THE ANTARCTIC, A LAND OF SUPERLATIVES

Presented By

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With the holidays behind us and winter a time of cold and dread for most of us now clamping its icy fingers around us, I have chosen a place of superlatives as the subject of my paper this evening.

Descriptive words such as cold, dry, windy and high are relative terms. Much of their meaning depends on where you are and when you are there. However when you think of the continent of Antarctica, then all of these normal words of description take on new meaning. For the Antarctic is a land that makes up the highest, driest, windiest, not to mention the coldest continent on the face of the Earth.

The Antarctic is in fact our fifth largest continent, covering an area of approximately five and a half million square miles. This is an area roughly equal to the size of the United States and Mexico combined.

The elevation of the continent ranges from sea level along the coast to 16,860 feet on the Vinson Massif, which is located in the quadrant of the Antarctic bound by the Prime Meridian and 90 degrees west. On the other extreme, one must remember that the ice shelves which surround most of Antarctica are layers of ice which are about 650 feet thick at their outer edges. These shelves are so thick and heavy that some parts of them are actually sitting on the floor of the ocean, hundreds of feet deep in some cases.

While these elevations may not sound that spectacular, one must keep in mind that the average elevation of the continent as a whole is nearly six thousand feet or roughly

1 1/8 miles above sea level. This easily makes it the highest of our seven continents.

One usually thinks of the Antarctic as a land with a lot of snow. Actually this is far from true. A land of ice, yes, but there is really very little snowfall. Most of the Antarctic continent receives less than twenty - four inches of snow annually. The snow is very fine and granular in nature. However, this relatively small amount of snow is recycled very effectively. The snow also begins to pack and to turn to ice as soon as it is warmed by the mid-summer sun. By most accounts the falling snow amounts to less than two inches of liquid precipitation annually since records have been kept. So with an average precipitation of less than two inches a year one can understand why Antarctica is our driest continent.

I mentioned the fact that the snow is recycled. This is accomplished by the winds which seem to be ever present in much of the Antarctic. At The British Commonwealth Bay Station, the wind blows at an average speed of fifty miles per hour year round. Gales of two hundred miles per hour are not the least bit uncommon at this station. (Commonwealth Bay does hold the honor of being the windiest spot on Earth.) Wind gales of 50-100 M.P.H. are not unusual on the rest of the continent. There are some extended periods in mid-summer when the winds do lay quiet and some of the more daring personnel at the more than 40 research stations strip to the waist and do a little sun bathing. However,

the slightest breeze quckly sends them scurrying for their clothes and protection from the wind chill.

The wind chill is simply a measure of how fast a warm body of building loses heat. However, in a land where 80% of the continent has an annual mean temperature of -25 degrees F., a blowing wind and lower wind chill simply means more blowing snow and the possible suspention of all outdoor activities. This is done for fear of being lost in blinding blowing snow as much as out of respect for low temperatures.

Of course when you think of the Polar Regions of the Earth probably the first thought you have is cold! If cold is what you want then the Antarctic will not disappoint you. The average annual temperature for more than 60% of the continent is -40 degrees F or lower. The U. S. South Pole Station has an average temperature of -57 degrees F annually, and it is not the coldest permanent station. This dubious honor belongs to the Russian Station at Vostok, on the Eastern Antarctic Central Plateau, with an annual average temperature of -75 degrees F. Vostok is also the home of the coldest natural recorded temperature on our planet at -128.6 degrees F.

Antarctica itself is covered by an ice cap, with less than two percent of its surface being bare rock or uncovered soil. It is estimated that this ice cap and the ice shelves around Antarctica contain more than 9/10 of all the world's fresh water. It is said that if the ice of Antarctica were

to melt that the level of the world's oceans and seas would be raised by more than 200 feet. This would make the eastern coast of the United States somewhere in Central Pennsylvania. It would also put most of the major population centers of the world on the ocean floor.

