and found a 30 to 40% reduction at a wind velocity of 25 m.p.h. Pugh (1966a) reported a similar loss of insulation at 9 m.p.h. wind velocity in clothing worn by hikers, which included an anorak. Much greater loss of insulation can be expected without a windproof outer garment. The loss of insulation associated with wetting has been found to be about 50% (Hall and Polte, 1955; Hall *et al.*, 1958; Pugh, 1966a). In the investigation carried out by Pugh (1966a) the combination of wind (9 m.p.h.), wetting, and exercise was studied. It was found that the insulation value of the outfit examined fell to only 10% of its nominal value.

In contrast with the above, the heavy waterproof suit and thigh-boots worn by A. might be expected to give good protection, since heat loss by convection and evaporation from the surface of the woollen clothing would be virtually eliminated, and loss of insulation due to wetting might be compensated by pockets of air trapped under loose-fitting parts of the outer garments. Fig. 2 suggests an insulation value of 2.7 clo,¹ assuming a mean O₂ intake of 0.5 l./min., air temperature of –7° C., and rectal temperature of 37° C. Somewhat similar clothing examined by me during the H.M.S. *Vengeance* trials in Arctic waters carried out in February 1949 had insulation values of around 3 clo in the absence of wetting (Pugh, 1949).

It is conceivable and indeed likely that if the raft had been full of people, and the entrances properly closed, B., at least, might have survived, for Glaser found that under such conditions the air temperatures in a raft may rise 20° C. or more (Glaser and McCance, 1950; Glaser and Hervey, 1951). However, this accident has demonstrated that, unless these conditions are met, waterproof outer garments are indispensable to survival in a raft in strong winds with subfreezing air temperatures. Waterproof outer garments might indeed be considered more important than a life-jacket, for without them a man may die quickly, whether he is in a raft, or in the sea supported by a life-jacket.

The fact that many trawlermen go to sea without waterproof outer garments demands some positive action. Rather than compelling the men to buy suitable outer garments, or providing a free issue which would not be looked after, it might be wiser to attach a small pack containing emergency garments to the life-jackets or store such packs in the rafts. Suitable garments have already been developed for the Royal Navy. The joint working party of the Naval Life-saving Committee, the M.R.C. Survival at Sea Subcommittee, and the Royal Naval Personnel Research Committee suggested attaching them to life-jackets in their report of 1961 (Survival Trials, 1961).

To proceed further with the physiological aspects of A.'s survival, his condition was evidently good when he landed, since he pulled a heavy raft ashore with two men in it, which he could not have done had there been significant muscle-cooling or hypothermia (Pugh, 1967). There is also his own statement that he was not shivering.

A.'s decision to leave the raft is contrary to the advice usually given in survival training, but it turned out to be a wise decision, since the rescue boat failed to see the raft, and the flares were missing.

His slow progress along the shore is typical of exposure accidents. In the hills and mountains of Britain such accidents commonly happen on trips that would be considered easy in good conditions (Pugh, 1966b).

It would seem that his condition was still good when he reached the summer-house, because his judgement was sound and his shivering response intact. Had he been seriously

¹ Assuming tissue insulation (I_t) of 0.7 clo and air insulation 0.3 clo.

FIG. 2.—Chart for calculating the steady state value of rectal temperature (T_R) for given conditions of air temperature (T_A) and metabolism (M), and the combined thermal insulation (ΣI) of air (I_A), clothing (I_{cl}), and body tissues (I_T) (Pugh, 1966a). $\Sigma I = I_A + I_{cl} + I_T = \frac{T_R - T_A}{0.9M}$, where M is metabolic heat production and 0.9 is a correction for heat loss via the respiratory tract. Values of ΣI are stated clo units, with c.g.s. units Kcal./sq.m./hr. in parentheses. The ordinate is difference between rectal and ambient air temperature. The abscissa is metabolism in Kcal./sq.m./hr. The scale below the abscissa is the oxygen intake for an average person weighing 75 kg. In some forms of exercise a correction is required for energy dissipated as external mechanical work. I_A varies from 1.0 clo for still air to 0.1 clo for strong winds. For an average person at rest and shivering mildly I_T is about 0.7 clo and oxygen intake about 0.5 litre/minute.

exhausted or hypothermic he would very likely have pushed on, believing it to be dangerous to rest. Mental impairment leading to foolish errors of judgement is one of the common manifestations of exhaustion either with or without hypothermia (Pugh, 1967, 1968). So far as rectal temperature is concerned, 34.5°C. seems to be the low limit for continued exercise, while below 34°C. shivering diminishes progressively (Pugh, 1967).

His decision to remain standing for fear of going to sleep is contrary to accepted practice. By sitting in a fully flexed posture a man can reduce by 30 to 40% the surface area from which heat is lost. There is no danger in going to sleep if one is not exhausted, since one is woken up by each bout of shivering. He might also have avoided cold injury to his feet had he withdrawn his feet into the legs of his thigh-boots (Pugh, 1949).

Physically, both he and his companions were of muscular build with moderately well developed subcutaneous fat. It has been shown that such persons are more tolerant of immersion in cold water than men of slender physique who have little subcutaneous fat (Pugh and Edholm, 1955; Carlson *et al.*, 1958; Keatinge, 1960; Pugh *et al.*, 1960; Daniels and Baker, 1961), but it is by no means certain that this principle holds good for exposure in air (Pugh, 1963).

