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499TH ORDINARY GENERAL MEETING.

MONDAY, DECEMBER 7TH, 1909.

PROFESSOR E. HULL, LL.D., F.R.S. (VICE-PRESIDENT),
IN THE CHAIR.

The Minutes of the preceding Meeting were read and confirmed.

The following elections were announced :—

Members : Cecil Broadbent, Esq.
Colonel F. B. P. White.
Colin MacLarty, Esq.
Professor F. Roget, of Geneva.
Rev. Prebendary Shelford, M.A.
Associates : F. P. Trench, Esq., M.B., F.R.C.S.Ed.
Rev. F. Cecil Lovely, B.A.
Rev. F. Webster Maunsell, M.A.

In the absence of the author the following paper was then read by the Secretary :—

THE IVORY ISLANDS IN THE ARCTIC OCEAN.

By the Rev. D. GATH WHITLEY.

IN many recent and valuable works of science, the distribution of the remains of the Mammoth in Siberia have been described. We now understand fully that the bones and tusks of Mammoths are found over the *whole* of Siberia, and that they are particularly abundant in the northern portions of that country. The remains of the Mammoth in fact increase in numbers as we travel from southern to northern Siberia, until we find them in their greatest abundance on the shores of the Arctic Ocean. We also frequently find that many perfect bodies of Mammoths and rhinoceroses are found in the frozen soil of northern Siberia.* These carcasses are, when discovered, quite perfect, and have been preserved in this condition, by the perpetually frozen soil in which they are buried. It is therefore absolutely necessary to believe that the bodies were frozen up immediately after the animals died, and *were never once thawed*, until the day of their discovery. No other theory will explain the perfect preservation of the bodies of these great elephants.

* Isherski, J. D., *Mem. Acad. Imp. St. Petersburg*, vol. xl, 1892.

Strange as these facts are we have now to examine something still more remarkable, and to consider the extraordinary phenomenon of the occurrence of enormous masses of elephants' bones in desolate islands of the Arctic Ocean. In the icy waters of the Polar Sea to the north of Siberia, there lie islands which are enclosed in ice for the greater portion of the year. Nevertheless the soil of these desolate islands is absolutely *packed full* of the bones of elephants and rhinoceroses in such astonishing numbers, that no places in the whole world contain such quantities of elephants' remains, as do these icy islands in the Arctic Sea. The whole records of science contain no stranger chapter than that which describes the discovery and position of the remains of the Mammoth in the islands in the Arctic Ocean.

It would be difficult to imagine a more dreary expanse of the sea than that portion of the Arctic Ocean which lies directly to the north of Siberia. For nine months in the year it is continually frozen, and during the long winter it seems to be abandoned to the spirit of the North Pole. What adds to its loneliness also, is the fact that even in summer nearly the whole extent of its coast is uninhabited by human beings. Nordenskiöld says that, in his voyage along the northern coast of Siberia in the *Vega* during the summer of 1878, he did not see a single human being on the shore, in the whole stretch from Yug or Schar (at the westernmost point of Siberia) to Cape Chelagskoi. In fact it was only when the *Vega* reached the land of the Chukches, in the extreme north-east of Siberia, that human inhabitants were seen.* This loneliness of the Siberian coast is in striking contrast to the constant signs of man which are met with along the arctic shores of America, where the huts of the Eskimo cover the coast, and their boats are constantly passing to and fro over the waters. In sailing along the Siberian coast neither boats nor houses are seen, and until the Chukche country is reached no signs of man are visible.

The navigation of the Arctic Ocean to the north of Siberia is, in summer, both difficult and dangerous. At that season of the year the enormous fields of ice which cover the ocean during the winter are indeed broken up, but great masses of ice are always drifting to and fro, and these are often of great size, although the colossal icebergs which float over the Greenland seas are not encountered. Fogs in summer are thick and frequent, and render the progress of a vessel slow and difficult,

* *Voyage of the "Vega,"* vol. i, pp. 429, 430.

as they conceal the icebergs, and hide all indications of shoals and sandbanks. Animal life is, in summer, wonderfully abundant and varied. Whales swim and spout in the sea. Seals abound on the beach, and sport amid the waves. The white whale, and the beautiful narwhal with its spotted body and its long horn, plunge and toss to and fro in the waters, and the walrus in great numbers basks on the ice-fields or swims in the waves. Birds of all kinds exist in countless numbers, either soaring overhead, or perching in myriads on the ledges of the cliffs, where they keep up a perfectly deafening screaming.

The ice on the Arctic Ocean to the North of Siberia breaks up in the end of June or in the beginning of July, and the sea, in this region, may freeze at any time from the middle of September to the beginning of October. The *Vega* entered the Kara Sea on August 1st, 1878, and was frozen in a short distance to the north-west of Behring's Straits on September 28th, and the ice around the vessel did not break up until July 18th of the following year. When frozen the surface of the sea is not smooth, but is covered with ridges of ice which are often 70 or 80 feet high, and are most difficult to cross in the dog-sledges in which the natives traverse the frozen sea. Even in winter animal life is not entirely absent from the icy wilderness. Bears prowl over the ice-fields, seals appear here and there, stone-foxes wander about, following the tracks of the bear, to pick any leavings from its feasts, and the ptarmigan and snowy-owl winter amidst the icy wilderness.

