Of Penguins, Pinnipeds, and Poisons

Anesthesia on Elephant Island

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ABSTRACT

Although Ernest Shackleton’s Endurance Antarctic expedition of 1914 to 1916 is a famous epic of survival, the medical achievements of the two expedition doctors have received little formal examination. Marooned on Elephant Island after the expedition ship sank, Drs. Macklin and McIlroy administered a chloroform anesthetic to crew member Perce Blackborow to amputate his frostbitten toes. As the saturated vapor pressure of chloroform at 0°C is 71.5 mmHg and the minimum alveolar concentration is 0.5% of sea-level atmospheric pressure (3.8 mmHg), it would have been feasible to induce anesthesia at a low temperature. However, given the potentially lethal hazards of a light chloroform anesthetic, an adequate and constant depth of anesthesia was essential. The pharmacokinetics of the volatile anesthetic, administered via the open-drop technique in the frigid environment, would have been unfamiliar to the occasional anesthetist. To facilitate vaporization of the chloroform, the team burned penguin skins and seal blubber under overturned lifeboats to increase the ambient temperature from −0.5° to 26.6°C. Chloroform degrades with heat to chlorine and phosgene, but buildup of these poisonous gases did not occur due to venting of the confined space by the stove chimney. The anesthetic went well, and the patient—and all the ship’s crew—survived to return home. (Anesthesiology 2016; 125:25-33)

“NEVER perhaps was anaesthetic administered under more extraordinary circumstances,” wrote Frank Hurley, the expedition photographer of Ernest Shackleton’s storied Antarctic expedition. Shackleton’s Imperial Trans-Antarctic Expedition (1914 to 1916) failed to complete the first crossing of the Antarctic continent. However, the extraordinary feats of leadership, endurance, and survival of this bygone expedition continue to capture imaginations for the century since then.

While the expedition doctors made tremendous contributions to the survival of many of their party’s members, their medical innovations and professional accomplishments have received relatively little formal examination or general recognition. Marooned on a gale-lashed, ice-bound island, with no communication with the outside world, Shackleton’s two doctors had to improvise the medical care required to manage the consequences of exposure to the extreme polar elements. Most remarkable, perhaps, was the challenge of delivering an inhalational anesthetic, using a dangerous and frequently lethal volatile anesthetic agent, in the penumbral depths of an austral winter.

Polar Travels

By 1914, during a 25-yr period termed the Heroic Age of Antarctic Exploration (1897 to 1922), many of the key geographical objectives of the Antarctic continent had been attained. A basic outline of many parts of the southernmost land mass had been mapped, and the South Pole was reached in 1911. Shackleton felt one last achievement was needed—to traverse the Antarctic continent, from the Weddell Sea to the Ross Sea, **via** the South Pole.

His expedition ship, the Endurance, left England in August 1914, as Europe was descending into war. By December, the Endurance crossed the Antarctic Circle, only to become beset by the pack ice (fig. 1). Ten months later, she was crushed like a shell by the shifting sea ice, sinking without trace into the black depths of the Weddell Sea on November 21, 1915.2

Marooned with sparse supplies saved from the shipwreck, the 28 crew members camped on the pack ice for more than 5 months, from October 1915 to April 1916, as they drifted 1,600 miles north. Finally reaching open sea, they launched their three lifeboats on April 9 as the pack ice broke up underneath them. For 6 days, the small party navigated in open boats through autumn Antarctic gales and the appalling weather of the South Atlantic, eventually reaching Elephant Island on April 15, 1916.3

Despite making landfall, their situation remained desperate. Elephant Island was a bare icy rock a few miles in length, lashed by storms, sleet, and snow. There was little shelter. Expedition doctor Alexander Macklin4 wrote in his diary:

...everything deeply snowed over, footgear frozen so stiff we could only put it on by degrees, not a warm pair of gloves amongst us. I think I spent this morning the most unhappy hour of my life—all attempts seemed so hopeless, and Fate seemed absolutely determined to thwart us. Men sat and cursed, not loudly but with an intensity that shewed their hatred of this island on which we had sought shelter.
The nearest human settlements, in Tierra del Fuego, the Falkland Islands, and South Georgia, were hundreds of miles away across some of the worst seas on the planet. With no radio communication with the outside world, and no prospect of a passing ship, the crew would have to ensure their own rescue. In a brief lull in the weather on April 24, Shackleton set off with five crewmen in the largest lifeboat in a desperate attempt to reach land and obtain help.

