In the fridge of the world

A fascinated continent

Antarctica is a continent with a very particular charm. It was the last to be discovered and explored (the South Pole was reached in 1911) and many difficulties were encountered when exploring Antarctica due to its particularly hostile environment, that required a great tribute in energy, drama and effort. The stories of the first explorers, that now date over a century ago, are filled with details that highlight the severity and hostility of the climate, the ever-present dangers and risks that accompanied practically every step – yet in all the stories there is great astonishment and admiration when looking at the landscapes, because of the charm and splendour that this continent evokes.
Today the picture has changed. Going to Antarctica no longer means exploring places that have never been reached by man. Today we know in detail the shape of the Antarctic mountains, the glaciers and valleys. People go to Antarctica to understand better how the Antarctic continent "works", to exploit some extreme characteristics (as for example the clearness of the air), to carry out determined experiments, and to read the immense quantity of data on the history of our planet, that Antarctica contains, like an immense file with a number of documents for us to slowly browse through.
The way of life and work are different. There no longer is the risk of not returning, the equipment has greatly improved, and even though working in Antarctica is still extremely demanding, today all the activities are carried out in safe conditions.

Extreme antarctic environment

The Antarctic environment is considered an extreme environment. Often, in fact, the Antarctic continent is referred to as being "the coldest, most barren, most inhospitable".
In fact even though Antarctica covers an area of over 14 million square kilometres it does not offer many resources for living and only a minimal part of the territory, near the coast, is colonized in a permanent or semi-permanent manner by plants or animals.

Polar night

As for territories near the North Pole, also in Antarctica there is the phenomenon of the "Polar night". The alternation of day and night is not the same as in our latitudes. Due to the inclination of the Earth's axis, as we go nearer to the Poles, the duration of night in winter becomes so much longer that on a particular day the sun drops below the horizon and rises again only after a very long period time. At the real Poles this occurs between the autumn and the spring equinox, therefore during the period in between these two days, the sun's disc is no longer visible. After a period of dusk (as usually occurs in our latitudes after sunset) darkness falls. On the contrary, in summer, the sun never sets below the horizon and the Poles remain illuminated all of the time.

Temperatures

One of the main characteristics of Antarctica is the cold: during the Polar night, on the plateau temperatures drop to almost -90° C, while on the coast the average is -30°C.
In summer, with the sun, the situation improves, however here too we must distinguish between the two areas. On the plateau, even during the summer months the air temperature rarely rises more than -30° C. Near the coast, instead, at lower altitudes the effect of the sea is felt and the temperatures rise markedly, so much so that near the base they may even reach 0°C.

Ice covering

Unlike the North Pole which is an ocean covered by ice that is many metres thick, Antarctica is a real continent covered by an ice sheet that reaches a thickness of over 34 km in some inland areas, from which only the land near the coast emerges, or along the mountain range that crosses Antarctica cutting it into two large portions. This is the Transantarctic

mountain range whose peaks reach above 4,000 metres.
The environmental conditions vary greatly from the coastal area to the interior area dominated by ice. The inland area, called plateau, consists of ice sheet; in this environment no rocks appear on the surface, there is no visible trace of life and the only thing that can be seen is the white blanket of ice that extends for thousands and thousands of kilometres. The other area is the coastal area where there are large areas that are not covered with ice in which there are rocks and detritus, and it is possible to see the tops of the mountains that surround large valleys crossed by immense glaciers.

Water and precipitations

A direct consequence of the low temperatures is the lack of liquid water on the continent even during the summer months. Actually there is abundant water in Antarctica, in fact the continent accounts for **over 90% of the fresh water reserve in the world**, however it is all in the form of ice. Only in the warmer months (December and January) snow and ice melt a lot and in the coastal regions, puddles of liquid water may be seen, or even small rivulets. Occasionally, even on the plateau some puddles of liquid water form, but these are ephemeral and occasional.
Another aspect that is instinctively associated with Antarctica is snow.
In contrast with what we may think, however, precipitations in Antarctica are not plentiful; this is because the environment is very dry. Actually it is even difficult to measure how much snow actually falls. In fact there is snowfall, and there are also real snowstorms that continue for many days. In these cases, however, the snow is pushed by the wind and therefore it accumulates in a very irregular manner. If in some areas it can reach a thickness of a few metres (behind an obstacle, near some irregularity in the ground), in another point only a few metres away the layer of snow may be just a few centimetres thick.
In these conditions it is really difficult to measure how much snow falls. Furthermore, because of the wind, it rarely falls vertically, but it falls obliquely and this makes it difficult for the instruments to record correctly.
Furthermore, since the winds blow intensely, the snow that accumulates in a particular spot often also includes a high percentage of snow that is transported form other areas, so that the snow that falls on a specific spot is the sum of the snow that actually precipitates plus the snow transported from other areas.

