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SIX YEARS IN THE ARCTIC

The six years in the Arctic which form the background for my address today were spent on an expedition which was organized and partly conducted by the late Roald Amundsen in an attempt to repeat the famous drift of the FRAM, Fridtjof Nansen's vessel, across the Polar Sea.

Before starting on this expedition Amundsen had already achieved world fame as an Arctic explorer. After years of preparation he succeeded, in 1903-06, in sailing through the Northwest Passage following the northern sea route along the American Continent from the Atlantic to the Pacific Ocean. His small vessel, the GJöa, stands now in Golden Gate Park. In 1908 Amundsen advanced his plan for crossing the Polar Sea, but as he could not obtain the necessary funds he changed his plans and went to the Antarctic where he reached the South Pole on the 14th of December, 1911. He had, however, not abandoned his hope to repeat the drift across the Polar Sea, although many circumstances had delayed his plans. Finally, in 1916 during the world war he decided to build a new vessel which was completed in 1917 and was given the name MAUD after the Queen of Norway.

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The MAUD was built along the same lines as the FRAM, broad and round. She had a length of 120 feet and a beam of 40 feet, and the amount of wood used in constructing the vessel was large enough to construct at least three other vessels of ordinary strength. She received her round shape in order to be lifted when jammed by the ice and not crushed.

Slide 2.

The MAUD left Norway in July,1918, with a total party of ten men on board. She carried no special crew. When we were sailing every one had to act as a sailor, and during the years spent on board the MAUD I have, besides being in charge of the scientific work, performed every duty on board a ship from cook's mate to navigator.

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Amundsen intended to follow the coast of Siberia to the vicinity of the new Siberian Islands penetrating into the drift ice in this region and, if possible, be carried by the ice fields across the Polar Seato the vicinity of Spitzbergen. However, we met unfavorable ice conditions there and in September 1918 were stopped at Cape Chelyuskin, the northernmost point of the Asiatic Continent where we spent the winter of 1918-19. A great number of scientific observations were taken during this winter and the most northerly peninsula of the continent was surveyed and explored.

In the summer of 1919 the ice broke up very slowly and for a long time it looked as if we would have to stay for one more year in the same place. Finally, on September 12, we got under way and proceeded to the east to enter the drift ice if possible. At that time we had no wireless station on board. Two men were therefore left behind with instructions to carry the observations of the winter and information as to the fate of the expedition back to Port Dickson where a Russian wireless station was located. The journey which these two were to undertake appeared less risky and dangerous than the one we thought we had ahead of us. But on the journey one of them took ill and died, and the other was unable to finish the journey alone. Their bodies and the records which they were to take home we found years later.

It soon became apparent that it had not been necessary to send these men off, since we did not succeed in entering the drift ice. The season was too far advanced and we had again to establish winter quarters at the coast, this time at Ayon Island 800 miles from Bergen Strait. Arriving here we met, to our surprise, a number of natives of the Chukchi tribe, in a region which on our maps was indicated as uninhabited. We soon found out that these Chukchi were nomads who had great herds of domesticated reindeer and used to spend the spring and summer on the barren tundra near the coast and the winter in the inland forests.

slides4,5 The Chukchi represent one of the so-called old Siberian tribes, their appearance is slightly Mongolian, but widely different from that of the Eskimos. Their language is more closely related to languages of Indians in northwestern America than any of the Siberian languages. It has been dealt with in the Handbook of Languages of the American Indians published by the Smithsonian Institution but this publication had not appeared at the time we encountered the Chukchi, and even if had we should not have known it, since we had not anticipated getting in touch with any of the Siberian natives. Some of them understood a few Russian words and since one in our party knew Russian it was possible for us to communicate with them.

The group which we met appeared to be very primitive and to have very little knowledge of the outside world. We had left Norway, as I have already said, in July, 1918 before the war had ended and had been without communication. In September, 1919, we were naturally anxious to learn whether or not the war was over, but when we asked the natives if they had had any news concerning

the war, they looked very surprised and asked which was we were talking about. They did not even know that the so-called civilized world had been at war since 1914.