**Elephant Island**

While the lifeboat’s chances of survival on the savage seas of the South Atlantic were slim, so too were those of the remainder of the *Endurance*’s crew left on Elephant Island. Besides the immediate issues of food and shelter, the 22 men left on the island faced other life-threatening problems. During the boat trip, dehydrated, constantly wet, and exposed to freezing winds in inadequate clothing, many had suffered frostbite. In the constant damp and cold of Elephant Island, preventing infection and secondary damage to these thermal injuries was challenging.

To attend to these problems were two doctors: Alexander Macklin and James McIlroy. Born in Melrose, Scotland, in 1889, Macklin had graduated from Manchester University, Manchester, England, in 1912 and worked for 2 yr in Manchester and Blackburn before sailing on the *Endurance.*

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**Fig. 1.** Map of the voyage of the *Endurance.* Reproduced from Levack and McGowan with permission.

**Fig. 2.** Dr. Alexander Macklin. Reproduced with permission from the Macklin family.
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(ﬁg. 2). McIlroy was born in Northern Ireland in 1879, and after graduating from Birmingham University, Birmingham, England, in 1904, he spent several years working as a medical ofﬁcer and ship’s doctor in the Middle and Far East before joining the expedition.6

The most severely affected of the crew was Perce Blackborow, at 22 yr the youngest member of the expedition (ﬁg. 3). During the trip in the lifeboats, he had suffered severe frostbite to his feet.2,3 As the weeks on the island passed, it has become clear that the toes of his left foot were necrotic. By June, given the risks of infection and gangrene, the doctors decided that the dead digits would have to be excised.

Although the doctors had initially thought that anesthetic supplies had been left on the pack ice,7 they discovered a small store of 8 ounces4 (227 ml) of chloroform in their medical kit. There was no news of Shackleton’s desperate attempt to reach South Georgia 8 weeks earlier, and the winter pack ice blocked off access to Elephant Island. Whatever the dangers and difﬁculties of administering anesthesia and operating in such an austere setting, the two clinicians felt that there was no alternative in order to save Blackborow’s life. In the frigid conditions of the polar midwinter, with no prospect of immediate rescue, the doctors set out to anesthetize and operate.

Frostbite

While Blackborow’s case of frostbite was the most severe, several other of the crew had frostbite, localized infections, or other problems.7 Conservative management, whether surgical or anesthetic, was appropriate. For most cases of peripheral frostbite, careful cleaning and bandaging was adequate—although even this was challenging. Macklin4 wrote:

McIlroy and myself have several patients to see daily; this with the difﬁculty of getting hot water, shelter or good light was very difﬁcult and trying. Added to this my own little ﬁnger got frost-bitten … (during the boat trip), and has been insensitive ever since, and the tips of all my ﬁngers had blisters from the same cause, making skillful bandaging or manipulation difﬁcult.

Lionel Greenstreet, the Endurance’s second ofﬁcer, had suffered more severe frostbite to his foot. More extensive damage had only been prevented by the quick thinking of his crewmate Thomas Orde-Lees, who warmed Greenstreet’s frozen foot under his clothing during the boat trip.8 On May 2, 3 weeks after landing, Macklin4 noted “Greenstreet’s toe not good.” By May 16, “Greenstreet’s (frostbitten) toe is not doing well, and I am afraid I will have to confine him to his bed, and arrangement he will not like, being an active chap.”

Surgery without Anesthesia

Dental pain, a common complication on prolonged expeditions,9 was another problem the doctors had to deal with. In May, Macklin wrote “On one day I pulled a tooth for Kerr, and a grimy quack of a dentist I must have looked. Not much reﬁnement here—‘Come outside and open your mouth’—no cocaine or anaesthetic.”4

Another dental patient presented on July 25: “Wordie has some tooth ache tonight. I gave him some iodine, but recommended ‘cold steel’ which he refuses.” The next day Alexander Kerr again had some dental work: “Pulled a tooth for Kerr after supper. Had an interested audience.” This demonstration, combined with the pain, perhaps persuaded the reluctant patient 2 days later: “After supper pulled a back molar tooth for Wordie: another interested audience, pretty embarrassing for poor Wordie.”