Geologically speaking, the continent is divided into two distinct parts. East Antarctica is almost a perfect semicircle. This part of the continent makes up roughly three fourths of the land mass and is covered by a domed shaped ice cap with an average thickness of 9,800 feet. In one place this cap has a measured thickness of more than 16,000 feet. Weighted down by this heavy load of ice, the Earth's crust is depressed as much as 1,970 feet below sea level. In West Antarctica, in contrast, the surface relief reflects more of the irregularities of the terrain laying beneath the ice. In some places sub-glacial mountains emerge as prominent peaks.

In addition to the ice cap, the surface is streaked with glaciers which slowly creep down mountainsides and ooze through gaps between mountain barriers. One of these, The Beardmore, is the largest glacier in the world. It is from these glaciers and the ice shelves mentioned earlier that the largest icebergs in the world are calved. These icebergs sometimes range as far north as Capetown, South Africa. Fortunately, they seldom enter the important shipping lanes of the Southern Hemisphere. The largest iceberg yet found measured 208 miles long, 56 miles wide and was more than 1000

feet tall! An iceberg this size would contain enough fresh water to supply the city of Hopkinsville for more than 1,600,000 years. It is not surprising that considerable time and money has been used exploring the possibilities of towing these frozen reservoirs to some of the more arid regions of the world for use.

To most people the words "South Pole" are synonymous with Antarctica, but this is simply not the case. The "South Pole" is actually five points on this huge icy continent.

There is the Geographic South Pole. This is the southern most point on the Earth's surface. It is here that the 360 degrees of longitude come together. This is what most people consider "The South Pole."

The Geomagnetic South Pole is the point where the lines of the Earth's magnetic field converge. This point is about 790 miles from the Geographic South Pole. This point also plays havoc with most electrical research equipment.

The Magnetic South Pole is the spot at which the compass points straight down. This is, perhaps, the most confusing pole of all since it is constantly on the move. It is frequently as far as 1000-2000 miles from the Geographic South Pole.

The Pole of Inaccessibility is that point on the Antarctic continent which is fartherest inland from all shore lines. It is situated approximately 550 miles from the Geographic South Pole. Presumably, it is the most difficult place to reach in Antarctica.

Finally, there is the Southern Spin Pole. It is an imaginary point at which the Earth's axis sticks out. Since the Earth wobbles as it spins on its axis, the Spin Pole has a wavering path. The Spin Pole is generally located at about the same spot on the Earth as the Geographic South Pole.

Actually, all of the poles are imaginary, insofar as a visible position goes. They exist only as a result of our ability to measure the world in which we live and the great dynamic forces that shape and control it. If one didn't have instruments to make the complex measurements, one could walk over the five poles and never know the difference. The sensations at each of these five locations would be the same - COLD!

The Antarctic itself has long been somewhat of a mystery. Its existence was predicted in ancient times by Aristotle. His prediction was based on the theory that a southern continent was necessary as a counterbalance for the known lands of the north, thus keeping the world balanced and the northern lands upright.

Another reference to the existence of Antarctica is made on the "Piri Reis, Columbus' map of 1513." Piri Reis was a Turkish Admiral who conquered the southeastern portion of the Arabian Peninsula. During one of his conquest he was the captor of a man who claimed to have been a pilot of Columbus'. Along with the captive came the "Portolano Charts" which was one of the maps used by Columbus on his first voyage to the New World in 1492. Piri Reis, whose hobby it was to collect

charts, combined the "Portolano Charts" with others dating back to before 400 B.C. and developed the "Piri Reis - Columbus map of 1513." Interestingly, this map, which is still in existence is Istanbul today, shows us a mostly ice free Antarctic which was visited by ships 5000 years ago. While this would be in conflict with nearly everything we know of this continent today, we cannot prove or disprove this interesting theory - not yet at any rate.

By 1700 the existence of lands in the high latitudes had been confirmed. The general belief was that these lands were simply ice covered islands in an icy sea. The acceptance of the existence of a southern continent, The Antarctic, was not widly accepted until the late 1890's. Up until the early 1900's these lands were called Terra Australus Incognita or Unknown Lands of the South.