As Amundsen thought that here a unique opportunity had presented itself for studying the customs and daily life of a very primitive group of people, he suggested that I should join the group, move inland with them in winter and return to the coast with them in the following spring. Thus it happened that I spent almost eight months alone among these people. The

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The subsistence of the natives depends on the raindeer only. Hunting is unnecessary because the reindeer gives them tents, clothing and food, and is the beast of burden which pulls the clumsy sleighs when the Chukchi are moving from one place to another. They need a few things in addition. From the natives living permanently on the coast they obtain seal blubber for their lamps and seal-skin for soles and strings, in exchange for reindeer meat and skins. At the Russian settlements on the Kolyma River they once a year exchange their fur, fox and squirrel, for tobacco, tea, matches, and knives, rifles and ammunition. The circumstance that these natives are able to acquire modern weapons, knives, and matches has, however, very little influence upon their daily life. Their customs are the same as they have been for centuries. Firearms have not brought much change since they are not a hunting people. They use the fire arms mainly for keeping the wolves away from their reindeer herds, and it makes small difference whether they are armed with a modern rifle or with bow and arrow. Also it makes small difference whether they kill a reindeer by a knife of steel or a knife of stone. Now ~~that~~ they use

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matches for ordinary purposes, but they still carry their old implements for making fire by drilling wood against wood and use these on many occasions when fire has to be made for ceremonial purposes, when using the white men's matches would mean sacrilege. In view of this I do not exaggerate much when stating that I have lived one winter in the Stone Age.

The tents in which the natives lived are very well adapted
Slide 9 both to the climatic conditions and to their nomadic life. The most striking feature is that the tents are double, one tent inside of another. The outer tent is large and almost conical, covered with reindeer skins from which the hair has been cut off. If, however, a tent of this type should be heated in winter to an agreeable temperature, a great amount of fuel would be needed, and the Chukchi spend only a few months of the year in the forests where wood is abundant, as during the greater part of the year they stay on the barren tundra where they find willows enough for cooking but not for heat. Inside
Slide 10 of the large tent, therefore, they play a smaller one in which they sleep. The inner tent is made of heavy deer skin and has the form of a square box with no bottom. There is no door, one lifts the skin and creeps in. The tent is illuminated and partly heated by a lamp of Eskimo type, but is mostly heated by the many people who gather in that small space. The temperature may rise to 80° or more, even when a blizzard is blowingand the outdoor temperature is 30° below, because the outer tent protects the inner one from the wind and because the heavy deer skins of the inner tent are highly insulated. During the night, however, when the natives sleep on the ground covered by deer skins, the temperature is likely to drop. The last thing before going

to sleep, therefore, is to adjust all openings so that no air may escape. The natural consequence is that the air in the morning is frightful beyond description.

The Chukchi dress in deerskin only, one suit with the hairy side in and another with the hairy side out. For the inner suit they use very soft and pliable skin of young deer or calves, and from personal experience I know that this very soft skin makes a pleasant underwear. The Chukchi live exclusively on reindeer meat and use no
Slide 11 vegetables at all, but they eat the entire deer except the bones and the skins.

The reindeer are also the beasts of burden which pull the light sleighs on which the Chukshi themselves travel and the heavy sleighs used for all their belongings. One who is travelling with the Chukchi must have unlimited patience. The preparations in the morning take an endless time. The tents have to be taken down, the sleighs to be packed and the reindeer to be driven together and hitched to the sleighs. Beginning before dawn everything is perhaps ready by noon, but after having covered a few miles camp is again established at the same slow tempo. One must, however, bear in mind that time is of no consequence to the Chukchi. Moving from one place to another is part of their ordinary life and they are not in
Slide 12 any hurry about getting from one place to the next.