The honour of discovering and of surveying the Siberian Arctic Ocean belongs entirely to the Russians. Sir Hugh Willoughby, with the English expedition of 1553, died before he could enter the Kara Sea, and although the Swedish expedition under Nordenskiöld in the *Vega*, was the first that made a continuous voyage in a single vessel from Novaya Zemlya to Behring's Straits, the coasts along which the *Vega* sailed had been surveyed and mapped by the Russians long before. In the latter part of the sixteenth century the merchants of Archangel carried on an extensive coast trade with northern Siberia. They dragged their large boats across the Kanin peninsula on the east of the White Sea, and having traversed the Kara Sea, they reached the coast of the Yalmal Peninsula. Ascending a river in this peninsula they dragged their light boats across the watershed, and descending another river they gained the Gulf of Obi. Thence they voyaged to the Yenesei, and made their way up that river to the town of Mangaseia, where they met merchants and natives from the south and east, and after

exchanging goods, the Russians returned to Archangel with valuable cargoes of furs and other merchandise. This trade was carried on for some time, until the conquest of Siberia by the Russians diverted it into other channels. When the conquests of the roving Cossacks had firmly established the Russian authority over the greater portion of Siberia, bands of traders searching for furs, began to explore the coasts of the Arctic Ocean. All through the last half of the seventeenth century these expeditions were carried on, and vague reports of islands, situated amidst the ice-fields of the Polar Sea, from time to time reached the Russian settlements. In the early part of the eighteenth century more scientific voyages were undertaken, and the coasts were more carefully examined. Vessels were built at Tobolsk, and Irkutsk, and in these the Obi and the Lena were descended to the icy sea, and the shores were surveyed in all directions. In these voyages the Russians often caught sight of islands far to the north, although they were not able thoroughly to examine them. In 1711 Permakoff, a Cossack who lived near the mouth of the Yana, made a voyage from the Lena to the Kolyma, and saw large islands off the mouths of the Kolyma and the Yena, which were according to his report, very mountainous. In 1712 a large expedition left the mouth of the Yana for the north, and discovered a large island, which was rugged and barren, and in 1760 a Yakut called Eterikan saw a large island to the north-east of the mouth of the Lena. These reports raised the interest of the fur-hunters, and before long a remarkable discovery was made.

One of the most active and successful of the fur-hunters of that time was named Liakoff, and he from time to time obtained great quantities not only of valuable furs, but also of fossil ivory from the tusks and teeth of the mammoths, which he himself collected or received from the native Siberians. In 1750 Liakoff had been particularly successful, and had gathered a vast quantity of mammoths' tusks and remains on the desolate plains between the rivers Anabar and Khatanga. From this region he returned with his spoils, to the southern districts, and in order to carry on his expeditions with greater celerity, he built huts near the mouth of the Yana, at a place called Ustÿansk, where he and his assistants could pass the winter. In 1770 in the month of March, he left this winter settlement accompanied by a friend named Protodiakonoff, and reached the promontory of Svaiatoi Noss. This is a bold headland which runs out into the Arctic Ocean, about 300 miles east of the mouth

of the Lena, and half-way between the mouths of the Yana and the Indigirka. It derived its name the "Holy Cape" from the fear with which the Russians regarded it, for the ice was piled against it in such masses, that it was most difficult to sail round it. It had been thought impossible to pass it, and one gallant voyager, Demetrius Laptieff, had declared that it could not be doubled. But in 1734 he himself sailed past the dreaded cape and voyaged in safety to the Kolyma. It was in the month of April when Liakoff reached Svaiatoi Noss, and at that time the sea was fast frozen. Standing on the promontory and looking out over the icy expanse of the frozen ocean, nothing could be seen save the dreary prospect of the icy waste, ridged into long furrows, and still and motionless as death. As Liakoff looked out over the vast frozen expanse, he saw a long line of black objects approaching over the ice and drawing near to the shore. and speedily perceived that the moving mass consisted of an enormous herd of reindeer on the march. He concluded that they had left some land far to the north, and were returning to the southern regions. Such a supposition was not necessarily correct, for it has constantly been observed by the fur-hunters, that the reindeer will frequently go over the ice to a long distance from the shore, in order that they may get at the salt, which is left by the evaporation of the sea water, and of which they are extremely fond. Liakoff, however, felt certain that the reindeer were coming from some northern land, and in the beginning of April he started in his sledge drawn by dogs over the ice, from Svaiatoi Noss, in search of the northern land. He started early in the morning, and after sledging over the ice nearly all day, in a northerly direction, came to an island, about 50 miles from the shore, where he spent the night. Next morning he followed the traces of the reindeer still further to the north, and having gone about 15 miles over the ice reached a second island, much smaller than the first. The reindeer track, which he still followed, continued to lead to the north, and Liakoff drove his dogs forward in this direction. He had not gone far from the second island, however, before he found that the ice was so rugged, and was ridged up into such high mounds and hummocks, that he was quite unable to proceed further as his dogs could not advance over the high ridges of ice which covered the frozen surface of the sea. No land could be seen in any direction, and the dreary prospect of snow and ice extended on all sides as far as the eye could reach. Liakoff therefore was placed in a position of great peril, and had to spend the night on the ice. He then returned, and after

passing through difficulties, owing to the want of provisions for his dogs, he succeeded in regaining the coast at Svaiatoi Noss. He next went to Yakutsk, and informed the Russian authorities there of his discoveries, and they forwarded the account to St. Petersburg. The Empress Catherine II. ordered the islands to be called by Liakoff's name, and she also granted to him the sole right of collecting mammoths' tusks and of searching for furs in the islands he had found, and in any others that he might discover.

In the summer of 1773 Liakoff resumed his discoveries. He was accompanied by Protodiakonoff and other companions, and as the ice had at this time melted, they made the voyage to the islands in a five-oared boat. They crossed the strait between the mainland and the first island, and found the water in the strait very salt, with the current setting strongly from the west. From the first island they went to the second—which was afterwards called Maloi—and then steered boldly towards the north, in search of still more distant lands. The air was clear, and they soon discerned land to the north, and before long the bold voyagers reached a third island, which was of great size. The land was barren and mountainous, and bore not the least vegetation, although the shore was covered with driftwood. No trace of man could anywhere be seen, but bears, wolves, and reindeer were wandering over the desolate wastes, and whales were swimming and spouting amidst the waves. Liakoff and his companions found tusks of mammoths on this island, which they called Kotelnoi, as one of the party left a copper kettle on it. Liakoff returned to his first island, and built a hut of driftwood for his workmen on it, and all were engaged in collecting mammoths' tusks, which were also found abundantly on the first island. Having passed the winter on the latter, Liakoff returned in the spring to Ustÿansk, with a rich supply of mammoths' tusks and valuable furs.

