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On Arctic Sledge-Travelling

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graph of H.M.S. *Terror*, Captain G. Back, in Frozen Strait; the crew saving the boats and provisions (*Sir G. Back*, D.C.L., F.R.S.)

Before the commencement of the ordinary business of the evening, the PRESIDENT announced that the Council had decided on holding a meeting of the Society on the 28th instant, in order to make up for that which was deferred in the month of May in consequence of the sudden death of Admiral Sherard Osborn. At the meeting on the 28th the Sultan of Zanzibar would be present. His Highness, as members were aware, was one of the few foreign Honorary Members of the Society, and had deserved well of all geographers, inasmuch as it was mainly owing to his encouragement and support that the recent expeditions for the Exploration of the Interior have been able to succeed so well in making Zanzibar their starting point. It was therefore incumbent upon them to give him a cordial welcome.

Referring to the special business of the evening, the PRESIDENT said the paper to be read by Sir Leopold M'Clintock would be of interest at any time, but was peculiarly so now that a New Arctic Expedition had just left England. Sir Leopold M'Clintock had been a most successful explorer himself, and had brought the system of sledge-travelling to such a degree of perfection that it had become the most effective means of Polar exploration.

*On Arctic Sledge-travelling.* By Rear-Admiral Sir F. LEOPOLD  
M'CLINTOCK, F.R.S.

So widespread an interest in the subject of Arctic geographical research has been evinced, that I am encouraged to believe that some details of the means by which that research is chiefly effected may not be uninteresting to those who are here present. And in this belief I have undertaken to give an outline of sledging exploration.

My subject has one feature peculiarly its own—it is this: whereas all other geographical discoveries are performed either by land or by water, modern Arctic exploration into the higher regions of the Frigid zone, is prosecuted independently of either, and the ice, which arrests the progress of the ship, forms the highway for the sledge.

In early Arctic voyaging, the ship alone was relied upon for penetrating into unknown seas.

In the second and third voyages of Parry, and the second voyage of Sir John Ross, between 1821 and 1834, sledging was commenced, and a number of short journeys were made, mainly by the assistance of the Esquimaux, whose methods were closely observed and more or less imitated.

But our seamen had not yet familiarised themselves with the idea, that it was quite possible for well-equipped Europeans not only to exist, but to travel in an Arctic climate, as well as the Esquimaux themselves; and it was not until the Franklin Searching Expeditions were sent out, between 1848–54, and thus a motive far stronger

than that of geographical discovery was supplied, that men seriously reflected upon the possibility of any extensive exploration on foot. And no more powerful incentive could have been imagined to rouse the utmost energies of the searchers, than the protracted absence of the missing Expedition.

The endurance of the hardiest was called forth, and the talent of invention evoked and stimulated, until at length a system of sledging was elaborated, such as I will now proceed to describe.

It may be as well here to explain, that sledge-travelling is limited to the spring months. It cannot be commenced until there is sufficient daylight; it cannot be continued after the summer thaw has denuded the land of snow, or rendered the sea-ice unsafe: therefore it can seldom be prosecuted with advantage before the month of April, or later than June.

The late Admiral Sir James Ross, the distinguished Commander of the Antarctic Expedition, who had served with very great credit in all the six voyages of Parry and John Ross, from 1818 to 1834, formed the connecting link between them and the Searching Expeditions, which commenced in 1848, and the first of which he commanded. He was acquainted with the flat sledges of the Hudson's Bay territory, which alone can be used in deep snow, gliding as they do over its surface; he was also acquainted with the Greenland dog-sledge, with its high narrow runners shod with ivory or bone, and which cut down through the usually thin layer of snow, and run upon the ice beneath; he was familiar with the various modifications of these typical forms, which had been used in the Arctic Expeditions of Parry and John Ross.

He had, moreover, made several journeys with the natives of Boothia Felix, culminating in his discovery of the Magnetic Pole; and, on one of these journeys, he was absent from his ship for the *then* unprecedented period of twenty-nine days.

It was under his directions that our sledges and tents were made in 1848; and these designs, with comparatively slight modifications, have continued in favour in all subsequent expeditions.

The tent requires but little description. It is merely a pent-roof, about 7 feet high along the ridge, supported on boarding-pikes or poles, crossed at each end, and covering an oblong space sufficient to enclose the party when lying down, and closely packed together. Its duty is merely to afford shelter from the wind and snow-drift, and its weight, when completely fitted, is, for a party of eight men, only about 40 lbs. It is made of light closely-woven duck.

The sledge is a much more important article of equipment. That

which our experience has proved to be the most suitable is a large runner-sledge.

It must be borne in mind that I am speaking of latitudes beyond the 70th parallel, where, unlike regions which lie somewhat less remote, the fall of snow is less considerable and never deep; and, moreover, that our sledges often have to be drawn over the sea-ice when flooded with water a foot in depth.