The ship’s navigating ofﬁcer, Huberht Hudson, had more severe problems. He was bed bound with persistent hip pain following a severe blow from a tent pole ﬂung by the gale force winds during their ﬁrst arrival on the island,10 and had also developed an abscess in his buttock after the days of rowing in soaked clothes.

By July, his abscess was worsening. Macklin noted on July 7 “McIlroy asked me to look at Hudson to-day. He seems worse, and the swelling in his buttock is larger. I advised incision and drainage, or at any rate passing in a trocar and can-nula, as he has had considerable pain from the tenderness.”

On 16, Macklin reported “Hudson has been suffering great deal of a pain for the last few days. I recommended McIlroy to drain his abscess a little while ago, and he attempted to do so, but did not succeed in doing it. I wish that he would decide to do something radical for Hudson: I would advise giving (chloroform anesthesia), and making a thorough attempt.”
Cold and Chloroform

Notwithstanding Macklin’s urgings to use chloroform for Hudson’s surgical drainages, the senior doctor’s caution about general anesthesia was well founded.

In the best of environments, chloroform was a dangerous medication. Less than 3 months of the discovery of the anesthetic effects of chloroform in 1847, the first anesthetic death was recorded. A healthy 15-year-old girl, undergoing a minor elective toenail surgery, died abruptly during chloroform anesthesia.11

As the number of chloroform anesthetics increased in the immediate years following, scarcely a month passed without further record in the medical literature of unexpected and fatal anesthetic complications. The impact of these iatrogenic fatalities was compounded by the apparently random epidemiology and nature of the deaths. Debate over the cause of fatalities during chloroform and ether anesthesia raged for decades. Slowly, however, with the accumulation of clinical experience, formal research and the professionalization of anesthetic practice, a clearer picture of the problem emerged.12,13

While excessive dosing could lead to respiratory depression, another issue was inadequate depth of anesthesia, with laryngospasm and upper airway obstruction frequently triggered by a painful surgical stimulus during light anesthesia. While these problems could occur with both ether and chloroform, chloroform produced an additional hazard. Laboratory animal research demonstrated that small levels of chloroform sensitized the myocardium to arrhythmogenic effects of epinephrine. During light anesthesia, a noxious stimulus could trigger fatal ventricular fibrillation and cardiac arrest.

Given the hazards of both light and deep chloroform anesthesia, an adequate and constant depth of anesthesia was essential. The method used would be the open drop technique—simply pouring the chloroform onto a cloth held over the patient’s face, the delivery of the vapor being by spontaneous ventilation. The low temperature and decreased vaporization of chloroform, therefore, posed a significant challenge to safety, since the altered pharmacokinetics of the inhaled volatile at frigid temperature would have been unfamiliar to the two doctors.

The only general anesthetics previously given below the Antarctic Circle were administered indoors, in the more sheltered and presumably warmer settings of expedition ships14 or an overwintering hut.15 Was it safe, or even feasible, to anesthetize in this inclement environment?

Penguins and Pinnipeds

There was at least a potential operating theatre: the crew had raised low stone walls, turned over the two lifeboats to serve as a roof, and lined the resulting shelter with canvas sails and tents (fig. 4). “It is hard to realize one’s position here, living in a smoky, dirty, ramshackle little hut with only just sufficient room to cram them all in: drinking out of a common pot with people suffering from caries etc., and lying in close proximity to a man with a large discharging abscess—a horrible existence.” It was not an ideal surgical space—“but … our hut is a mansion to us, being our only shelter from the incipient weather of Elephant I.”

While there was some kerosene to fuel a Primus stove, the supply was very limited and irreplaceable. With lichen and kelp the only vegetation on the ice-covered treeless island, the sole wood was the lifeboats and supply boxes—their shelter and possible means of future escape to sea. Fortunately, the island’s marine animals provided not only food for the hungry castaways, but also heat and light.