The young men have to look after the herds of reindeer and are often leading a strenuous life while the elder men are enjoying leisure. When the old man was young he had to follow the reindeer and sleep under the open sky night after night. He is now entitled to letting the young men work and the highest ambition of

a man is, therefore, to have a son or at least a son-in-law who can work for him in his old age.

The young men have a surprising knowledge of the reindeer. A single family has an average of from three to six hundred deer, and a young man knows not only his and his father's deer by sight but also those belonging to the neighbors, often several thousand. But he is unable to tell how many he knows, because he has great difficulty in handling figures beyond 100 or 120. The largest unit known to the Chukchi is 20, the total number of fingers and toes, and the simple expression for 100 runs about as follows, "equivalent to fiye persons, all fingers and toes counted." With such a system it is difficult to handle large numbers.

The women have to tan the deer skins, make clothes, cook, keep the tent dry and warm. The same applies to them as to the men. The younger do the work and the older do what they like.

Slide 13. When I went to the natives I did not know one word of their language and not one word of Russian. I had the unique experience of trying to learn a language which does not exist in written form and I met all kinds of unexpected difficulties. I can not enter upon these, but must mention one thing which puzzled me very much, namely, that a number of words are pronounced differently by men and women. In most cases, when a man uses a hard consonant, the woman replaces it by a "sish"ing sound. For instance, the word for walrus is by a man pronounced "lerrerka", but a woman says, "tsitsa." Or, the word for sinew the man calls "rettit," the woman "tsetsit." A woman naturally can pronounce any word in the same manner as the men do, and when they quote a man they do use the same pronunciation, but otherwise,

it is not good etiquette to do so. It happened that I had learned a word from a woman before I was aware of this difference and when I used it among the men they laughed at me because I talked like a woman.

The chronology of the Chukchi is very simple. It does not exist. Nobody counts the years, nobody knows his age. The social organization is similarly simple. It also does not exist. The Chukchi are governed by the unwritten laws of public opinion, and these laws require in the first place respect for old age, kindness towards the weak, and generosity towards the poor. The only thing the children are taught is respect for their elders, and the worst crime any one can commit is to raise his hand against an old man.

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Time does not permit me to go on telling you about the customs of the Chukchi, but before leaving the subject I wish to add a few words about the attitudes of the Chukchi towards the nature which surrounds them. I have mentioned the respect for old persons. This respect is intimately associated with their conception of the mind or the soul. They disciminate distinctly between the body and the soul and believe that the soul continues growing when a person gets older. An old person has therefore a great soul, a great wisdom, and must be honored. When a person dies, his soul goes to the northwest where he continues life among his herd of reindeer which have been sacrificed during many years.

Their knowledge of what we call the laws of nature is very, very limited. They are living in a constant fear of unexpected events which may bring disaster to them or to their herds of raindeer upon which their existence depends. They believe that all their

surroundings are inhabited by living beings, mostly by evil spirits, and the greater part of their numerous ceremonies and all the small matters to which attention must be daily paid is directed towards keeping these evil spirits away. They believe, for instance, that every illness is caused by an evil spirit entering the body, that excessive snowfall which makes it difficult for the reindeer to find food, is brought about through the action of some demon, and they perform their rites to appease these beings. They have made up a picture of their surroundings which is consistent, so far as it goes, and which makes it possible for them to some degree to overcome their fear of because they can turn to these spirits which surround them, try to influence them, to gain their good will or to appease them if they have aroused their anger. They have created a conception which to some degree brings them in harmony with their surroundings, but does not eliminate their fear of nature.