The antarctic wind

A last protagonist in the Antarctic environment is surely the wind. In fact due to the particular orographic situation, in Antarctica there are particular winds that can blow at over 200 km/h. These winds, called **katabatic winds**, form in particular atmospheric conditions – they originate on the plateau, and then move towards the coasts, making their way into the valleys.
Katabatic winds can blow for several days on end, and in extreme cases they can even reach a speed of 300 km/h, even though their normal speeds are much lower. When these winds blow, practically all activities stop, because if one stays out in the open it can become dangerous, visibility decreases remarkably, because these winds can carry snow and dust.
A katabatic wind can be recognized even from far, as even dozens of kilometres away it is possible to see the characteristic gusts of snow on the mountain profiles, formed by snow that is tossed up by the wind. The katabatic wind also has a great impact on the pack (frozen sea) because it is one of the motors that can break the sea ice that forms near the coasts, and push it away.

Sea ice

Sea Ice forms when the air temperature drops and the surface of the sea freezes. Sea water is salty and therefore does not freeze at 0°C but at lower temperatures (at -1.5°C – 1.9°C) and slowly forms a layer that may also reach a thickness of various metres. Freezing is not immediate and a large variety of sea ice forms – ice-packs of various shapes and sizes subsequently join to form a compact uniform layer. The formation of sea ice takes place mostly in winter and the ice-fields (i.e. the layer of sea ice) can reach a surface area of over 20 million km^2 extending across the ocean for over 1,000

kilometres from the coast. In summer the ice wears away and the area of the ice-pack decreases to 3 million square kilometres. Breaks in the pack can occur all of a sudden. Rough sea conditions or a long wave can break the pack into large floes which are carried away with the currents and the wind. Many square kilometres of ice can drift away in very few hours.
All this (however the interesting aspects of Antarctica are not limited to this) has a great impact on the continent. The extreme climate in fact prevents plants from growing (except some lichens and moss in the coastal area) and therefore animals can colonize Antarctica only seasonally near the coast. In the interior, near the Pole not even this is possible and Antarctica here is a true desert area.

Why study Antarctica?

Living conditions in Antarctica are particularly severe and therefore working there is not an easy task. Then why is it worthwhile to face so many difficulties to study the Antarctic environment? Researches that are carried out in Antarctica are extremely varied, and they cover practically every branch of science. This is because Antarctica is the last continent to have been discovered and as it has an extreme environment, many aspects still have to be studied. Furthermore as it is an uninhabited continent surely it is the least polluted area in the world and therefore particular experiments can be carried out and some phenomena which have remained undisturbed by man-made products can be observed.
Studies are carried out on site, away from the base camps, and also in the laboratories set up inside the base camp or in laboratories that are not so distant (to eliminate the slightly disturbing effect that the base creates). In other cases instead, only samples are taken (of rock, ice, water or biological material), which are then studied calmly in Italy.
Otherwise, instruments are installed on site to record data (such as air temperature or the magnetic field) in points that are far away from the base camp. The data are forwarded directly or alternatively are downloaded manually once or more times a year, and are then examined in the laboratory.
To list them all is practically impossible as there are numerous branches of science involved and there are really many people who have been working in this field in the past years.

Astronomy

Even though it may seem strange, since in Antarctica in the summer season the sun is always present and the stars are not visible, part of the scientists are astronomers.
In fact, part of the observations are carried out with instruments that do not detect visible light but, for example, the infra red rays of celestial bodies, and which therefore can easily be used even in daylight.
Another area that is studied are the polar auroras, that are monitored with the help of automatic instruments that work in winter, because these phenomena are only visible when it is dark.