Elephant Island was the land base for large numbers of seabirds and seals. Penguins arrived in their thousands, of varying types of pinnipeds, or seals, also used the shelves as landfill. Weddell seals were ubiquitous, and huge, eponymous Elephant seals also frequented the island.

An iron cooking stove, fashioned from an ash bucket, had been placed inside the lifeboat shelter. While penguin meat turned to tasty steaks, the oily feathered pelts were fuel to the stove to cook the meat and heat the room. Seal fat was another energy-rich food staple and fuel source. The blubber was fuel for the stove, and, melting in assorted tins primed with cotton wool wicks, provided a feeble light.4

Preoperative instrument sterilization and surgical scrubbing were rudimentary: “We managed to sterilize instruments pretty well by using a Primus and a (cooking) pot. We heated up water over the stove ... I had brought with me some soap and a towel, foreseeing some such use for them, and McIlroy, Wild and myself had the luxury of a WASH. THE FIRST FOR SEVERAL MONTHS. Even this was only a half wash ... We had not sterilised overalls to get into: we merely stripped to our vests.”

Antarctic Anesthesia

The morning of June 15, 1916, dawned damp and dismal, but the wind had dropped and, crucially, the temperature...
was a relatively mild 31°F (−0.5°C). It was a nasty morning with a wet sort of drizzle, but all hands turned out and kept themselves occupied outside (un)til we were finished—it was unpleasant for them. Greenstreet and Hudson stayed in; Hudson lay in his bag with his face averted, he did not like it; but Greenstreet lay on his place in the thwarts and took a lively interest in the proceedings. Both of them are semi-invalids and as such were not turned out.

A surgical team and suitably heated operating theater were improvised. One of the sailors, Able Seaman Walter Howe, served as the circulator, the group’s leader, Frank Wild, was the scrub assistant, while the expedition photographer, Frank Hurley, worked to warm up the shelter. Hurley reported: “The operating table was built from a number of nut boxes covered with blankets, the temperature of the ‘Theater’ (our murky interior) being maintained at 79° by ardently stoking the bogie with penguin skins.”

Macklin wrote, “The operating table consisted of packing cases, and I had another case for a stool ... We managed to get the temp up to 80° (26.6°C) and the CHCl₃ (chloroform) vapourised splendidly ... Wild lent a hand at the operation, he is a hard case, and did not show any signs of revulsion at the sight ... Howe stayed in as a ‘generally useful’ man and indeed was very useful in many ways.”

The amount of a volatile substance in the gaseous form is measured by the saturated vapor pressure—the pressure generated by the vapor in equilibrium at a standardized temperature of 20°C. The saturated vapor pressure of chloroform at this temperature is 159.8 mmHg. At 0°C, the diminished amount of vaporized chloroform only exerts a pressure of 71.5 mmHg, reflecting just under one half the amount of molecules in the gaseous phase at 20°C.

The measure of volatile anesthetic potency is estimated by the minimum alveolar concentration (MAC), measured at sea-level atmospheric pressure (760 mmHg). The MAC of chloroform is 0.5%, or 3.8 mmHg. Since chloroform is extremely potent, even the smaller amounts available in the gaseous phase at low temperatures are adequate to induce surgical anesthesia.
It was therefore feasible, both in theory and in practice, to induce anesthesia with chloroform at very low temperatures. It is unlikely the doctors would, however, have had any way of knowing this: the concept of MAC as a measurement of anesthetic potency was only outlined in the early 1960s, some half century later.17,18

**Poison**

The extreme perils of an inaccurate dose of chloroform were therefore clearly apparent to clinicians. Duncan, Flockhart, and Company, the Scottish pharmaceutical firm that manufactured the chloroform used on the Endurance expedition,19 put a blunt warning on the label of their chloroform bottles: “Poison.”20 However, another menace, perhaps more directly related to the warning label than originally intended, was less widely recognized.

Leonard Hussey was the expedition meteorologist whose weather instruments allowed for accurate measurement of temperature. Hussey,21 who would later qualify as a doctor on returning to England, subsequently recollected: “I think the most difficult part ... must have been the anaesthetic. The patient’s head was placed as near to our little oil-drum stove as was possible and the stove was then stoked up with lavish supplies of seal-blubber. This helped the chloroform to volatilise, which otherwise would have been difficult owing to the cold.”