It is of interest to compare this primitive conception of nature with the one which we now have arrived at. Through scientific research we have discovered that events in nature occur in logical sequence. We have found what we call the laws of nature, and we have used them partly to increase technical knowledge, which makes possible better and better use of natural resources, and partly to build up a strong feeling of being in harmony with our surroundings. The first part, the contribution of research towards improving the standard of living, is so obvious that to many this appears to be the aim and end of all research, but the other one, the elimination of the fear of nature, the feeling of security based upon the knowledge of the laws of nature, is no less important and should not be forgotten any time when talking about the value of scientific research. I think we can

say that the Chukchi have strengthened themselves in their fight against nature by populating nature with living beings to whom they can turn and whom they can influence. We have created universities and institutes for scientific research. We bring our experiences together in a logical system and we try to create a unified conception of nature on the basis of that research. Fundamentally, there is not such a vast difference between the primitive and simple society formed by the Chukchi and the highly complicated and differentiated society within a modern civilized country.

We have to leave the Chukchi and proceed with the fate of the expedition. In 1920 we tried again to get into the drift ice, but without success, and had to spend a third winter 1920-21 at the coast only 70 miles from Bergen Strait, where we came in contact with a group of Chukchi which stays in more or less permanently dwellings and lives by hunting as the Eskimos do. This group had been in contact with many undesirable elements from civilization and were by no means so attractive as the reindeer nomads. I had opportunity to visit a great number of the native villages on a 1200-mile sleigh trip during the winter.

During the struggle with the ice in the fall of 1920 the propeller of the MAUD had been broken and the propeller shaft had been damaged to such an extent that it became necessary to take the vessel to the nearest dry dock for repairs. The nearest dry dock was in Seattle more than 2,000 miles away, to which The MAUD had to be sailed 2,000 miles and the fourth winter quarters were established in Lake Union close by the campus of the University of Washington.

In the spring of 1922 the MAUD was again fitted out in order to make a fourth attempt to get into the Polar drift ice. The crew was partly replaced and of the original crew only Amundsen, Mr. Wisting, the captain, Olonkin, the engineer, and myself remained. Captain Amundsen in the meanwhile decided to attempt a flight from Alaska to Spitzbergen. The airplane was carried on board the MAUD to Alaska where Amundsen left us at Point Hope in order to attempt the flight in the coming spring. He had, however, to abandon his plans since the airplane could not carry a sufficient load. He did not give up, but undertook in 1925 together with Lincoln Ellsworth a spectacular flight from Spitzbergen and, finally, in 1926, he crossed the Polar Sea on board the Italian-built airship, the NORGE. But that is a different story.

The MAUD proceeded to the drift ice under command of Captain Wisting, and this time we finally succeeded in getting far enough north to begin our drift. For two years we drifted with the ice from the region of Wrangell Island to the new Siberian Islands, as shown on the map. In this map are also entered the routes of other expeditions which intentionally or unintentionally have drifted with the ice in the same region. To the left is shown the place where Fridtjof Nansen's ship, the FRAM, began her successful drift which carried her to the vicinity of Spitzbergen. In the middle is seen the route of the American ship, the JEANNETTE, which was caught by the ice near Wrangell Island in 1879 and crossed north of DeLong's Island in 1881, and to the right is indicated the drift of Stefanson's ship, the KARLUK, which after five months was crushed in the vicinity of Wrangell Island. Of the crew and personnel of the JEANNETTE which consisted of 32 men, 20 perished. Of the 25 persons on board the KARLUK 11 met with death.

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The JEANETTE and the KARLUK are not the only ships which have been crushed in the ice north of Alaska and Siberia. Numerous whaling and trawling vessels have been caught in the ice. In some instances the crew has reached land safely, in other instances nothing has later been heard of the ships. Considering this it might seem fool-hardy to enter the drift ice voluntarily, but the MAUD had been constructed especially for the ice. The hull was so round that when jammed she was lifted. We had perfect confidence in our ship.