The runners are rather broad, that is, 3 inches, and they stand high, carrying the lading about a foot above the ice. An average-sized sledge is 3 feet wide and 10 feet long, and is drawn by seven men. It is constructed with only just so much strength as is absolutely necessary, since every pound of weight saved in wood and iron enables so much more provisions to be carried. All our sledges have been drawn by the seamen, and the labour of doing so is most excessive.

The first sledge expedition in the search for Franklin was led by Sir James Ross in person. By very great efforts a distance out and home of 500 statute miles, was accomplished in forty days; but out of the twelve picked men by whom the two sledges were drawn, five were completely knocked up, and every man required a considerable time under medical care to recruit his strength, after this lengthened period of intense labour, constant exposure, and insufficient food.

Throughout this paper, the distances will be in English statute miles, as being most generally understood.

It is necessary to apprehend clearly the nature of the surface over which our sledges have to travel.

People unacquainted with the subject, commonly fall into one or other extreme, and suppose that we either skate over glassy ice, or walk on snow-shoes over snow of any conceivable depth.

Salt-water ice is not so smooth as to be slippery; to skate upon it is very possible, though very fatiguing. But hardly is the sea frozen over, when the snow falls, and remains upon it all the winter. When it first falls, the snow is soft, and perhaps a foot or fifteen inches deep; but it is blown about by every wind, until having become like the finest sand, and hardened under a severe temperature, it consolidates into a covering of a few inches in depth, and becomes so compact, that the sledge-runner does not sink more than an inch or so: its specific gravity is then about half that of water.

This expanse of snow is rarely smooth: its surface is broken into ridges or furrows by every strong wind. These ridges are the "Sastrugi" of Admiral Wrangell; and although the inequalities

are seldom more than a foot high, they add greatly to the labour of travelling, especially when obliged to cross them at right angles.

As the spring season advances, the old winter snow becomes softened, fresh snow falls, and sledging is made more laborious still.

At length the thaw arrives; the snow becomes a sludgy mixture, with wet snow on top and water beneath, through which men and sledges sink down to the ice below. It is now almost impossible to get along at all; but in a few days the snow dissolves, and we make fair progress again over the now flooded ice.

Our dry provisions and clothing are so packed upon the sledges, as to be protected from the wet, but everyone is of course drenched, and remains so during the march through this ice-cold water. This is cold-water cure in real earnest, but I would not recommend any one with the slightest suspicion of a rheumatic tendency to try it!

Later still, the water drains off the sea-ice through cracks or holes decayed in it, and only tortuous pools of water remain upon it.

Later than this, sledge-travelling, without the accompaniment of a boat, becomes unsafe.

Such is the nature of the travelling, when the sea-ice has not been crushed up into hummocks, or masses of various sizes and shapes.

We seldom find either unbroken ice, or ice so crushed up into ridges that we cannot get over it at all; but, as a rule, crushed up or hummocky ice, three or four feet in height, is of very frequent occurrence, and of course adds much to the labour of sledging.

Having accompanied Sir James Ross on his sledge-journey in 1849, I was entrusted with the preparations for sledge-travelling in the second and third searching expeditions, under Austin and Belcher; and this method of exploration now became recognised as an important feature of these voyages.

The utmost attention was devoted to the travelling equipments, and to the methods adopted by Wrangell and other distinguished Arctic travellers; and the spring parties of the second expedition set out in 1851 on the 15th April, instead of the 15th of May, as in 1849; and the sledges, carrying forty days' provisions, were dragged with less labour than thirty days' rations had previously occasioned: moreover, the allowance was a much more liberal one. The result was a corresponding increase of work done: one party remaining absent for eighty days, and making a journey of 900 miles.

But in 1853 and 1854, the sledge parties of the third searching expedition did still better service: one party accomplished about

1400 miles in 105 days. Another party, having several depôts along its line of route and favourable circumstances generally, travelled nearly 1350 miles in seventy days.

These two journeys, which have not yet been surpassed, are deserving of our special notice.

The first was purely an exploring journey. Melville Island, which is some 50 miles broad, and is of moderate elevation, had to be crossed and recrossed. At the outset, very heavy loads had to be dragged; and ignorance of the direction in which the unknown coast-line might trend, interfered with the deposit of provisions to serve for the return journey; nevertheless, the daily average march was 12 miles. The second was a despatch journey, and it shows how rapidly ground can be got over with a tolerably light sledge, under somewhat favourable circumstances; and it is a feat which the sailor, who is not generally credited with good marching powers, may justly point to with pride: throughout this journey the daily march averaged the astonishing distance of 20 miles.

These facts afford the strongest proof of the suitability of our travelling equipments.