In 1773 British explorer, Captain James Cook sailed south in an attempt to either prove or disprove the existence of the Unknown Land of the South. What he did accomplish was to circumnavigate the globe south of 50 degrees South and to penetrate the Antarctic Circle three times. Upon reaching approximately 70 degrees South, the usually modest Captain Cook boldly declared in his log that "I have sailed as far South as it is possible to go and that no man will ever go any farther." This great explorer was in time proven wrong.

In 1820 a German, Captain Thaddeus Billingshansen in the employ of Czar Alexander I and the Russian Navy, explored

Antarctic waters by circumnavigating the globe south of the Antarctic Circle. However, there is no evidence to support Russian claims that he raised the main Antarctic land mass.

The first documented sighting of The Antarctic came in 1821 by a U. S. sealing expedition under the command of Captain Nathaniel Palmer. Today the largest peninsula in the Antarctic is named for this daring lad of only 19 years of age. Later that same year another American sealing expedition, under the command of Captain John Davis, actually landed on this southernmost continent to examine the sealing potential of the area. There was not another documented landing on the main land mass of the Antarctic for more than 50 years, though there were several landings, some intentional but most accidental, on islands within the Antarctic Circle.

Virtually all of the expeditions inside the Antarctic Circle during the Nineteenth Century were conducted for commercial reasons. Since Captains and crews shared in the profits of whaling and sealing expeditions, little or no time was taken for the gathering of scientific data.

The first known scientific venture to the south was a British affair led by Lieutenant Robert F. Scott. He landed in Antarctica in January, 1902, and spent the next 20 months on the ice or in his ship, "The Discovery", which was frozen in ice just 200 yards off shore. Actually later expeditions would make better use of his hut and shore base than Scott himself did.

Scott's expedition was a success. His geographic exploration and scientific observation added considerably to the limited knowledge then available. However, his adventures were the beginning of a long and fatal ten year love affair with this frozen land of the South Pole.

In 1910 Scott began a quest to be the first human to reach the South Pole. An attempt had already been made by one of his subordinates from his first Antarctic expeditions. Scott was spurred on by the announcement that Norwegian Roald Amundsen has set for himself the same goal. The story of these two men and their race to the bottom of the world would be another paper in itself, so let's just say that Amundsen was able to reach the Pole and returned to Europe and glory, while Scott arrived at the Pole 34 days later. He died on his return from the Pole just Eleven miles short of a base camp where he would have been safe. This was after he had walked more than 1500 miles to reach his goal. He was still carrying 40 pounds of samples. I mention this to point out the importance science has played in the exploration of the Antarctic during this century.

A note here. The race between these two men, their sacrifices, and contributions to the exploration of the Antarctic have not been forgotten. Today their names are on the U. S. Amundsen - Scott South Pole Station at the Geographical South Pole.

In 1928 the most famous of the U. S. explorers made his appearance on the scene of Antarctica. This was Rear

Admiral Richard E. Byrd. His name would become synonymous with exploration in the Antarctic. Admiral Byrd led four separate expeditions to our southermost continent and spent 1/3 of the remaining 28 years of his life mapping, charting, exploring, training, and doing scientific research in the Antarctic. He was the first to use aerial surveys and the most advanced scientific techniques of the day in Antarctica. He was personally responsible for mapping more than 1 1/4 million square miles of unknown lands.

In 1955 Byrd was made Commander of the entire U. S. Antarctic Expedition during The International Geophysical year. The International Geopysical year was an extraordinary venture which included nearly 70 nations in almost total co-operation. This venture was undertaken in an attempt to scrutinize virtually every area of our planet. ~~never attempted before~~. All the sciences of land, sea, and air were brough to bear on the single problem of getting to know our environment and the forces which shape it better than ever before. The Antarctic received its full measure of attention.

Now I point out what the International Geophysical year was and the co-operation that existed in scientific research, because in most areas that co-operation ended after the end of the International Geophysical year in December, 1958. But after 18 months of total international co-operation, in an environment as hostile as the Antarctic, it became obvious that no single nation could or wanted to undertake the task of large scale exploration in this frozen land. In 1959,

the Antarctic Treaty was signed by twelve nations and has since been signed by four others. The treaty states "No acts or activities taking place while the present treaty is in force shall constitute a basis for asserting, supporting, or denying a claim to territorial sovereignty in Antarctica." Since seven nations now claim territory in Antarctica the nations in essence have said - "Here is an insoluble problem; Let's set it aside and continue our joint research and studies until 1991." Strangely the U. S. and Russia neither claim nor recognize any territorial claims in the Antarctica.