The enormous quantities of mammoths' bones and tusks found by Liakoff in these islands raised the curiosity of the Government, and the Russian officials at Yakutsk ordered a surveyor named Chwoinoff to proceed to the islands, and to survey them thoroughly. Chwoinoff left Yakutsk for this purpose in the early part of 1775, and reached Liakoff's station on the mainland at Ustÿansk in the end of March. He crossed the bay to Svaiatoi Noss, and reached the first island discovered by Liakoff, and which has always afterwards been called Liakoff's Island. He found that this island—which contained the huts of the diggers for fossil ivory—was of considerable

size, but with the exception of some high mountains, it seemed to be wholly composed of ice and sand. Such was the enormous quantity of mammoths' remains, that it seemed to Chwoinoff that the island was *actually composed* of the bones and tusks of elephants, cemented together by icy sand. The horns of buffaloes (or rather of musk-oxen) and rhinoceroses were also wonderfully abundant. The sandy shores and slopes were full of mammoths' tusks, and when the ice cementing the cliffs was thawed by the heat of the sun, the sand fell down in great quantities, bringing with it great numbers of elephants' tusks, of which these cliffs seemed to be full.

About fifteen miles from Liakoff's Island was the second island discovered by him, and afterwards called Maloi, and here also Liakoff's people had collected a rich supply of the bones and tusks of the mammoth. The surface of the island consisted of a bed of thick moss on which many beautiful flowers were growing, but underneath were cliffs of pure ice. It was possible to strip off the moss like a carpet from a floor, and beneath was pure ice which never thawed.

Chwoinoff now started northwards for the third island or Kotelnoi, and found the straits beneath it and Maloi to be about 75 miles in breadth. He travelled along the shore, and having discovered a considerable river, he named it in honour of the Empress, the Czarina River. All the shores were covered with driftwood. He discovered three large rivers which were full of fish, and the waters of which brought down large quantities of driftwood from the interior of the island. This last discovery shows that *trees* once existed in this island (Kotelnoi) in great abundance. Chwoinoff climbed to the top of a lofty mountain, and as the weather was clear he obtained an extensive view, which consisted of lofty mountains, which stretched away to the east, west, and north, for a long distance. He passed the summer on Kotelnoi, and returned in the autumn to Svaiatoi Noss.*

For thirty years Liakoff enjoyed the sole right of carrying away the vast stores of fossil ivory from these wonderful islands. He built huts and formed settlements for his people on them, and his agents went to them in sledges over the

* The account of these discoveries was given by Protodiakonoff to Martin Saur when the latter was at Yakutsk in 1788. Saur wished to hear of them from Liakoff himself, but Liakoff being old referred him to Protodiakonoff, who related the narrative to him. The account may be found in Saur's *Narrative of an Expedition to the Northern Part of Russia*, by Captain Joseph Billings, pp. 103-106.

ice in winter, and in boats in the summer. Every year great quantities of ivory were taken from the islands and sold in the markets at Yakutsk.

On the death of Liakoff, the Russian Government granted the monopoly of trading in these islands, in 1805, to a merchant of Yakutsk named Sirovatskoi, who sent his agent Sannikoff to explore the islands, and, if possible, to discover more islands in these wonderful regions. Discoveries now commenced which were as remarkable as those of Liakoff, and which amply repaid Sirovatskoi for his labour and outlay. In 1805, Sannikoff discovered to the east of Kotelnoi, a large island which he called Fadeyeffskoi; and in 1806, the younger Sirovatskoi discovered another large island still further to the east, which received the name of New Siberia.* Two smaller islands—Stolbovoi and Belkova—were at the same time discovered. These islands were full of mammoth bones, and the quantity of tusks and teeth of elephants and rhinoceroses, found in the newly discovered island of New Siberia, were perfectly amazing, and surpassed anything which had as yet been discovered.

Before long—as was natural—disputes arose as to the monopoly of collecting the fossil ivory in these wonderful islands, and petitions were addressed to the Russian Government on the subject. This induced Count Romanzoff, then Chancellor of Russia, to order Hedenström, a Siberian exile, to explore the islands, and Romanzoff fitted out the expedition at his own expense. Hedenström started from Ustÿansk, near the mouth of the Yana, on March 19th, 1809, taking with him two companions, and for three consecutive seasons they examined the islands. Hedenström found that the quantity of fossil ivory on the first island found by Liakoff (*i.e.*, Liakoff's Island) was so enormous, that, although the ivory diggers had been engaged in collecting ivory from it for forty years, the supply seemed to be quite undiminished. On an expanse of sand little more than half a mile in extent Hedenström saw ten tusks of mammoths sticking up, and as the ivory hunters had left these tusks because there were other places where the remains of mammoths were *still more abundant*, the enormous quantity of elephants' tusks and bones in the island may be imagined. Sannikoff—who accompanied Hedenström—was equally amazed at the quantity of the remains of the mammoth in Liakoff's Island, and—like Chwoinoff thirty years before—he declared

* Wrangell's *Siberia and the Polar Sea*, pp. 481, 482.

that the *whole soil* of the island seemed to be formed of elephants' bones. Another of Hedenström's discoveries was equally wonderful. He found that on a sand-bank on the western side of the island after a strong gale, mammoth bones and tusks were always found to be washed up, so that it was plain that there was an enormous accumulation of elephants' remains *under the sea* in this region. The other islands further to the north were also visited by these explorers. Sannikoff explored Kotelnoi, and found that this large island was full of the bones and teeth of elephants, rhinoceroses, and musk-oxen. Having explored the coasts Sannikoff determined, as there was nothing but barrenness along the shore, to cross the island. He drove in reindeer sledges up the Czarina River, over the hills, and down the Sannikoff River, and completed the circuit of the island. All over the hills in the interior of the island Sannikoff found the bones and tusks of elephants, rhinoceroses, buffaloes, and horses in such vast numbers, that he concluded that these animals must have lived in the island in enormous herds, when the climate was milder. When on the island of Fadeyeffskoi, which lies immediately to the east of Kotelnoi, Sannikoff saw far to the north a distant land with high mountains, and started in sledges over the ice to explore it. He, however, could not reach the unknown island, for when he had gone about thirty-five miles over the ice, he came to a large expanse of open water which extended on every side. This was in the beginning of April, 1811, and another attempt to go northwards, made by him shortly afterwards, was also stopped by open water. Hedenström and Sannikoff thoroughly examined the large island of New Siberia, which contained wonders as surprising as Kotelnoi, and so enormous were the quantities of mammoths' tusks on it, that in 1809 Sannikoff brought away 10,000 lbs. of fossil ivory from New Siberia alone. It was on this dreary and icy island that Hedenström made another remarkable discovery. He found in this desolate wilderness, the shores of which are blocked by ice for the greater part of the year, the remains of enormous *petrified forests*. The trunks of the trees in these ruins of ancient forests were partly standing upright and partly lying horizontally buried in the frozen soil. Their extent was very great, and he described them as follows:—
“On the southern coast of New Siberia are found the remarkable wood hills (*i.e.*, the remains of the forests). They are 30 fathoms high, and consist of horizontal strata of sandstone, alternating with strata of bituminous beams or trunks of trees. On ascending these hills fossilized charcoal is everywhere met,