In any comparisons which we may make between these and any other marches, we should bear in mind, that this Arctic work is not merely marching, but that a sledge, often heavily laden, has to be dragged the entire distance.

The provisions and the clothing found to be most suitable may now be briefly described.

Tea, chocolate, biscuit, preserved meat, and pemmican are commonly used. Pemmican is a description of preserved meat used by the Indians of North America, from whom it has been copied. It is a preparation of beef, whereby all that is fluid is evaporated over a wood fire; the fibre is then pounded up, and mixed with an equal weight of melted beef fat; no salt or preservative of any kind is used; and no more concentrated food for working-men in a cold climate is known.

With chocolate, biscuit, and a little warmed-up pemmican, the traveller makes a good breakfast; a few ounces of specially-prepared bacon, almost free from salt, some biscuit, and a mouthful of grog, forms his hasty luncheon on the march; and on encamping, he has his supper of warmed pemmican, or other preserved meat, and tea.

Rum is the spirit used in the Navy, and therefore in our Arctic ships. If the men were not accustomed to the use of spirits, I think that, except on special occasions when a stimulant is desirable, they would be even better without it, as an equal weight of

some nutritious food might then be carried instead of it; however, the ration of rum is very small.

This simple dietary is invariable, except when the party is so fortunate as to procure game; and then the awkward question crops up, of fuel wherewith to cook it. We are at a disadvantage with those hardy men who are content to cook their meat with frost; although a sandwich of frozen bear's blubber and biscuit is palatable enough, and I think most of the gentlemen in this room would agree with me, if they were fairly educated up to it, by a few days' sledging in the month of March.

All our cooking is done with lamps, the fuel being either spirits of wine, or some fatty substance such as stearine of cocoa-nut oil, tallow, or blubber. The latter alone is used by the Esquimaux; we prefer the stearine, as it cooks more rapidly and makes less smoke, and the stearine-lamp suits equally well for blubber, or any animal fat procurable on the march.

The clothing of the men is a subject of equal difficulty and importance; it must be suited to the temperature under which they travel, and this often ranges over 100 degrees, that is, from  $+50^{\circ}$  to  $-50^{\circ}$ ; it must not suffer by frequent wettings, and should dry quickly; and, as only the outer wrappings of the feet are ever taken off while the frost lasts, it should also be suitable for sleeping in.

Our system of dressing is this: soft, warm woollen articles under a cloth which is impenetrable to the wind, and is commonly known as box-cloth; and this again under a suit of closely-textured duck overalls, as snow repellers.

The feet are wrapped in squares of blanketing, and covered with leather moccasins during extreme cold; or with duck boots, having leather soles, for moderate Arctic cold or for wet.

The entire suit of clothing in wear weighs from 16 lbs. to 21 lbs.

The tent furniture consists of a Macintosh floor-cloth spread upon the snow, over which is a thick duffle blanket, and upon this the men lie down in their sleeping-bags, which are made of the same material; and another duffle blanket is then drawn over the party, their knapsacks serving as pillows.

It will be noticed that furs are not used. Although they are very warm and agreeable when in good condition, to sit in, to sleep in, or even to work in where they can be dried each night before a fire; and although they have been generally used hitherto, yet they have been deliberately set aside for such dresses as I have described; because we have found that they check the escape of

evaporation, they more readily absorb moisture, are more difficult to dry, and shrink much when wetted and frozen. I speak of such furs as are commonly procurable in this country. Those which have been dressed by the Esquimaux or North American Indians are much better suited to our rough work.

Let us imagine the scene when spring travelling-parties set out from their ships, to explore the unknown expanse before them.

It was on the morning of the 4th of April that they started from the *Resolute* and *Intrepid*, commanded by the late Admiral Sir Henry Kellett and myself, at Melville Island. Out of the 88 individuals composing the crews of both vessels, 71 were away sledging at one time; each separate sledge party consisting of 1 officer and 6 or 7 men.

Each sledge hoists a gay silken banner, emblazoned with some heraldic device, some pointed motto, perhaps the name given to the sledge, or perhaps some mysterious initials, known only to the leader of the small party—a little mystery, however, which only awaits the return home of the Expedition for its satisfactory solution.

After mutual cheers, they part upon their lonely and toilsome mission. But, trying as is the work before them, it would be difficult to over-rate the enthusiasm displayed. They have just passed through many months of darkness and confinement on board, spent chiefly in preparation for this great spring effort; nor is the keenest emulation wanting to complete a most impressive and characteristic display. Strong sense of duty, and an equally strong determination to accomplish it—dauntless resolution and indomitable will; that useful compound of stubbornness and endurance which is so eminently British, and to which we Islanders owe so much—certainly our colonies and our commerce, possibly even our existence as a nation.