Amid this unusual level of international co-operation, the research in this frozen land has continued. This research has centered on four main areas. These are the study of the plant life, animal life, the climate, and various geological areas.

The list of plants in Antarctica is about as exciting as drinking flat cola. While the land fringe of the Arctic supports more than 400 species of flowering plants, all of Antarctic supports no more than 60 plants of any description. Two known Antarctic plants, a pink and a grass, are flowering, and these are found only far north on the Palmer Peninsula. All of the other plant life consist of lichens, mosses, and some algae. Only the most primitive kind of plants seem able to survive in this frozen land.

The Arctic has its giant of the northlands. It is of course the Polar Bear, which can reach a height of more than eleven feet. So it seems only fitting that the South should

have its own giant. The largest known land animal in the Antarctic, and a true giant he is in his own land, is a wingless mosquito a full 1/8 of an inch long. There are about 65 species of insects and anthropods that have been identified. These constitute the total true land animal population so far discovered. This population consists of mites, snow fleas, and others for which science has not yet found a proper niche for.

There is, of course, a great deal of unexplored territory. It isn't likely that any chimpanzees, parrots, or boa constrictors will be found in these new areas, once they are opened up to science; but there may be a slight extention of the present population list. It is fairly certain that whatever is found will be of more interest to the specialist than to the general Antarctic enthusiast.

It is interesting that, among both the plants and animals, there are no advanced races. Specialized, highly developed forms of life cannot adapt. The secret of survival belongs to those organisms close to the original secret of life. Whatever life was looking for in its ascent from one-celled animals to intelligent mammals, it couldn't find it in the ice and snow of Antarctica.

While the land and ice of the continent are as devoid of life as any place on earth, the Antarctic Ocean is quite literally the richest pasture on our planet. It is estimated that there is more life in an acre of Antarctic Ocean than in any other acre anywhere on land or sea.

The edge of the continent actually chills the surrounding waters creating an upwelling of deeper warmer waters. These turbulent vertical currents cause mineral sediments to rise off the bottom and to remain in suspended circulation. The mineral rich surface waters, exposed to 24 - hour sunlight for a good part of the year, supports diatoms and other microscopic plants which reproduce by the billions. These in turn support absolutely incredible numbers of tiny shrimp known as krill. The red knill occur in such astronomical numbers that they discolor the water for thousands of square miles. At certain times during the Antarctic summers, these waters are so rich with life that they become soupy - actually thickened by the incredible mass of life. This plankton - rich sea plays host, on a seasonal basis, to the largest mammals that ever lived on this planet - the whale.

Whales are the backbone of the only real industry the Antarctic ever had, whaling. It was and still is of great economic importance. There are two suborders of whales. The baleen whales are without teeth and feed on plankton like the rich red krill of the Antarctic coastal waters. The toothed whales are the other suborder which also includes all true dolphins. Of all the whales hunted in the Antarctic, 90% are baleen whales, mostly the distinctive humpback whale.

It is a need to find warm waters in which to bear their young and the need to revitalize themselves in the rich Antarctic Oceans, that causes these great creatures to migrate vast distances each year. Their migratory routes are generally

well known, and they are hunted mercilessly during their annual treks. There are 6 species of whales which are hunted annually in the waters of Antarctica. The harvest of these great mammals amounts to between 5,000 and 10,000 kills annually in the Antarctic regions alone. This number is roughly 1/10 that of what it was 50 years ago.

Seals represent the only other group of mammals that exist in the Antarctic. This group has only six southern species. Four of these species, the Crabeater, the Weddell, the Ross, and the Leopard seals cause no economic interest and therefore are allowed to exist in large numbers unmolested by man. A fifth, the Elephant seal is found only occasionally. It is one of only two seals of the far South having economic value. It yields an important oil. It was the fur seal, which along with whales, first attracted the serious attention of the world to the Antarctic waste. The fur seal had for years been believed to be extinct. A few small herds have recently been seen and their numbers are increasing.