covered apparently with ashes, but on closer examination this ash is also found to be a petrification and so hard that it can scarcely be scraped off with a knife. On the summit another curiosity is found, namely, a long row of beams, resembling the former, but fixed perpendicularly in the sandstone. The ends, which project from 7 to 10 inches, are for the greater part broken. The whole has the appearance of a ruinous dyke.* These "wood hills" rise to such a height that they were visible from a distance of nearly 80 miles: similar buried forests are found in the island of Kotelnoi. By these expeditions the islands were thoroughly surveyed.†

These discoveries were truly wonderful. These islands had never before been visited, and a most lucrative trade in fossil ivory was speedily opened up from them. So enormous was the quantity of tusks of elephants and rhinoceroses discovered in New Siberia that in 1821 one trader brought away 20,000 lbs. of fossil ivory from New Siberia *alone*.

In 1821-23 the Russian Government sent Admiral Wrangell to the Northern coast of Siberia, in order that he might survey the regions around the mouth of the Kolyma, and Lieutenant Anjou, who accompanied Wrangell, was directed to examine the New Siberian Islands. Anjou was instructed to survey the islands, and to endeavour to reach the unknown land which Sannikoff had seen from the northern coasts of Kotelnoi and Fadeyeffskoi. The instructions of the government were ably carried out by Anjou, but he was unable to advance far over the ice to the north of the New Siberian Islands, because he was always stopped by open water. He was consequently quite unable to discover Sannikoff's mysterious island. The "Wood Hills" in New Siberia, discovered by Hedenström, were visited by Anjou who thus describes them—"They are merely a steep declivity, 20 fathoms high, extending about 5 versts (3 miles) along the coast. In this bank, which is exposed to the sea, beams or trunks of trees are found, generally in a horizontal position, but with great irregularity, fifty or more of them together, the largest being about ten inches in diameter. The wood is not very hard, is friable, has a black colour, and a slight gloss. When laid on the fire it does not burn with a flame, but glimmers, and emits a resinous odour."‡

* Wrangell, *idem*, p. 486 (note).

† The account of Hedenström's journey is given by Wrangell in his book, pp. 482-500.

‡ Wrangell, p. 486 (note). An account of Anjou's expedition is given in Wrangell's book above quoted.

In 1829 the scientific German traveller Erman visited Yakutsk, and obtained some valuable information about the wonderful stores of fossil ivory in the Liakoff and New Siberian Islands. The monopoly of trading in the islands had been abolished, and the traders from Yakutsk and Ustÿansk journeyed to the islands in dog-sledges every year. The soil of the islands was described to Erman as being full of the bones of elephants, rhinoceroses, and buffaloes, and the tusks of elephants could be seen sticking up out of the frozen sand. In order to find good deposits of mammoths' bones in the islands, the traders were in the habit of ascending the hills and marking the places where they saw the tusks projecting above the ground, and deposits of ivory in the desolate plains, were often discovered by the sight of a single tusk sticking up from the ground.* From information furnished him by the ivory traders, Erman thus describes the "Wood Hills" in the island of New Siberia: "In New Siberia, on the declivities facing the south, lie hills 250 or 300 feet high, formed of driftwood; the ancient origin of which, as well as of the fossil wood in the tundras, anterior to the history of the Earth in its present state, strikes at once even the most uneducated hunters. They call both sorts of *Adamovchina*, or Adamitic things. Other hills on the same island, and on Kotelnoi, which lies further to the west, are heaped up to an equal height with skeletons of pachyderms, bisons, etc. which are cemented together by frozen sand as well as by strata and veins of ice. It is only in the lower strata of the New Siberian wood-hills that the trunks have that position which they would assume in swimming or sinking undisturbed. On the summit of the hills they lie flung upon another in the wildest disorder, forced upright in spite of gravitation, and with their tops broken off or crushed, as if they had been thrown with great violence from the south on a bank, and there heaped up."†

In 1878 the *Vega* traversed the Arctic Ocean north of Siberia, and Nordenskiöld was anxious to land on the wonderful islands, which contained such masses of the remains of mammoths, rhinoceroses, and musk oxen. Before the *Vega* started, M. Sibiriakoff (who defrayed a portion of the expenses of the expedition) collected much information from the ivory hunters about the "islands of bones" in the Polar Sea. They informed him that the trade in fossil ivory still continued, and that many

* *Travels in Siberia*, vol. ii, pp. 376, 383.

† *Ibid.*, vol. ii, pp. 379-380.

traders made their living by collecting mammoths' tusks on the New Siberian Islands, and the ivory hunters declared that in summer the sea between these islands and the mainland is generally free from floating ice.*

On August 28th, 1878, the *Vega* sighted the most western of the Liakoff Islands, *i.e.*, Semenoffskoi and Stolbovoi, but the sea was so shallow and was so encumbered with rotten ice that navigation was slow and difficult. Nordenskiöld thus describes his further experiences amongst the islands:—

“It was not until August 30th that we were off the west side of Liakoff's Island, on which I intended to land. The north coast and, as it appeared the day after, the east coast was clear of ice, but the winds recently prevailing, had heaped a mass of rotten ice on the west coast. The sea besides was so shallow here, that, already at a distance of 15 feet from land, we had a depth of only 8 metres. The ice heaped against the west coast of the island did not indeed form any very serious obstacle to the advance of the *Vega*, but in case we had attempted to land there it might have been inconvenient enough, when the considerable distance between the vessel and the land was to be traversed in a boat or the steam launch. The prospect of wandering about for some days on the island did not appear to me to outweigh the danger of the possible failure of the main object of the expedition. I therefore gave up for a time my intention of landing. The course was shaped southwards towards the sound, of so bad repute in the history of the Siberian Polar Sea, which separates Liakoff's Island from the mainland.