These lonely little parties, daring and enduring so much, resemble sparks from that great fire which, I venture to say, is not yet extinct in this nation—the ardent love of the most adventurous enterprise.

Each officer leads his party, selecting the route, jotting down everything noteworthy in his diary, making a running survey as they advance, and checking his estimated distances by astronomical observations. He is also constantly on the look-out for game. When he can leave these ordinary duties, he takes part in the manual labour of dragging the sledge. Clothed and fed like his men, he is housed, or rather tented, exactly as they are, sharing in all things with them; thus he becomes something more than the



leader, or even the head of the party : he is its very pulse. These relations fairly established, he receives, in return, the most implicit confidence and devotion of his people. If he reserves anything for his own private use, it is his spoon : there being, of course, no washing up of mess-traps after meals in frosty weather.

In the extensive sledging operations of the third and last Government Searching Expedition, our entire immunity from severe frost-bites was in strong contrast with the second Expedition, where there were some thirty cases of seriously frost-bitten feet ; and this fact affords most satisfactory proof of the greater efficiency of the men's clothing.

Before taking leave of these spring parties, let us glance at them on the march, and notice the amount of work accomplished by those we have already alluded to.

During the month of April, the snow is hard, and favourable for travelling, but the winds are, of course, still very cold ; and if at all fresh, frost-bites are almost constantly playing about the men's faces. Thirst is also a good deal complained of. May differs in being milder : the sun is now constantly up ; snow-blindness is more frequent than frost-bites, and, to avoid it as much as possible, the travellers sleep by day, and march by night. Some fresh snow falls, and therefore, although the sledges are lighter, the labour of dragging is scarcely diminished. Between the old frost-bites, the keen winds, and strong sun, all faces are badly blistered ; most noses are absolutely raw, and, finger-tips quite callous from frequent, though slight, frost-bites. Early in June, a few Eider ducks, gulls, and ptarmigan appear. As the month advances, the snow becomes very soft. Soon the thaw bursts forth ; the land is rendered impassable by innumerable streamlets ; the sea-ice is flooded, and the whole aspect of nature has suddenly changed.

Matters now look serious. But frost-bites are things of the past ; even snow-blindness is less troublesome, and the abundance of water is an unspeakable relief. Those who have soap are now tempted to use it ! This, however, is the season for rheumatic pains, consequent upon the daily march through ice-cold water. It is well to avoid such late travelling as this.

The travellers return with prodigious appetites ; they weigh on an average 12 lbs. less than when they set out ; they are reduced in strength as well as in flesh, yet they can walk for hours without fatigue ; their sight for distant objects is much more keen, and their powers of observation of external objects, such as traces of men or animals, &c., much sharpened by exer-

cise: in fact, they have advanced a stage towards the condition of the North American Indian.

The nine sledge parties employed in the spring of 1853, from the *Resolute* and *Intrepid*, accomplished in the aggregate 7000 miles, and discovered and explored about 1800 miles of coast-line. This single spring season's travelling may be taken as a suitable basis for calculating what possible amount of work may be performed by the out-going Arctic Expedition, provided that all the circumstances prove to be somewhat similar.

In the spring operations alluded to, Captain Nares took a share, and played his part well, giving proofs of those high qualities, which have since borne such good fruit, and which so amply justify his translation from one very interesting and important command, to another still more important, more difficult, perhaps the most difficult to which a commander could aspire.

In the Government Searching Expeditions we gained no experience of snow-houses, and but little of sledging with dogs, yet that little was sufficient to convince us of their value. For instance, during the spring of 1854, our only team of dogs was kept constantly at work, and, without counting occasional short trips, they accomplished, in sixty days' travelling, 1830 miles, affording an average rate of 30 miles, their sledge on the whole being rather lightly laden. On several occasions they performed the distance of 60 miles between the *Assistance* and *North Star*, in from twenty to twenty-four hours.

The Government having finally abandoned the search, Lady Franklin nobly determined to make one more effort, and in 1857 she sent out the little *Fox* under my command.

As our entire crew numbered only twenty-four souls, the employment of dogs now became a necessity; accordingly twenty-four were embarked. In the spring of 1859 we sent out from the *Fox* three separate divisions of search, each consisting of six men and six or seven dogs; each division accomplished about 1000 miles of distance, and men and dogs worked harmoniously together for the lengthened period of nearly eighty days.

Dog-driving is so well-known that but little need be said here about it. Sometimes there was a little delay at starting, the dogs not allowing themselves to be caught and harnessed. Their harness consists of a few strips of canvas, and a single trace of about 12 feet long, the leading dog having a longer trace than the rest. Once started they are guided by the whip, which the driver should be able to use effectively with either hand. As

the dogs on each flank are most exposed to its influence, there is a continual striving to get into the middle, by jumping over each other's backs, so that it is often necessary to halt, pull off one's mitts, and, at the risk of frozen fingers, disentangle the traces, which have become quite plaited up together. When a dog feels the lash, he usually bites his neighbour, who bites the next dog, and a general fight and howling begin. The lash is no longer of any avail, and the driver is compelled to restore order with the handle of his whip. The journey is then more briskly continued for a little time, and so on throughout the march, until at length camping time arrives.