From the route taken by the MAUD it is seen that in the fall of 1923 we were in a favorable position. We hoped then to drift on the northern side of DeLong's Island and to cross the Arctic Sea perhaps in a higher latitude than the FRAM, but we were bitterly disappointed. Continuous northerly winds carried us to the south, where Captain Wisting received from Roald Amundsen an order by wireless, which had been installed during our stay in Seattle, to the effect that if possible, he should take the MAUD out of the ice and return through Bering Strait. We were unable to do anything about getting out, but on the northern side of the new Siberian Islands the ice opened to such an extent that we could work through it and reach the mainland. However, we met unfavorable ice conditions as usual, and had to spend a sixth winter on the coast, this time at the Bear Islands off the Kolyma River. We finally reached Nome on August 22, 1925, and Seattle on October 5 of the same year.

When leaving Point Hope our entire party consisted of eight men, including a native boy from the Siberian coast who acted as a cabin boy. After one year in the ice we lost one of our comrades who took ill and died. Later there were only seven of us. We saw no human beings outside of our small party until the spring of 1925 when we were visited by so-called Russians from the Kolyma District. These settlers are so mixed up with natives that they appear like natives, but they spoke Russian.

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As soon as the MAUD had been enclosed in the ice we prepared for a long stay. A roof was built over the for deck giving us a sheltered place
Slides for many types of work. With this roof and other minor additions the MAUD took the appearance of what our mate used to call a three-masted barn.

The drift ice may appear monotonous, but it is never at rest and is always carried along by currents and by the wind. The motion is not
Slide uniform. In some places the floes break and layers of open water are formed. In others, floe grinds against flow and enormous pressure ridges are built up. In this way the surface takes the appearance of a small-scale mountain landscape, and travelling over the ice becomes exceedingly difficult. We built a small village on the ice close to the ship, - houses for observations,
Slide a blacksmith shop, and a dog-house, but we had day and night to keep watches and be prepared in case the ice should crack near the ship. The first winter and the first summer were fairly peaceful, but in October, 1923, the
Slide MAUD was subjected to very severe ice pressures during which our immediate surroundings were crushed to pieces. During these ice pressures we learned that we had been justified in having confidence in our ship. She was lifted, now with the bow high, now with the stern high, and was listed from one side to another, but always remained on top.

The ice is not silent when it attacks. The sound of ice grinding against ice, of the crushing and jamming, may rise to deafening thunder and to this sound is added the creaking, squeaking of the timbers of the vessel. A person does not feel very important when watching the display of such enormous forces.

Slide We had trust our ship, but naturally we had to be prepared for leaving and trying to reach the coast. Captain Wisting had, therefore, from the very beginning paid great attention to the preparation of a light and

convenient travelling equipment, and as a result of his efforts three sleds were soon placed on deck all packed and ready to be taken off

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at short notice. In the picture you see them when they had been taken taken out to be photographed. On the middle sled you will notice a canvas boat which would have been necessary if we should have to cross

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open water. For pulling the sleds we had 18 dogs on board. These were used for some shorter trips over the ice, but spent most of the time standing leashed on the ice. Most of them were Siberian dogs, heavy and husky, and excellent sled dogs.

We could not think of making any long trips away from the ship with the dogs, but in order to make such trips and extend the geographical exploration to both sides of our drift route we carried a small airplane, a Curtis Oriole, equipped with skis to take off

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from and land upon the ice. The airplane was mounted in the spring of 1923 and a few successful trial flights were made. Our aviator, Mr. Dahl, can claim to be the first aviator who ever has taken off from and landed upon the ice. On the third flight, however, the motor missed fire in the take-off, the pilot had to make a forced landing in the rough ice, with the result that the plan was damaged beyond repair. I was not sorry, since our plane was not equipped with wireless and could, therefore, not keep in communication with the ship when away. Under these circumstances, any flight had been very risky and I did not regret seeing the airplane being taken apart and the

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parts being stored away on board.