“So far as we could judge at a distance from the appearance of the rocks, Stolbovoi consisted of stratified rocks, Liakoff's Island, on the contrary, like the mainland opposite, of high hills, much shattered, probably formed of Plutonic stone-masses. Between these there are extensive plains, which, according to a statement by the land surveyor, Chwoinoff, who by order of the Czarina visited the island in 1775, are formed of ice and sand, in which lie embedded enormous masses of the bones and tusks of the mammoth, mixed with the horns and skulls of some kind of ox and with rhinoceros' horns. Bones of the whale and walrus are not mentioned as occurring there, but ‘long small screw-formed bones,’ by which are probably meant the tusks of the narwhal.”†

* *Voyage of the “Vega,”* vol. i, pp. 24, 27.

† *Ibid.*, pp. 415–418.

A few months afterwards the unfortunate American vessel *Jeannette* entered the Siberian Polar Sea. She left San Francisco on July 8th, 1879, and in September of the same year she was frozen into the ice, from which she was never extricated, as she sank on June 13th, 1881. Captain De Long (her commander) and the crew escaped over the ice, partly in boats, and partly in sledges. Just before the *Jeannette* was enclosed in the ice, she discovered two islands which were named Jeannette and Henrietta Islands, and which lie in longitude 160° E. After having threaded their way for some time amidst masses of floating ice, and being carried along by drifting ice-fields, the crew of the *Jeannette* discovered a very large island which had hitherto been quite unknown. This they named Bennett Island, and took possession of it on behalf of America.* This island contained high mountains which rose to a height of 2,500 feet above the sea, and were covered with snow, while glaciers descended from their snowy sides, and flowed down to the sea. Towering cliffs rose above the beach, and the precipices were alive with sea birds, which kept up a deafening screaming. The lower hills were quite bare of trees or bushes, but were covered with green moss, which made them look quite refreshing to the weary voyagers, who had been so long shut up in the ice-fields. The island is, in the main, volcanic, being chiefly composed of trap rocks. Bituminous coal also was found, which burnt readily. This occurred in a vein extending down the mountain side.† According to Baron Toll, who in 1902 visited Bennett Island, sedimentary rocks of Cambrian age occur in it, whilst in the brown coal he discovered the remains of conifers.‡ Further to the eastwards, and close to the shore the water deepens, and the islands are fewer and smaller.

Leaving Bennett Island on August 6th, the *Jeannette's* crew shortly afterwards left the ice, and in three boats began their voyage to the south. The north shore of the island of New Siberia, which is perhaps the richest of all the islands of the Arctic Ocean in mammoth remains, was seen on the 20th, but the ice around the island prevented a landing. Much beset in the ice the boats slowly drifted down the strait between the two islands of Fadeyeffskoi and New Siberia, until on the 31st of August, the wearied voyagers landed on the island of

* See Gilder's *Ice Pack and Tundra*, chap. xxi.

† *The Voyage of the "Jeannette,"* by Emma de Long, vol. ii, p. 283.

‡ *Geographical Journal*, June, 1904, p. 770.

Fadeyeffskoi. This island was discovered by Sannikoff in 1805, and large quantities of the tusks and teeth of elephants (*i.e.*, mammoths) and rhinoceroses have been carried away from it. The *Jeannette's* crew, however, did not find it a very attractive spot, for, as far as they could observe, the island was mainly composed of mud hills, which were fast wearing away and forming shoals off the land. Beyond the low hills inland the island seemed to consist of mossy swamps. The searchers for ivory had been there not long before, as an empty hut stood not far from the shore. The *Jeannette's* crew found on Fadeyeffskoi an elephant's tusk and a bone of the same animal.* Much troubled by floating ice and snow storms, and buffeted by winds and waves, the voyagers after leaving Fadeyeffskoi, landed on September 2nd on the S.E. coast of the island of Kotelnoi. The land was moderately high, with small beaches here and there, and flocks of snowy owls were sitting on the ledges in the cliffs. The searchers for mammoths' tusks had been at work in this island, for in some earth hills excavations were found. A hut was also seen, as well as some Russian relics. Two elephants' tusks and other fragments of fossil ivory were found in this island by different members of the *Jeannette's* party.†

Captain de Long and his companions left Kotelnoi in their three boats for the Siberian coast on September 7th, and, steering southwards amidst rough gales and snow storms, and encountering much trouble from the masses of floating ice, they reached on the 10th the island of Semenoffskoi. They landed, and found teeth of elephants, as well as horns and traces of reindeer. The earthy deposits on this island evidently contain mammoths' remains.

A terrible disaster now overtook the voyagers. A storm burst upon them on the 14th of September when they were near the coast of Siberia, and the three boats were separated. One sank, no traces of her being ever discovered. Captain de Long and the party in his boat reached the shore, and landed at the northern mouth of the Lena. They made their way southwards for a short time, but, overcome by famine and exhaustion, all died with the exception of two sailors. The party in the third boat, under Lieutenant Melville, reached the Russian settlements in safety. Thus we find, that although the

* *Our lost Explorers*, p. 314.

† *The Voyage of the "Jeannette,"* vol. ii, pp. 740, 741.

Jeannette's crew did not meet any searchers for fossil ivory in the New Siberian Islands, they found the tusks of mammoths in all the islands on which they landed.

Dr. Henry Lansdell, who has given such a valuable account of Southern and Central Siberia, refers to the ivory trade from the New Siberian Islands.* He describes the trade as it existed in 1882, and refers to the vast quantity of fossil ivory brought to Yakutsk from the islands in the Arctic Ocean. That there is even now no falling off in the trade in elephants' tusks is shown by the fact that in 1898, some 80,000 lbs. of fossil ivory were offered for sale at the fair at Yakutsk. This is greatly in excess of the average annual sale of fossil ivory at Yakutsk, which, according to M. Stadling, is 40,000 lbs.