The moment our weary dogs were allowed to cease dragging, they fell asleep, and remained motionless, until the cook for the day commenced chopping-up the pemmican, or the dog's meat. At the first sound of his axe they would spring up and surround him like so many famished wolves, darting upon any splinters of meat which flew off, or watching an opportunity to steal some pieces. Besides this severe trial of the cook's temper, more of his time was spent in chopping at the dogs than in chopping up the frozen supper. We were careful not to feed the dogs until an hour after halting; when that time arrived, their food (commonly frozen seal's or bear's flesh) was strewed over the snow, and trampled into it, before the *rush* for supper, so as to enable the weak ones to secure an equal share with the strong. I think this was the only care we found it necessary to bestow upon them. We were, of course, obliged to take numberless precautions against them, removing out of their reach anything which they could eat or gnaw.

Dogs are most useful when dispatch is required, or when the temperature is so low that it is undesirable to expose more men than is absolutely necessary. Two men, with a good team of a dozen dogs, can travel with astonishing speed; the men securing themselves each night against frost-bite in a small snow-hut or burrow, when they can find a sufficient depth of snow to do so, but this is by no means always the case on sea-ice at a distance from the land. In this manner I made a journey of twenty-five days, with fifteen dogs, a driver, and an interpreter. We started on the 17th of February, and accomplished 420 miles; the temperature, which was sometimes as low as  $-48^{\circ}$ , averaged  $-30^{\circ}$  throughout. Snow-huts were built each night, although we were very slow and clumsy masons, requiring an hour and a half, instead of from one half to three-quarters of an hour, to house ourselves. My dog-driver, whose previous experience had taught him what luxuries this mode of travelling was capable of, used to sleep warmly

enough, with one dog at his back and another at his feet! An Esquimaux dog is more remarkable for the thickness of his fur than for anything else. He has a broad head and chest, keen scent, and strong dislike to the water. Our largest and best dogs measured 23 inches high at the shoulders, and weighed about 70 lbs. when in fair condition. Two dogs require the same weight of food as one man, and they will draw a man's full load for about one-fourth a greater distance than the man would. If both man and dogs are but lightly laden, the dogs will almost double the distance which the man could do.

I have now completed my brief outline of Arctic sledging operations, down to the return of the *Fox*, the last of the English expeditions.

All the experience gained in that memorable series of voyages between 1818 and 1859 has been brought to bear upon the equipment of the Expedition of 1875, and it is further intended that dogs and snow-huts should be used to a considerable extent.

As on former occasions, so now also, upon the persistency of their efforts in sledging will mainly depend the amount of their success.

To sledging we are indebted for almost all our modern Arctic achievements.

To it we confidently look, as a means of escape where neither ships nor boats would avail. And here, permit me to quote from a paper which I wrote some years ago:—

“It is now a comparatively easy matter to start with six or eight men, and six or seven weeks' provisions, and to travel some 600 miles across snowy wastes, and frozen seas, from which no sustenance can be obtained. There is now no known position, however remote, that a well-equipped crew could not effect their escape from, by their own unaided efforts.”

I had the great satisfaction of learning from Lieutenant Payer, when he recently visited this country, that these words of mine afforded very great encouragement to him and his companions, when their ship became inextricably beset, and when she was finally abandoned in the 80th parallel of latitude.

To sledging we owe many thousand miles of coast-line discovered and explored. And, finally, the recovery of the sad, but glorious, record of the heroic deeds of Franklin's Expedition. And to sledging we shall owe the principal share of whatever work may be accomplished by the brave men who have now gone out.

What their measure of success may be, none dare predict.

The public mind, perhaps unaware of the formidable difficulties

which surround it, points to the crowning glory of reaching the North Pole—that goal of so much ambition and endeavour.

This consummation is possible, and may the high distinction be theirs! But it is only fair to state, that so little practical improvement could be effected in the equipment of travelling parties, that we cannot reasonably expect that the sledging exploits of 1853 and 1854 will be eclipsed by those of 1875.

However, what has been done will be done again, if the state of the ice is at all similar; but of this we are, of course, uncertain. This is a grave uncertainty. We know that an open sea has been found at no great distance off the Siberian coast; and that it rendered nugatory all Wrangell's attempts to sledge northwards. Yet it is worthy of remark that Wrangell was one of the first, if not the very first person, to suggest an attempt to reach the Pole from Smith Sound.