We had excitement enough when the ice was jamming and grinding trying to crush our ship, or when we attempted to use our airplane, but long periods were tiresome and monotonous. Our surroundings were not stimulating. In the winter we had the long dark season

with perhaps a gray dawn in the middle of the day. In summer, fog was prevalent for the sky was covered with gray colorless clouds. Under such conditions a completely regulated life and days filled with

slide work are necessary to keep every man in good spirits and to maintain good comradeship. Noone had realized this more clearly than Roald Amundsen, and in the drift ice we kept strictly to the routine which he had established. Month after month we had our meals strictly at the same hours, we had our fixed hours of work when nobody was allowed to stay in his own or in the common room. In the evening we used to gather around a big lamp in our common room reading or mending clothes, and at ten o'clock everyone retired except the night watchman. The night was divided in watches of two hours and I can assure you that we looked forward to the time when these watches should be over and we would know that we should not be aroused in the middle of the night in order to take over the watch and read off the various instruments which had to be attended to day and night.

The scientific work required much attention and took naturally

Slide most of our time, but beside that there was always something to do in order to keep everything on board in good order. The blacksmith had many jobs in his shed on the ice, and in spring the sail-maker could

Slide take his work up on deck and sit in the warm sunshine.

Saturday afternoon was free and Saturday evening was looked forward to during the week. In winter movies were shown every second Saturday, and every second Saturday we played our gramophone. Also everyone got a glass of grog which really helped to loosen the tongues and to smooth out minor controversies which might have arisen during the week.

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On Sundays we usually received a weekly newspaper from the outside world. We had a radio station but could be in cross communication with an outside station in winter only, since in summer our range was much reduced owing to the continuous daylight. In this season we could, however, receive news from powerful stations. Before our departure in 1922 it had been arranged that a Norwegian radio station should send us weekly abstracts of the most important news, kepping us informed about outstanding events. This news did not matter so much to us, since we were living in our isolated world, but it gave us every week something new to talk about. It can not be denied that a small group is talked dry in less than three years. It is annoying to listen to the same story for the twenty-fifth time or, when a thrashed-out subject is brought up, to know exactly what the next man is going to say a long time before he opens his mouth. I may add that in winter when we were in close communication we sent daily weather reports, but only two reports concerning conditions on board were sent during each winter.

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The wireless was not the only thing which kept us in contact with the outside. We also had a garden on board. This garden was a piece of turf which we had taken from an Arctic Island in 1918 and placed in an empty box. Since then the box had been standing on the upper deck summer and winter. When we took the turf it was covered with Arctic flowers. Most of them died in the course of time, but a few returned every summer and reminded us that in other regions of the world there were lawns with green grass, sunshine, and flowers, when we, according to the calendar, had summer but were surrounded by ice and gray fog.

We did not suffer any special privations on board. The quarters werekept warm and we had abundance of food, but we were too much dependent upon canned goods. The mound of empty tins aft of the vessel shows clearly enough that we used considerable quantities during the years. However, well prepared this type of food may be one gets tired of it in the long-run and we especially appreciated any visit of a polar bear which furnished us with fresh meat. We were ourselves not the only ones who were interested in the capture of a bear. When the mate scraped the blood off the skin he was surrounded by a group of dogs which hoped that a piece might be thrown in their direction. In addition to bears of which we killed twenty-two we also succeeded in getting a few seals and walruses, but the meat of the walruses is so coarse that we preferably used it for dog food.

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A question which very often has been asked me is if we did not get on each other's nerves. We were seven only living together in narrow quarters in surrouddings which, after a short time, were so familiar that we knew what to expect in every season. On many similar expeditions controversies have arisen and members of the party have not spoken to each other for months. We succeeded in avoiding all such major controversies, I think mainly because we were all occupied and were able to divide the work in such a manner that most of us were independent of the others. We not only avoided getting on each other's nerves but we parted as the best of friends.