D., whose body was recovered on the Monday and who died of drowning and not hypothermia, was wearing an old-fashioned Board of Trade life-jacket. The jackets are being replaced on a five-year basis by a new model which prevents the wearer lying face-down in the water and so drowning (Merchant Shipping Rules, 1965 (S.I. 1965, No. 1105)).

Emergency radios I saw in Iceland trawlers were of old-fashioned design, and were carried on the bridge. I did not see British equipment. It seems obvious that emergency radios should be carried in the rafts. Inexpensive equipment suitable for this purpose is readily available. Another piece of equipment which requires attention is the bailer. In A.'s case the bailer was apparently washed overboard. Failure to empty the raft quickly and keep it dry may well have contributed to the rapid deaths of B. and C. (see also Survival Trials, 1961).

Full details of the happenings in the *Notts County* are not

yet known. One wonders whether the crew were fully aware of the danger of hypothermia and the fact that even those apparently dead can often be revived.

Summary and Recommendations

The trawler *Ross Cleveland* turned over and sank within seconds in a hurricane in Isafjordur Deep on the night of 4–5 February 1968. Air temperature was -7° to -8°C. , water temperature was $+2^\circ\text{C.}$, and wind velocity 60 knots gusting to over 100 knots. The only survivor of the crew of 19 was A. He escaped with two others in a 12-man self-inflating raft. Another ship, the *Notts County*, ran aground. One man was lost and the captain and mate were injured.

Five bodies were recovered, and necropsies were performed in Reykjavik. Three died of hypothermia and two of drowning. One man had advanced rheumatic heart disease. One of the men who died of drowning was wearing an old-fashioned Board of Trade life-jacket.

A., of the *Ross Cleveland*, survived because he was fully dressed and wearing waterproof outer garments and thigh-boots. His companions, who had no waterproofs, died within three hours. The men were unable to close the raft properly, and had difficulty in bailing water out owing to loss of the bailer.

Experiments conducted in 1950–1 by R.N.P.R.C. at similar temperatures, though with less wind, demonstrated that survival is easy even without waterproof outer garments if there are enough men on board the raft to warm the interior, and if the entrances can be properly closed and the floor kept dry.

It is recommended that emergency packs containing waterproof suits should be fitted to life-jackets or placed in rafts. Improved provision for bailing and drying, and the inclusion of emergency radio in the raft's equipment instead of on the bridge, are recommended.

Trawler crews require instruction in the prevention and treatment of hypothermia. Practice with rafts as well as theoretical training in their use is recommended. All crew members should have warm clothing, even if it is not required below decks.

Trawlers are entirely dependent for medical care on the good will of the Icelandic medical authorities.

ADDENDUM.—It was reported in *The Times* of 9 March that four survivors from a Danish coaster were picked up off the north of Scotland after drifting 28 hours in a life-raft. According to other information they were wearing only their underclothes. On checking with the Meteorological Office it was found that the air temperatures in the area at the time had been $+6^\circ$ to $+7^\circ\text{C.}$ and the sea temperature $+8^\circ$ to $+9^\circ\text{C.}$, and the wind velocity was 15–20 knots.

REFERENCES

- Breckenridge, J. R., and Woodcock, A. H. (1949). Environmental Protection Section Report No. 155.
- Carlson, L. D., Hsieh, A. C. L., Fullington, F., and Elsner, R. W. (1958). *J. aviat. Med.*, **29**, 145.
- Daniels, F., and Baker, P. T. (1961). *J. appl. Physiol.*, **16**, 421.
- Glaser, E. M., and Hervey, G. R. (1951). R.N.P.R.C. 51/650, SS 38.
- Glaser, E. M., and McCance, R. A. (1950). R.N.P.R.C. 50/591, SS 32.
- Hall, J. R., jun., Kearney, A. P., Polte, J. W., and Quillette, S. (1958). *J. appl. Physiol.*, **13**, 121.
- Hall, J. R., jun., and Polte, J. W. (1956). *J. appl. Physiol.*, **8**, 539.
- Keatinge, W. R. (1960). *J. Physiol. (Lond.)*, **153**, 166.
- Pugh, L. G. C. E. (1949). R.N.P.R.C. Report 49/561, C.E.S. 306.
- Pugh, L. G. C. E. (1963). *J. appl. Physiol.*, **18**, 1234.
- Pugh, L. G. C. E. (1966a). *Nature (Lond.)*, **209**, 1281.
- Pugh, L. G. C. E. (1966b). *Brit. med. J.*, **1**, 123.
- Pugh, L. G. C. E. (1967). *Brit. med. J.*, **2**, 333.
- Pugh, L. G. C. E. (1968). To be published.
- Pugh, L. G. C. E., and Edholm, O. G. (1955). *Lancet*, **2**, 761.
- Pugh, L. G. C. E., *et al.* (1960). *Clin. Sci.*, **19**, 257.
- Survival Trials (1961). Joint Working Party, Naval Life-Saving Committee and the Survival-at-Sea Subcommittee of the Royal Naval Personnel Research Committee.