A valuable addition to our knowledge of the Mammoth Islands in the Arctic Ocean geologically, was made by Baron Toll and Professor Bunge, who thoroughly examined both the Liakoff and the New Siberian Islands. In 1886, Dr. Bunge visited Kotelnoi, but the bad weather and want of fuel prevented his expedition from being a success. Dr. Bunge then proceeded to Liakoff's Island (*i.e.*, his *first* island) which he thoroughly explored. Granite peaks rose here and there on the island, but its greater portion was composed of alluvial soil. The sand and gravel was found to rest on blocks of ice, and the alluvial beds were full of the bones of mammoths, rhinoceroses, and musk oxen. Along with these animals there were also found the bones of oxen, horses, and deer; in fact, the island was *full* of the bones of animals, which must formerly have lived in this desolate island in enormous numbers. When we reflect that for *a hundred years* the ivory hunters have been every year taking away tusks and teeth from this island, and yet the supply continues, we may form some idea of the countless and incalculable masses of animal remains which it must have contained when discovered. Baron Toll in the same year visited both the islands of Fad'yeffskoi and New Siberia. He examined the "Wood Hills" on New Siberia, and found them to consist of carbonised trunks of trees, with impressions of leaves and fruits, and he considered that they resembled the fossil flora of the Tertiary Period of Greenland and Spitzbergen. Baron Toll made a complete circuit of the island of Kotelnoi in forty days. From the northern point of this island he was fortunate enough to obtain a view of the island which Sannikoff declared that he saw in 1806, and the existence of which had,

* *Through Siberia*, pp. 288-293.

up to that time, been doubted. This island has received the name of Sannikoff Land, and lies, according to Von Toll, 100 miles to the north of Kotelnoi and New Siberia. Baron Toll found the summer on Kotelnoi to be cold and cheerless. Snow showers fell nearly every day, and in most of the valleys the snow lay throughout the whole of the summer, while the shores were always blocked by ice; what the winter may be can be easily imagined. Neither trees, shrubs, or bushes exist on the island, and yet the bones of elephants, rhinoceroses, buffaloes, and horses are found in this icy wilderness in numbers which defy all calculation.

In May, 1893, Baron Toll again visited these remarkable islands in company with Lieutenant Shileiko. They first went to Maloi, which is one of the Liakoff Islands, and the second island that Liakoff discovered. In this island they discovered the bones of mammoths and other animals, and they also found the trunks of fossil trees, with leaves and cones. This striking discovery proves that in the days when the mammoth and rhinoceros lived in Northern Siberia, these desolate islands were covered with great forests, and bore a luxuriant vegetation. From Maloi, Baron Toll and Lieutenant Shileiko went on to Kotelnoi, the winter inhabitants of which seem only to be mice, although white bears were frequently met with on the ice near the islands. The return journey of the explorers over the ice to the mainland was difficult, because the ice was melting, and loose snow and open water were encountered. Nevertheless, the return journey from Kotelnoi was safely accomplished, and the expedition regained the Siberian coast.*

From these, and from the former explorations, it is clear that enormous deposits formed of the remains of fossil forests exist on the islands of Maloi, Kotelnoi, and New Siberia. The "Wood Hills" of New Siberia have been frequently described, and similar buried forests have been found in Kotelnoi in numbers perhaps even greater than in New Siberia. All this shows, that in times geologically speaking very recent, a vigorous vegetation reached far up into the regions of the North Pole, where at present neither trees, shrubs, or bushes are found. The remains of these great Tertiary or Post Tertiary forests, are constantly being discovered far up in the Arctic Regions. The relics of great forests of the Miocene Era have been found

* A notice of the journeys of Baron Toll and Professor Bunge will be found in the *Journals of the Royal Geographical Society* for September, 1887, and May, 1894.

in Alanekerdluk, near Disco Island, on the coast of Western Greenland, in N. Lat. $70^{\circ} 2'$, and have been well described by the late Professor Heer.* In Spitzbergen, as late as the Miocene Period, there was a vigorous vegetation, of poplars, limes, beeches, and alders, and it is with this mid-Tertiary vegetation, that Baron Toll would connect the fossil forests in Kotelnoi and New Siberia. Captain McClure found many fossil trees in Banks' Land (Lat. $70^{\circ} 48'$), and fossil forests have also been discovered in Prince Patrick's Island, in Lat. $76^{\circ} 12' N$. A most interesting discovery was made by Sir Edward Belcher, on the shores of Wellington Channel, in the very heart of the Arctic Regions. At this place he found the dead trunk of a giant tree, standing upright in the place in which it grew when the climate was in former ages more genial, and he thus speaks of this tree of past days:—"I at once perceived that it (*i.e.*, the dead trunk) was no spar, and not placed there by human agency; it was the trunk and root of a tree which had apparently grown there and flourished, but at what date who will venture to say? It is indeed one of the questions evolved in this change of climate. As the men proceeded with the removal of the frozen clay surrounding the roots, which were completely cemented as it were into the frozen mass, breaking off short, like earthenware, they gradually developed the roots, as well as what appeared to be the portions of leaves and other parts of the tree, which had become embedded where they fell."†

While the facts are very remarkable which prove the existence of the remains of great forests in the New Siberian and Liakoff Islands, it is equally wonderful that the *bed of the sea* around the New Siberian Islands, seems to be covered with the tusks and teeth of elephants, which are being constantly washed up by the waves on the sandbanks round the shores of these islands. Nordenskiöld says that the making of new collections of mammoths' tusks year by year in Liakoff's Island, depends on their being washed out of the sandbanks, so that after an east wind, which has lasted some time, they may be collected at low water on the sandbanks, then laid dry.‡ He also tells us, that when the *Vega* was sailing past Liakoff's Island, the trawl-net brought up from the

* See Nordenskiöld in the *Geological Magazine*, 1872, pp. 520-522, also Sir J. W. Dawson's *Geological History of Plants*, pp. 242, 245.

† *The Last of the Arctic Voyages*, vol. i, p. 380.