An article in the Lancet of 1894 noted: “Under certain circumstances attending its administration, chloroform may act as a severe irritant to the larynx, producing spasmodic cough and dyspnea; secondarily these toxic effects are not exerted upon the patient but upon the operator and his assistants.” The author reported four surgical procedures performed by gaslight in small, enclosed rooms where he and his colleagues were affected by “a choking, stinging, irritating sensation in the throat and chest, resulting in incessant coughing and gasping for breath.”22 Another surgeon, working with a small amount of chloroform in an enclosed room heated with an iron stove and lit by candles and an oil lamp, noted chest pain and coughing lasting for days in himself and his nursing assistant.23

Other practitioners reported similar or worse experiences, although the patients were not necessarily immune. Reports in the British Medical Journal and the Lancet in 1898 noted that, following a prolonged laparotomy performed with chloroform by gaslight, the surgeon and his assistants developed severe dyspnea, a nurse dying 2 days later.24,25 An anesthetist from Texas advised: “It is best not to use chloroform by gaslight; the (vapors) have not only killed the patient, but in a recent case also the attending physician, and made two nurses very sick for some time.”26 Multiple other reports were published of acute and delayed respiratory complications, sometimes lethal, that were attributed to chloroform delivered in a poorly ventilated room in the presence of an open flame.27-29

By a coincidence of history, an ominous sequel to these medical mysteries occurred days after Blackborow’s antipodean anesthetic. Unbeknown to the crew of the Endurance, who had left Europe in August 1914, millions of their contemporaries were locked in a different struggle for survival in the mud and trenches of the Western Front. June 22, 1916, was midwinter’s day in the Antarctic. The cast-aways lightened the gloom with extra rations and a variety of songs and performances. On that same day in Europe, a new weapon was unleashed in the battle of Verdun: phosgene gas.

It is estimated that nearly 80% of the poison gas deaths in the First World War were caused by this lethal poison. Phosgene is a highly reactive gas capable of damaging a variety of biologic materials in an oxidant-like fashion. It has a characteristic smell, sometimes described as moldy hay or green corn. The clinical symptoms may vary considerably, depending on dose and exposure conditions.30

Immediate onset symptoms are mainly due to irritation of the mucous membranes, causing eye irritation and cough at higher doses. However, prolonged exposure, at lower doses below the threshold of olfactory detection or immediate symptoms, can cause insidious damage. The gas damages the pulmonary alveolar lining, leading to delayed onset of pulmonary edema and, possibly, death.30

The anesthetic antecedents of this lethal chemical could be found in the medical literature some decades previously. The gas was first synthesized by John Davy in 1812.22 With the discovery of the anesthetic properties of chloroform (CHCl3) in 1847, a practical medical problem related to the new use of this organic solvent emerged. Chloroform degrades in oxygen over time to phosgene (COCl2) and hydrochloric acid (HCl), a process accelerated by exposure to light: 2CHCl3 + O2 --> 2COCl2 + 2HCl.

Pharmacists had produced an answer by adding a small amount of alcohol to the chloroform to minimize the degradation.31 Storing the chemical in tinted glass bottles also slowed breakdown. This meant that chloroform stored for prolonged periods was still safe to inhale as an anesthetic under most circumstances. However, when exposed to the high heat of an open flame, the breakdown to phosgene occurs rapidly.

In an era before electrical heating or lighting, open flames were commonly used to heat and illuminate operating rooms. In sharp contrast to ether, chloroform was non-flammable, a distinct advantage in these settings. If rooms heated and lit by open flames were poorly ventilated, however, the toxic by-products of chloroform could accumulate and injure staff and patients alike. At higher doses, the chlorine and phosgene could cause the coughing and irritations described by clinicians. Prolonged, undetected exposure to lower doses, however, could also produce delayed and potentially fatal pulmonary complications—whether in warfare or by iatrogenic accident.

**Postoperative Cigarettes**

McIlroy operated, while Macklin delivered the anesthetic. From his sickbed in the hut, Greenstreet32 noted: “Blackborow had an operation on his foot with the toes of his...
left foot taken off ¼” stumps being left ... the poor beggar behaved splendidly and it went through without a hitch .... The time from start to finish 55 minutes. When Blackborow came to he was as cheerful as anything and started joking directly ...