Flight is the most immediately recognizable characteristic of bird life. Yet two of the three species of birds native to Antarctica cannot fly. These, of course, are the penguins. Antarctica has only two of the ~~known~~ fifteen known species of penguins. The common Adelie and the relatively rare Emperor Penguins. The Emperor is the largest living penguin, reaching a heigth of four feet, while the Adelie rarely get taller than 18 inches.

I said that penguins cannot fly. If we use the word fly to mean to move through the air, then this is true. But if we take a broader view of the word, then the penguin can fly with superb skill, for the penguin literally flies through the water. Its flippers, vestiges of its once powerful wings, are the means by which it flies in the sea. It uses its flippers in the water just as other birds use their wings in the sky. Penguins can achieve speeds of 25-30 miles per hour once submerged.

Penguins feed on shrimp, fish, and squid. They return to ice or land only to breed, raise their young, hide from their enemies, and to play. Their only enemy on land is the skua, the only other bird native to the Antarctic. The skua, also known as the Antarctic vulture, feeds on fish, small marine life and the eggs and chicks of the penguins. None of these birds have a natural fear of man and have often proven to be a nuisance to researchers along the coast of Antarctica.

In doing the research for my paper the question "What effect does this frozen rock have on me?" kept occuring.

I found this answer actually came in two parts - the effects now and those yet to come. The biggest effect that you and I now feel from the Antarctic are in terms of our world climate.

There can be little doubt that the general climate at both poles is cold. This is due to two basic facts. First, the earth is tilted on its axis thus creating two seasons in the high latitudes. A dark season or winter, during which

no solar heat is available to these areas, and what little heat that is present is radiated into space. The summer or season of light is not much better. For though there are 24 hours of sunlight each day, between 50% - 90% of the solar radiation is reflected back into space by clouds and the polar ice caps.

Both polar regions are cold largely for the reason just mentioned. But Antarctica is even colder on the average than the Arctic, and here the reason must be attributed to its great height. Averaging over 6000 feet above sea level, it is the world's highest continent. This fact alone would result in the Antarctic being 22 degrees F colder than the Arctic. In winter, the freezing of the surrounding ocean outward from the coast, effectively doubles the size of the continent, removing it even further from the warming influence of open water.

I have mentioned that most of the solar radiation received by the Antarctic during the summer months is largely reflected back into space. If Antartica were losing heat in this way, year after year one would expect its climate to be getting colder. But this does not appear to be the case. Therefore, additional sources of energy must be making up the deficit. There seems to be two such sources of heat to the Antarctic.

The heat surplus of the earth originates in the middle and lower latitudes. Here the heat surplus is carried to both polar regions by advection. Advection is the process by which

heat is transfered from one point to another by a mass movement of the atmosphere in the form of warm air and water vapor. When this warm air reaches the polar ice sheets, its heat is transferred to the colder surface by a process of direct conduction.

The second method of heat transfer is through the movement of the oceans. Here the heat is transferred from lower latitudes to the polar regions via ocean currents. Then the heat passes into the air where the advection process again takes place.

We can now see how the Arctic and Antarctica act as heat sinks or radiators for surplus energy from the lower latitudes and thus maintain the earth's heat balance. Of these two heat sinks, Antarctica is by far the cooler.

The circulation of the atmosphere over the Antarctic is not all warm air in. Obviously, there are some very large cold air currents moving away from this land. These winds, though generally westward in direction, have been known to streak as far northward as the equator having devastating effects on local weather as well agriculture in these areas.

Exactly how much effect the Antarctic has on our climate is still being debated among scientists. But changes in the "Ninya", the prevailing equatorial Pacific, WIND during the late 1970's were attributed to atmospheric changes in Antarctica. This was, if you will remember, a time of severe winters and very dry summers for us locally. It should also be pointed out that the Gulf Stream Current, which is a major

element of the weather for our neighbors on the Gulf Coast, has its very beginnings in the oceans of Antarctica.