No reliable indications of a similar state of things to that which he experienced off Siberia has been found anywhere northward of the islands and shores of America. We have occasionally been startled by announcements of open water; but a little further exploration has proved these iceless spaces, or Polynias, to be very limited in extent, and solely due to local and apparent causes, such as currents or tides, and they have only been found in straits, and not to seaward of an open coast-line.

Captain Nares has this advantage over Wrangell, that he is provided with boats fit to navigate a partially iceless sea, should his sledging be interrupted by water. Now, we know that the failure of Parry's attempt to reach the North Pole in 1827, was largely due to the great weight of his boats, and the consequent difficulty of dragging them over the ice. This error we have attempted to correct, by supplying boats of considerably less than half the weight of Parry's.

But Arctic explorers are well aware that there is one condition which bars all progress: and that is—ice which is too thin to sledge over.

Let us hope that our explorers may not meet with any such insuperable difficulty.

We know full well that ordinary obstructions will but strengthen their determination to solve the great geographical problem committed to them; and we have the satisfaction of knowing that this national undertaking could not be placed in abler hands. They will carry with them the assurance that they have not only our heartiest wishes for their success, but our entire confidence in their resolute endeavours to deserve it.

Admiral Sir RICHARD COLLINSON said, when the expedition in which he was engaged left England in 1850 they had the advantage of the experience gained up to 1849; but as they did not return until 1855 they could not profit by the improvements made in the intervening years, and were thrown upon their own resources. They never enjoyed the pleasure of scudding under easy sail over the ice, or the luxury of driving fourteen-in-hand. Three of the Eskimo dogs were embarked as the ship passed through Behring Straits, and others were subsequently purchased from the Esquimaux. It was our habit to harness three dogs next to the sleigh, and then to man the drag-ropes in front of them. Still they got through a great deal of work—in a great measure owing to the assistance they had from dogs. They became so attached to the ship, that when the ice broke up, and they could not get on board in any other way, they would go round for miles so as to get on the pack on the opposite side, and so reach the vessel. On one occasion, in travelling up the Victoria Strait, and the thirteenth day of absence from the ship, they were aroused by the dogs giving tongue. The disturbance was caused by the presence of a bear, and the party set off in chase, but were unable to overtake him. When they returned to the sledge, they found that a favourite dog was missing. They waited some time, but at last had to go on without him. In the middle of the next night, however, the dog overtook them. In all probability he had chased the bear, and brought him to bay, and stuck by him, hoping that the party would come up; but eventually had to abandon the bear, and had the sagacity to follow the new track of the sledge instead of that which led back to the ship. When he returned, nothing would satisfy him but to enter the tent and salute every one. He believed great things would be accomplished by the new Expedition; but still, as Sir Leopold M'Clintock had said, difficulties might be encountered which would prevent the attainment of the grand success which was hoped for. All that could be done, however, would be done by Captain Nares and his men. As Captain Allen Young, who was about to leave England on an independent private expedition, had left the meeting, he would state, for the information of the Society, that it was the intention of Captain Young first to follow (according to arrangement with Captain Nares) the track of the *Alert* and *Discovery* as far as the Carey Islands, where he would leave letters for the Expedition, and then endeavour to penetrate westward. Whether he would follow his own former track when serving with Sir Leopold M'Clintock in the *Fox*, or that of the *Erebus* and *Terror*, must depend upon the state of the ice. The *Erebus* and *Terror* got from Beachy Island to Victoria Strait in one season; but in attempting to pass through that strait they were blocked by the ice, and remained there for 18 months, until the ships were abandoned. If Sir John Franklin had known that King William's Land was an island, instead of attempting to get through Victoria Strait, he would have followed the Boothia shore-line, and so got out. He hoped the *Pandora* would be able to do that; and when it is remembered that Dr. Rae in his boat coming from the westward reached a point on the opposite side of Victoria Strait, in the same latitude that the *Erebus* and *Terror* were abandoned, and that the *Enterprise* wintered at Cambridge Bay, it would be seen that there was but a very short distance more to accomplish the whole passage. Ice-navigation was so uncertain that it would be an impropriety to hold out any very great hope, but he saw no reason why the *Pandora* should not accomplish the North-West Passage in one season.