Macklin wrote: “he took his anaesthetic very well and was not at all sick afterwards .... We had only 8 oz. of chloroform, but although the operation lasted 55 minutes I only used 1 oz .... Blackboro’ was soon round from his anaesthetic, and asking for that now rare luxury—a cigarette ....” The delivery of the anaesthetic had been flawless.

The medical staff did well too. It is an ill wind that blows no good—and particularly so on Elephant Island. Despite the crews’ best efforts at insulation, the small stone hut remained drafty. The burning penguin skins and seals blubber produced copious oily smoke, so a stove chimney had been fashioned from flattened biscuit tins to vent the black choking fumes. “Hurley took charge of the fire and succeeded in keeping it going, without making any smoke in the hut.” Any poisonous anesthetic by-products generated in the well-ventilated hut were therefore expelled with the stove smoke.

After the job was finished there was some hot water left, so we decided not to waste it, and borrowed 3 lumps of sugar from tomorrow’s lunch and made a drink of hot sugar water. This, with the unusually high temperature, soon made us pour with sweat – we oozed at every pore in a way we had not done for many along day.

The rest of the crew, passing the operative time in the snow cavern, engaged in a different sort of cutting that unconsciously echoed the surgical profession’s origins as barbers: trimming each other’s hair. Orde-Lewes reported: “It was nearly three hours before we were again able to get back into the hut by which time we were bored and hungry. The operation had been successful in spite of difficulties, and when we got back into our cozy bags, the patient was sleeping off the effects of the anaesthetic.”

**Recovery**

Blackborow was not out of danger yet. The unsanitary environment was not conducive to healing, and “the docs are anxious about whether the foot will heal properly.” Four days after the operation, Hurley reported that “Blackborow’s foot is not progressing as well as might be expected. It is suppurating badly and the surrounding tissues are in a very unsatisfactory condition.”

By August 21, Orde-Lee’s noted: “Poor Blackborow’s foot is very bad. It is much swollen and inflamed and the osteomyelitis is extending slightly ... (he) deserves all credit for the manly fortitude with which he puts up with his serious infirmity. He is a model of patience.”

The other two patients, however, recovered well. While the incision and extensive drainage of Hudson’s abscess without anesthesia must have been painful and unpleasant, it was at least effective. By the third day postoperatively, “Hudson is better to-night, arguing freely as is his wont when well.”

Greenstreet’s frostbitten toe improved with conservative management, and the enforced bedrest had been put to good use: “I have been giving Greenstreet lectures on First Aid to the Injured: he is taking an ‘extra masters’ certificate when he returns to England. I have no books and have to trust my memory for it all. One has to be careful not to teach a ‘First Aider’ too much as too little. His toe is very much better.”

**Discharge**

August 30 was the day the men had waited for—the arrival of a rescue boat. Shackleton and his men had navigated hundreds of savage miles across the south Atlantic to make landfall on South Georgia, walked across the glaciers and mountains to reach a whaling station, and on their fourth attempt to fight their way through the encroaching pack ice, made it back to Elephant Island in a small Chilean tug boat. Blackborow was carried from the shelter, and all were hastily evacuated in the brief period when the bay was free of pack ice. In the rush, McIlroy’s diary was left behind, his medical notes sadly lost to history.

The Antarctic sailors, long marooned on ice or rock and recovered or recovering from assorted illnesses, now suffered a fresh medical indignity. The careful medical diarist Macklin noted: “The next day there was a good chop and I was interested to note that Wild, Greenstreet, Richardson, Kerr, Blackborow, and Howe, all hardened seamen, were sea-sick. At this time I felt quite well and felt it was one up for a landlubber this time; but my turn came the next morning (yesterday) when I felt very ill, but am all right again today. Lees, James, Husey, McIlroy and in fact nearly every member of the party, was ill.”

The crew was transported to Chile, where they received a hero’s welcome. “‘Blackboro’ our invalid was met on the pier by ambulance, and taken to the hospital. He is still there and is doing well. He will go straight home by the mailboat ‘Orissa.’” In the dry, clean hospital setting, Blackborow recovered well. He was walking with a slight limp when he set off for England. Not only had all the crew survived, but, as Hurley recorded, “it has been through the indefatigable diligence of Drs. Macklin and McIlroy, that numerous hands, fingers and feet have been saved.”