As for the future effects of Antarctica on mankind, one can only speculate. We have never been able to tell for certain what benefits current research might hold for the future. I can tell you that scientists by the thousands are asking for an opportunity to go there. Antarctica offers them a chance to work in what most call a clean lab. Here exist an opportunity to study the earth's geological history layer by layer, packed in a natural deep freeze, undisturbed by man or nature for the most part.

Most people look here and see a frozen barren land. But Antarctica is far from barren. The resources of Antarctica range from possible oil and hard minerals, to huge blocks of frozen fresh water, to whales and krill.

Sediments of the continental shelf could possibly hold large amounts of oil. On the Antarctic Peninsula, there are occurrences of copper, molybdenum, lead, zinc, tin, tungsten and other metals. Because of the Palmer Peninsula's geological similarity to the Andean belt in South America, speculation has been fueled. The continent contains iron, coal, traces of copper, molybdenum, nickel, chromium, cobalt, uranium, thorium, and other minerals. A total of 18 minerals of commercial value have already been uncovered in Antarctica.

But it is the Dufek intrusion in the Transantarctic Mountains that dominates any conversation about the continent's minerals. This 20,000 square-mile formation may contain

large valuable quantities of iron, copper, cobalt, and chromium. The Dufec intrusion's history is like that of some of Australia's richest deposits. The formation has been compared with famous mineral intrusions in Montana, Zimbabwe, Minnesota, and South Africa. But even this area, which has been studied more than most of the continent, has not yet been seriously prospected and is largely unknown.

Antarctica is rich in fossils: stems, fragmenting impressions of wood, and tropical ferns have been found in quantity. This means that Antarctica was once tropical or at least semi-tropical. Sandstone and coal have been found within 300 miles of the Pole itself. Extensive deposits of high-quality anthracite coal have been located in good-sized seams. Petroleum may be there, too. It is certainly a possibility worth examining.

Locating these minerals is just the beginning of economic uses of Antarctica. John Behrendt, a U. S. Treaty delegate from the U. S. Geological Survey, states in the publication, Petroleum and Mineral Resources of The Antarctica that oil is more likely than hard minerals to be developed in the next decades. He also points out that "technological problems in the far South are not identical to Arctic development problems, and the petroleum industry is not particularly interested at the present."

Members of the Antarctic Treaty are not so worried about a bootleg attempt to mine or drill for oil without treaty sanction. The environment is so severe that any effort would

need international help, and no bank is likely to lend money for an operation in which title to the resource is unclear. But all the delegates believe that it is necessary to have a mineral regime in place before miners and oil companies come pounding on the door. A New Zealand delegate, Christopher Beeby, said it best when he said, "It is necessary that it is done before someone finds a super giant oil field." It is highly desirable that we negotiate in ignorance.

In an attempt to address the question of mineral rights, the United Nations debated Antarctica in 1983. Some Third World Nations argued that the current treaty created an exclusive club whose members were intent on locking out the rest of the world. The U. N. ordered a study. The first report on it will be debated this spring. To treaty nations, a mineral regime that welcomes all comers might defuse any U. N. attempt to preempt the Antarctic Treaty.

Environmentalists have also gotten in on the picture. In 1980, they urged treaty delegates to consider making Antarctica a world park or preserve, and to solve the problem of mineral explotation by simply prohibiting it. This world park concept was met with a dull thud by treaty delegates. A more recent environmentalist proposal for an Antarctic-wide environmental protection agency has met with more promise. This agency would regulate issues as diverse as tourism and mining impact. Such an agency might have prevented the present controversy over the construction of a French airstrip near a penguin rookery.

No matter how these and future problems of Antarctica are solved one thing is for certain. Man can no more ignore this region than he can the oceans, the deserts, or the clouds overhead. Antarctica is as much a part of our future and the future of our decendents as crops not yet planted or the rain that is yet to fall. Antarctica is no more remote to our orld than the days ahead of us in this new year. This once remote Southern Continent is sure to be an important part of man's future course on this planet Earth.