Dr. RAE said he had listened with great pleasure to the admirable paper that had been read. The wonderful way in which Sir Leopold M'Clintock carried out the expedition in the *Fox*, showed an indomitable courage and energy which must be the admiration of everyone. He, however, differed from Sir Leopold as to the kind of sledge best adapted for Arctic work. He tried the runner-sledges in 1847, and made a journey of more than 700 miles; but

on the second journey of 590 miles the ice was so rough that no sledges could be used, and everything had to be carried. He had brought with him to the meeting a rough sketch of the sledge which he considered best adapted to the work. Flat-bottomed sledges were used in the large lakes, such as Superior, Winnipeg, and Bear Lake; but in the spring those lakes were covered with water, and therefore, when a sledge had a load of fine furs, the cargo must be so raised that the water could not reach it. Dr. Rae then described, with the aid of diagrams which he exhibited, the formation of his flat-bottomed sledge. It could not sink, he said, more than an inch or two, for the moment the snow got beyond the runners the whole of the flat body of the sledge rested on the snow. The runners were shod with steel and rounded off, so that the friction was extremely small. He was delighted to hear that the new Expedition would have recourse to snow-houses, which would enable them to reduce the weight on the sledges, there being no tents to carry, and less bedding. The sailors might soon learn to build snow-houses nearly as quickly as the Esquimaux. In crossing land the flat-bottomed sledge would be found of great advantage. The long journey made by the late Lieutenant Mechem was excellent, but he had the advantage of four or five depôts, with provisions, each way homeward and outward on the route. The great difficulty was the carrying provisions for the whole journey. When Sir Leopold M'Clintock was out 105 days, he also had some advantages, for he killed as many musk-oxen and deer as he liked, the marrow of which would give fuel, whilst the flesh gave food.

Admiral OMMANNEY expressed his admiration at the able way in which Sir Leopold had treated his subject; as they had served together in the Franklin Search, he had nothing more to add on the subject of sledge-travelling, so fully described in the paper. He (Sir Leopold) had, however, omitted to mention one of the great feats which he performed in 1851, when he made a journey of 900 miles in eighty days, and settled the question as to whether or not Sir John Franklin had wintered in Melville Island. He himself (Admiral Ommanney) was at the same time away from the ship for sixty days, and they both returned without any reduction in their size, and better in health than when they started. Even if Captain Nares only equalled what had been done before, during the search after Franklin, he would explore a great deal of the hitherto unknown Polar region. No fear was to be apprehended about the safety of the Expedition; and even if the Pole were not reached, he should be satisfied if Captain Nares came round the north of Greenland and returned to England by the East coast. No Expedition had ever left this country so perfectly equipped, and no finer sailors had ever visited the Arctic regions.

Admiral RICHARDS said it would be much to be regretted if an impression was allowed to go abroad that the Expedition had not been perfectly equipped as regards the sledging operations. Due credit must always be accorded to the officers of the Hudson Bay Company for the extraordinary journey they had performed, both in the ordinary routine of their duties and in the search for Franklin; and, no doubt, they adopted the kind of sledge and other equipment which their long experience taught them was best suited to their requirements; but their mode of travelling differed in many respects from that inseparable from Naval Expeditions. The former were mostly performed over land-snow, while the latter were almost exclusively confined to the frozen sea, and over every condition of ice—from smooth to rugged, and from rugged to the heaped-up pack frequently over 20 feet high; and the strongest possible description of sledge frequently gave way over the heavy ground it had to encounter. As to snow-houses, it must be remembered that out of the maximum period when travelling was possible, about 120 days, nearly one-third of the time the floe was bare of snow, and in its place a foot or 18 inches of water frequently prevailed, under which circumstances it would be difficult to con-

struct snow-houses. Tents, therefore, which weighed something less than 40 pounds were invariably adopted by the Naval Expeditions. Of course, many present could not be expected to understand the detail of Arctic travelling, or to be able to judge between the rival plans of the Hudson Bay officers and the Navy. It was all the more necessary, therefore, that distinct and unmistakable opinions should be given by those who have had the benefit of experience. It must be borne in mind that Arctic travelling is not in its infancy, but was brought to perfection more than 20 years ago. It was not to be expected, nor can it be hoped, that the present Expedition will perform greater feats of travelling than their predecessors, nor is it necessary they should to ensure entire success. In his opinion, everything connected with the equipment of the present Expedition was as nearly perfect as it possibly could be, and if any one part of it was more perfect than another, it was undoubtedly the travelling equipment.