**Beyond Elephant Island**

The eyewitnesses and participants of Elephant Island’s first and only anesthetic went on to varied and interesting lives. By mid-October, 1916, returning to the north, Macklin wrote: “We have properly broken up. All things have an end; all of us on board are going home to take a part in this awful war; in a few weeks we shall each go our different ways. It would be nice if some day we could all meet again.” But they never did.

The three patients all returned to their former work. Perce Blackborow returned home to Newport in south Wales, where he worked as a boatman. He rarely spoke in public.
about his experiences in the Antarctic, but on one occasion when he was coaxed to talk, he recalled his achievements with quiet pride. Of their arrival at Cape Valentine after their epic boat trip, he mentioned, “Sir Ernest Shackleton gave me the great honour of being the first man to land. It was the first landing made on Elephant Island.”

Hubert Hudson served in the Royal Navy during the First World War, and later continued working at sea. He was killed in action in the North Atlantic during the Second World War, when his ship was torpedoed in 1942.

Lionel Greenstreet spent his career working on ships and in various marine businesses. An interview published in _The Guardian_ in 1964 noted: “That stubborn optimism that made the men of the _Endurance_ fifty years ago, has still not been dulled.” He passed away in 1979, the longest-lived of the “Imperishables,” and the last survivor of the crew of the _Endurance_.

The assistants in the anesthetic and operation also lead long and varied lives. Walter How joined the Merchant Marine, was injured when his ship hit a mine in the First World War, and was awarded two war medals. Together with Lionel Greenstreet, he attended the commissioning of the Royal Navy’s Antarctic survey ship HMS _Endurance_ in 1968. Frank Hurley continued his work as a photographer. In addition to his famous images of the _Endurance_ expedition, he produced some of the iconic photographs of the First World War.

Frank Wild went south again in 1921, with Shackleton, McIlroy, and Macklin, on an expedition to explore the scattered islands off the Antarctic. After Shackleton died from a heart attack in South Georgia, Wild led and completed the expedition, the last of the southern continent’s Heroic Age of Exploration. Shackleton was buried on South Georgia. Wild passed away in South Africa in 1939, and in 2011 his ashes, long misplaced, were interred next to his old comrade on the island.

McIlroy later worked as an itinerant doctor on various shipping lines. In the First World War, he had been severely wounded at Ypres. During the Second World War, his ship _Oronsay_ was torpedoed off the West Coast of Africa, and he survived five days in an open lifeboat before being picked up by a passing French ship the _Dumont d’Urville_. He was subsequently interned by the Vichy French in Timbuktu. He passed away, aged 89, in Surrey in 1968.

Macklin also served with distinction in the Medical Corps in France, Italy, and Northern Russia during the Great War. He was appointed Order of the British Empire and won the Military Cross for bravery tending the wounded under fire. In 1920, he received his M.D. with commendation for his thesis “The evacuation of sick and wounded from mobile columns.”

Settling in Dundee in 1925, he took the post of visiting anesthetist at the Dundee Royal Infirmary, which was then the teaching hospital of St Andrew’s University. Here, he practiced anesthesia in the days before intravenous induction agents and muscle relaxants. Not only a busy clinician, he also published an extensive series of nitrous oxide anesthetics and various articles on polar medicine.

After further distinguished medical service in the Second World War, he worked in student health services. Retiring briefly in 1960, age 70, he returned to continue full-time work. One day in March, 1967, he did not appear for work in his job as junior orthopedic house officer. He had left for home complaining of chest pain; the next day he died of a myocardial infarction.

### Conclusion

Some hundred years after the voyage the _Endurance_, the accounts of her crew’s battle for survival in an indifferent and unyielding world continue to fascinate and educate. Perhaps the interest in these tales endures because we recognize in these stories those fundamentals sometimes overlooked in the cluttered press of daily life and medical careers. In an existence reduced to the most basic of elements, removed and remote from the rest of humankind, the struggles of this small band of men illuminate the meaning of companionship, cooperation, and selfish dedication to others.

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