‡ *Voyage of the "Vega,"* vol. i, p. 412.

bottom some fragments of mammoths' tusks, which confirmed the statements of the ivory hunters, and showed that there must be immense deposits of elephants' bones, under the sea, at this place.* It has also been remarked that the land of the North Siberian coast is rapidly rising, and that fresh sandbanks are being constantly laid bare. Between the New Siberian Islands and the mainland the sea is very shallow, averaging only from 10 to 15 fathoms in depth, and the bottom is composed of green mud. As this is the case, we may expect that fresh deposits of mammoths' tusks, will, from time to time, be exposed, and the supply of fossil ivory from the islands in the Siberian Arctic Ocean will continue for a long time.

It is a curious fact, that the tusks of the mammoths which are found in the New Siberia Islands are much whiter and much better preserved, than those found on the mainland. It has also been observed that the tusks from the islands are much smaller than those discovered on the mainland.† Nordenskiöld explains this smallness in size of the tusks from the islands, by supposing that these tusks belonged to younger mammoths, which being more agile, and more troubled with flies, went farther north than those which were older.‡ This is very improbable, for very large mammoths' tusks have been found on the mainland of Siberia, nearly as far north as Cape Chelyuskiu, and this promontory is farther to the north than the Liakoff and New Siberian Islands.

East of the Liakoff Islands, and close off the mouth of the Kolyma, near to the shore, lie the Bear Islands. They are six or seven in number, and are of insignificant size. They were often seen by the fur-hunters and voyagers in the seventeenth and eighteenth centuries; and they were thoroughly surveyed, by Wrangell in 1821-22. He has described them in detail, and says that in one of them numbers of mammoths' bones are found in the earthy soil.§ On one of these islands he discovered four great pillars of granite, naturally formed, the highest of which was 48 feet in height. He called the island Four-Pillar Island; according to Nordenskiöld it is also called Lighthouse Island.

The easternmost of the Mammoth Islands is Wrangell Land, which has had a singular history. In 1763 Andrejew

* *Voyage of the "Vega,"* vol. i, p. 420.

† Wrangell's *Siberia and the Polar Sea*, pp. 499, 500.

‡ *Voyage of the "Vega,"* vol. i, pp. 412, 413.

§ Wrangell, p. 154.

sledged in dog-sledges over the ice of the Polar Sea from Nijnei Kolymsk, towards the north-east. He came to a large island of considerable extent, and saw other islands in the distance. Wrangell was very sceptical as to the truth of these discoveries, and in his fourth journey over the ice, made special inquiries of the Chukches as to whether any land existed in the Arctic Ocean north of the Chukche peninsula. He was informed that on a clear day the mountains of a distant land in the Polar Sea might be discerned from Cape Jakan, but when Wrangell reached this headland he could see no land to the north, and did not believe that any large island existed in that direction. In 1849, however, Captain Kellett sailed into the Arctic Ocean to the north of Behring's Straits in the *Herald*, and discovered Herald Island, and to the westward of this island he saw an extensive country traversed by a long range of snowy mountains;* to this new land the name of Wrangell Land was given. Dallman in 1867 conducted a trading expedition in the Arctic Ocean, and declared that he had landed on Wrangell Land, and that he found vegetation growing on it, and discovered there the tracks of reindeer and musk oxen. But all these doubts were set at rest, when the American steamer *Rodgers*, under Captain Berry, reached Wrangell Land in 1881. The island which lies in Long. 180° E., was found to be quite barren, as only moss and lichens formed its vegetation. The shores were blocked by masses of floating ice, and the beach was covered with driftwood. The island was about 150 miles in circumference, and contained lofty mountains, one of which was 2,500 feet above the sea; but it was an utter desolation, and its plains and hill-sides were perfectly barren. The only animals found on it by the officers of the *Rodgers* were bears, foxes and mice. Mammoths' tusks, however, were discovered. Some of these lay on the beach, and had probably fallen from the icy cliffs, or had been washed up by the waves. In the inland districts of the inland also, far from the shore, the explorers found many tusks of mammoths, one of which was of great size. It thus appears that Wrangell Land is full of elephants' remains, for the visit of the *Rodgers* to the island was of very short duration.†

In 1900 Baron Toll started on a third expedition to the New Siberian Islands. He left Tromsø in the *Zarya* on July 21st,

* *Voyage of the "Herald,"* vol. ii, pp. 114 116.

† For an account of the exploration of Wrangell Land see Gilder's *Ice Pack and Tundra*, chaps. vi and vii.

but had a troublesome passage through the ice in the Kara Sea. He was frozen up on the coast of Taimyr Peninsula, where he was compelled to winter. The *Zarya* was not released from the ice until August 25th, 1901, when she sailed for Bennett Island, which she reached on September 11th. Baron Toll had a fine view of the high snowy mountains and glaciers of Bennett Island, but the ice prevented approaching the shore closely, and the *Zarya* was, about a fortnight later, frozen up on the western side of the island of Kotelnoi. In this cruise Toll passed over the site of Sannikoff Land, the existence of which is therefore very doubtful; either it is a myth, or lies farther to the north. In the spring of 1902 Baron Toll left the *Zarya* for Bennett Land whither the ship tried to follow, but was prevented by the ice. Nothing more has been seen of the gallant explorer, although it is known that he reached Bennett Land in safety. In 1903 a relief expedition under M. Brusneff searched the New Siberian Islands fruitlessly for Toll, and then landed on Bennett Island. Here they found documents left by Baron Toll, but nothing more was found concerning him. It is now certain that he and his companions perished in attempting to force a passage through the frozen sea from Bennett Island to New Siberia. Thus died one of the most heroic and indefatigable of Arctic explorers.

The documents left by Baron Toll, and recovered by M. Brusneff, are most important. Bennett Island is formed of Palæozoic rocks, and masses of basalt. Mammoths' bones, and the remains of other Quaternary animals, are found in the valleys. It will thus be seen that Bennett Island is the farthest point north in which the remains of the mammoth have, up to the present time, been discovered.