I have now in my home a series of monthly calendars which show the spirit on board the MAUD. We had to make these calendars ourselves and, at my suggestion, two in our party alternately

supplied these calendars with some appropriate pictures. You will see here our calendar for April, 1924, showing a walrus which hatches his eggs. Introductory to showing another picture, I remind you that in February,1924, we received orders by wireless from Amundsen to attempt to get out of the drift ice and return to San Francisco. In San Francisco the vessel on board which Amundsen had saild through the northwest passage stands in Golden Gate Park. On our almanac for March,1924, appeared the picture of the GJAR, beside her the MAUD, and to the right, the Golden Gate. The magnificent coloring of the picture is unfortunately not shown here. The last almanac made on board for July,1925, shows the old Polar explorer sitting in front of his fire just ready to push the button in order to obtain his Saturday night grog.

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After this very brief outline I wish to show you in rapid succession a series of pictures which demonstrate phases of our scientific work.

Observations for position in winter.

Magnetic observations without shelter.

Magnetic observations in tent in summer.

The Crystal Palace.

Observations of the atmospheric potential gradient.in the Crystal Palace.

Field observations of the atmospheric potential gradient.

Recording electrometer in winter.

Northern light.

Kite reel on deck

Arrangement for guiding kite wire

Meteorological kite.

Meteorological screen.

Instruments for recording formation of frost

Comparison of instruments for measuring radiation.

Reading of resistance thermometers for measuring temperature in ice.

Collection of samples of bottom organisms

Specimens of organisms from the bottom measurements of currents in the water under the ice.

Taking samples of the water under the ice

Examining water samples in the laboratory

The very brief outline of my experiences in the Arctic has, I hope, shown you a phase of Arctic exploration which differs from the spectacular phase which is mostly known. I do not want to minimize the spectacular features which have been accomplished in the Arctic region. On the contrary, I believe that they are of the greatest importance as examples showing that man can overcome apparent insurmountable difficulties and as examples of splendid heroism. Many have fallen in their tracks, but new men have always been ready to continue where those had to give up, and the history of Polar exploration is, therefore, a history in which every defeat has been followed by conquest, a history which must appeal especially to youth and stands out as showing that difficulties can be overcome and that man can conquer a hostile nature.

But Polar exploration has also another phase. To any one who studies the ocean or the atmosphere, nature itself is the huge laboratory in which a display of complicated experiments continuously goes on. When we want to learn the laws behind these experiments it is a great help to go to the regions where conditions are simpler and where the logical sequence of events appears most clearly. The Arctic regions represent the simplest laboratory in nature. During the long Arctic night or during the long Arctic summer, the diurnal change between daylight and night which complicates conditions in our latitude is no longer present. The ice-covered Polar Sea represents a vast plane of uniform character. No contrasts between land and ocean are found, even the currents in the ocean are simpler since a direct communication between the atmosphere and the sea does not take place. And finally the effect of the rotation of the earth upon the movement of the water and the air is at its maximum near the Pole.

Under these circumstances, general laws, which in lower latitudes are obscure, are more readily detected in the Arctic. I could give you many examples, but will select a single one from the MAUD. We had hoped to study the tidal currents off the coast of Siberia, and we found that the currents were rotary, changing direction regularly from hour to hour and always turning to the right. We also found typical changes in the character of the currents when approaching the bottom. Similar features had been observed in lower latitudes, but no satisfactory explanation had been given. The conditions observed by us were, however, so simple that it could easily be shown that all characteristic features were due partly to rotation of the earth, partly to the friction along the bottom. This explanation is valid in lower

latitudes as well, and the observations from the Arctic have thus served to throw light upon the more complicated conditions in lower latitudes. As a second example, I will mention that Fridtjof Nansen's observations of the ice drift as carried out on his journey with the FRAM in 1893-96 gave the key to the understanding of the effect of wind upon surface currents in the ocean, and the present generally accepted theory of wind-driven currents is based upon the conceptions at which Nansen arrived on board the FRAM.

This phase of Arctic exploration is, as I said, far less known than the spectacular side, but I am convinced that the scientific exploration of the Arctic will continue for many years to come, and will go on for a long time after every white spot has been eliminated from the maps of the Arctic region and after very island has been charted.