SIR LEOPOLD M'CLINTOCK, in reply, said Dr. Rae and himself had talked over the details to which Dr. Rae had alluded, twenty years ago, and they were thoroughly acquainted with each other's views. If Dr. Rae had really and sincerely felt that he could have aided the Arctic Expedition by his diagrams and plans, he undoubtedly would have exhibited them before the vessels started. The method of utilizing a flat sledge for travelling over flooded ice, by raising its cargo a foot or 14 inches in order to keep it dry, was a very good makeshift, but nothing more; it would be topheavy, and upset the moment it attempted to move over hummocks. No Government Expedition had ever left this country without being provided with flat sledges, and abundant opportunity had been afforded of testing them, but they had been invariably discarded. He had taken them with him, and had found that when the cargo was on them they rolled over when they came to hummocky ice. Everyone could understand that for ice of any kind it was better to have steel runners, after the fashion of skates. If they trusted to Dr. Rae's flat sledges, and when 300 or 400 miles from the ships the provisions were upset, wetted, and spoiled, it would be unpleasant, to say the least of it. He himself had travelled nearly 5000 miles with sledges, and nearly 50,000 miles of sledging had been accomplished by the different Arctic Expeditions; there had been great competition among the leaders, each striving to invent something new, and it had been found that by grouping the men together better work was done than when small sledges, with only one or two men, were used. The longer the sledge the more easily it travelled, on the same principle that a large wheel would run more easily than a small one. Formerly sledges were only 10 feet long, but now they were made 14 feet; and for one description of work, namely, attempting to cross fissures and glaciers, they had 16-foot sledges. It would puzzle even Dr. Rae himself to carry a 20-foot boat to the Pole on a flat sledge; it was necessary to have large and wide sledges. The Arctic Expedition which had just started had sledges of different lengths: 16-foot; 14-foot (in which he hoped the Pole would be reached); 11-foot, to be drawn by seven men, and to do the great bulk of the work; 8-foot, for carrying dispatches, to be drawn by dogs; and 6-foot, or satellite sledges. His object in building these small ones was to enable the naturalists, with very little assistance, to drag their own specimens. He had used snow-houses in the *Fox* Expedition, and made it a part of the exercise during the winter to build them. He found that parties of four men each could hut themselves in about thirty-five minutes, under favourable circumstances; but the further north the Expedition went, and the further from the shore a party was, the less frequently was snow met with suited for building these houses. A tent to enclose eight men weighed only about 40 lbs., which was a mere trifle. It was Captain Nares' intention to make snow-huts wherever he considered it advisable, and he had been provided with snow-knives and saws, and everything necessary for the purpose. If a depôt were formed, say



100 miles from the ship, a series of snow-huts would be built between the two, so as to obviate the necessity, in such a case, of carrying tents.

Dr. RAE asked permission to make a few further remarks. The sledge he had described was nearly 2 feet broad, and would not turn over as Sir Leopold asserted. If a man walked at the head of it he could prevent its turning over, and could keep it as steady as was necessary. In 1851 he travelled in a flat sledge only 14 inches wide, near the Coppermine River, where there was deep water, and got along very comfortably. These sledges had iron runners on them, which would work on hard snow or ice, but the moment they came to soft snow the flat part or the sledge prevented it from sinking.

Mr. DALLAS asked what was the part of the Arctic Region in which the greatest cold occurred? He had spent several years in North America far to the south of the Arctic Circle, but the extreme cold there was not much less than the greatest he had heard of within the Polar Zone. Admiral Collinson had expressed an opinion that the greatest cold would be found near the Magnetic Pole.

Admiral Sir R. COLLINSON replied that the winter spent by the *Enterprise* in Cambridge Bay was colder than the winter spent by Sir E. Belcher and Captain Kellett, who were from 4° to 6° further to the north. There could be no doubt that an impression did prevail that the neighbourhood of the Magnetic Pole had some influence upon the temperature, but that was the result of only one year's observation.

The PRESIDENT, in concluding the proceedings, said these discussions with regard to sledge-travelling were of very great interest, because it was upon sledge-travelling that the success of the new Expedition mainly depended. There was no very determinate scientific advantage to be gained by reaching the Pole, though there was a certain popular sentiment with regard to that object, and no doubt the nation would be very much disappointed if the Pole were not reached. It was evident that if the expeditions which Sir Leopold M'Clintock had described had been directed northwards, instead of east and west, the Pole would have been reached. From the point where Captain Nares hoped to winter in 82° N., it was only 480 geographical miles to the Pole; and at the rate at which Lieutenant Meham travelled, the journey would only occupy from 25 to 30 days. The great object of the Expedition was to run as far north as possible, and to establish depôts along the route, so that the intervals over which sledge parties would have to carry their own provisions might be as small as possible. If such depôts could be formed halfway between 82° N. and the Pole, there could be no doubt that the remainder of the distance could readily be accomplished. At the same time this was not the essential scientific object in view. All would be very much delighted if the Pole were reached, but even if it were not, there could be but little doubt that many valuable scientific results would be attained, which would be intrinsically of much greater importance. Admiral Collinson, when alluding to Captain Allen Young's Expedition, omitted to mention that along the coast there was an inexhaustible supply of drift-wood for fuel. The *Pandora* is a steamer; and if she could once reach the coast, this drift-wood would, no doubt, enable her to run to Behring Straits within the month. Of course, it would be impossible for her to carry coal sufficient for the whole voyage; but availing himself of the natural supply of drift-wood, Captain Allen Young might very possibly be the first officer to perform the entire North-West Passage from Baffin Bay to Behring Straits. All present must wish him success in his attempt.