One of the most remarkable features of these islands are the great masses of rock-ice, which are found both on the coasts and inland. These are best seen on the great Liakoff Island, where, with the exception of some granite peaks, they form the chief solid substance in the island. Baron Toll calls these wonderful masses of rock-ice "Fossil Glaciers," and he gives some striking photographs of them. They form part of the great ice formation of north-eastern Siberia, and they were noticed long ago by the Russian explorers. Baron Toll maintains that they originated during the Glacial Period, and that they represent the remains of the old ice-cap. In support of this theory he declares that he discovered a true moraine, with scratched and polished boulders in the bay of Anabar.*

* *Geographical Journal*, May, 1894, pp. 412, 413.

There are serious objections to this conclusion. The islands off the coast of north-eastern Siberia, are full of delicate granite spires and pinnacles, which would have been destroyed had an ice-sheet passed over them. Nordenskiöld declares that along the whole of the northern coast of Siberia he could discover no erratics or glacial traces, and uses these emphatic words, "to judge by the appearance of the hills there have not been any glaciers in former times, and this is certainly the case on the mainland. The northernmost part of Asia in that case has never been covered by such an ice-sheet as is assumed by the supporters of a general ice-age embracing the whole globe."* And again he remarks, dealing with the same question: "It may perhaps be uncertain whether a true inland-ice covered the whole country; it is certain that the ice-cap did not extend over the plains of Siberia, where it can be proved that no ice-age in a Scandinavian sense ever existed."†

Summing up all the results of exploration of the remarkable islands in the Arctic Ocean to the north of Siberia, which contain such numerous remains of the mammoth, we are compelled to conclude, that formerly, and speaking geologically in recent times, the regions north of Siberia enjoyed a milder climate than they possess now. In those days, which were since the appearance of man on the earth, although probably before man had forced his way into northern Siberia, the country had a different aspect and outline from that which now characterises it. At that time a great tract of country must have extended from the mouth of the Lena to the New Siberian Islands, and it stood at a considerable level above the sea, while the islands which now exist in the ocean in that region formed upland districts and mountain ranges. This ancient land was covered with forests, and was traversed by the great Siberian rivers. Vast herds of elephants, rhinoceroses, musk-oxen, and buffaloes roamed over the grassy plains and wandered amidst the forests, and for long they enjoyed a peaceful and secure home. A great catastrophe at last overtook them. The land in the extreme north of Siberia, sank beneath the waters of the Polar Sea. As the waters rose higher and higher, the animals crowded to the uplands for safety, and congregated in enormous numbers on the mountain tops. The land, however, continued to sink, and the waters rose higher

* *Voyage of the "Vega,"* vol. i, p. 418.

† *Ibid.*, vol. ii, p. 246.

and higher. The tops of the highest hills were at last submerged, and the destruction was complete. After a time the land began to rise slowly, and the New Siberian and Liakoff islands, which had formed mountains in the land, rose above the waters. As they had formed a last refuge of the animals when the land was submerged, they were naturally covered with the bones, teeth, and tusks of the animals which had been drowned upon them. Currents also, in the waters, swept the bones into various places, accumulating them here and there in large deposits. The climate also at this time underwent a great change, and altered from one of a mild and genial character to one of intense cold and Arctic severity.

Sir HENRY HOWORTH stated that many of the facts in Mr. Whitley's paper were to be found in his book *The Mammoth and the Flood*, and proceeded to mention the historical references to ground ivory as far back as the days of Herodotus. There was proof of a considerable trade in this article in A.D. 1000. In China it was used as a medicine. It is generally supposed that most of it is the remains of the mammoth, or Behemoth of Job, which means "a great, big beast." Cuvier refers to this ground ivory in some of his geological arguments, and to the flesh when thawed being good enough for wild animals to eat, even the eye in some cases had been found in good preservation. Sir Henry had himself corresponded with Darwin on this subject, who considered the problem insoluble. He further stated that the contents of the stomachs had been carefully examined; they showed the undigested food, leaves of trees now found in Southern Siberia, but a long way from the existing deposits of ivory. Microscopic examination of the skin showed the red blood corpuscles, which was a proof not only of sudden death, but that the death was due to suffocation either by gases or water, evidently the latter in this case. But the puzzle remained to account for the sudden freezing up of this large mass of flesh so as to preserve it for future ages.

These notes of Sir Henry's speech are felt to be very inadequate, but owing to his subsequent prolonged illness they have not had the benefit of his personal revision.

The Meeting adjourned at 6.15 p.m.

NOTE BY PROFESSOR HULL, F.R.S.

Having read with interest Mr. Whitley's Essay, I wish to add a few remarks thereon. I think the facts he relates regarding the observations of the navigators who have visited the region north of the coast of Siberia justify the author in the conclusion that at the time when the mammoth inhabited this region the climate must have been much milder than at the present time—in order to admit of the growth of trees and vegetation for the sustenance of these huge pachyderms and ruminants. It is also shown that the sea-bed surrounding the Siberian Islands was in the condition of land over which these animals roamed, and is only covered by shallow water at the present time; the submerged land around the islands forms a portion of the "great continental platform"—determined by Dr. F. Nansen (*Bathymetrical Features of the North Polar Sea*, 1904)—which extends outward from the coast of Europe and Asia, and breaks off at a depth of about 100 fathoms, at which depth the land descends rapidly to depths of 1,000 fathoms or more, a depth which may be presumed to extend under the pole, forming a deep polar basin covered by ice. The conditions described by the author lead us to infer a great upheaval of the sea-bed during the "mammoth period," followed by subsidence resulting in the destruction of the mammoth and rhinoceros, and here a difficulty presents itself, for elevation might have been supposed to result in a climate of increased cold, rather than one which appears to have been almost temperate, and this difficulty is increased when we suppose that the elevation of the sea-level would have produced a barrier between Iceland and Norway sufficient to prevent the entrance of the Gulf Stream and cause it to be diverted southwards. The conditions of the Arctic Ocean, as determined by Nansen, are described in a paper read before the Institute (*Journal of Transactions*, vol. xxxvii, p. 214, with map) to which the reader is referred.*

* For further discussion of the interesting questions raised in this paper see *The Mammoth and the Flood*, by Sir Henry Howorth, K.C.I.E., F.R.S., now unfortunately out of print.