Rocks, ice and soil

A part of the research is carried out by geologists who study the rocks present in Antarctica. Even though most of the continent is covered with ice, the exposed rocks are good enough to tell us a very long story.
For example the rocks near the base are 500 million years old. By studying the composition, shape and ratio of the different types of rocks that are present in Antarctica and those present in other continents nearby, it is possible to reconstruct the more remote history of Antarctica, of when it formed and the slow movement of the Earth's surface.
There is also a group of geologists who study the more recent history of Antarctica, investigating the superficial sediments, the traces left by the glaciers, such as moraines, emersed beaches and other characteristics that tell a long story about the advance and retreat of Antarctic ice.
In order to do all this, the geologists must go on the site, mark the type of rocks on maps, together with the shapes, the type of sediment, and all the other characteristics. Furthermore, samples are taken, and then studied very carefully once these are brought to Italy, by means of chemical and mineralogical analyses, exploiting state of the art techniques. A correct comprehension of the history that rocks tell us is possible only by uniting the data seen on site (and therefore the position and certain characteristics of the rocks) and the laboratory data. In this manner it is possible to understand the

history of the Earth and the climate.
Glaciologists instead , as their name implies, study the ice. Some study how it forms, passing from snow to ice, others study the movements of the glaciers that slowly move towards the sea, and yet others study sea ice. In order to study the ice and the glaciers it is necessary to travel to the site and take samples of the same, and use instruments to measure the movements etc. Furthermore, some glaciologists use the ice to study the climate of the Earth in the past. In fact ice is formed due to annual snowfall which is gradually covered by other snow that becomes compressed till it becomes ice. In this manner many minor layers of ice are formed, which preserve the composition of the original snow. Furthermore in the ice small air bubbles are preserved, which maintain the composition of the air at the time the snow was deposited. By examining the different ice levels and the air bubbles it is therefore possible to unveil the history of the climate and of the atmosphere of the past. If we consider that the ice in Antarctica reaches depths up to 4 km, we can imagine how far back in time it is possible to go. So a part of the researchers is working to take ice samples in the form of very long ice cores. If we study the characteristics and the contents of this ice with a series of sections on an annual scale it is possible to date back up to one million years ago.
There is another group of people, mid-way between the geologists and the glaciologists, who study the characteristics of the iced soil, called permafrost. In Antarctica, in fact, due to the low temperatures, the land is always iced and therefore inside it water is stored in the form of ice. In the warmer season in fact only the more superficial layer of the ground melts (few dozens of centimetres). In order to study this type of ground, there are particular persons who put together the information collected from the ground and those obtained from the ice.
Another group of scientists, the geophysicists, study some of the characteristics and behaviour of the soil. Some study earthquakes and near the base there is a station that can record all the earthquakes that take place. By analyzing these data it is possible to better understand how earthquakes are generated and how the deeper layers of the Earth are made.
Other geophysicists study the magnetic field. Carrying out studies in this region is important as one of the Earth's magnetic poles is in Antarctica.

Studying life

Even though at first sight Antarctica seems an uninhabited continent, it is actually full of life, at least on the coastlines. In fact here colonies of migrating animals are present, such as penguins, other birds and sea mammals, and studying them requires much patience and perseverance, and requires observations in order to understand the animal behaviour and samples of blood in order to understand the state of health and the adaptation strategies of the different species.
Most of the life, however, is to be found underwater where, even though it may seem strange, the sea bottom is full of organisms such as starfish, sponges, worms and therefore also fish. Samples can be taken by means of fishing nets, or during immersions, in order to verify the state of the sea directly.
Besides studying the relations among the various organisms, and the organisms and the environment, and therefore a study of the ecosystem, some studies can be carried out on particular organisms. Some fish, in fact, have a real "antifreeze" in their blood that enables them to survive even when the water temperature drops below zero.
On the continent, instead, the most common form of life are lichens. Some biologists study these organisms in order to understand how they live and to study the interactions between lichens and frozen soil dynamics.

Meteorology

Another sector that is widely studied, also because it has an immediate practical effect, is meteorology. In fact, the data that are collected are used to elaborate weather forecasts in order to programme the scientists' activities and also in order to have more data to understand the atmosphere and circulation in the Antarctic and also on a global scale. For this purpose, there are a number of meteorological stations near the base and also in remote areas, distant hundreds of kilometres, near the coasts and inland. These stations collect data automatically and forward them to the base.
The stations are located in areas that are very far from the base and therefore cannot be connected with electric cables.

These must therefore be self-sufficient as far as electric power is concerned and must operate during the entire winter period when there is no sun and the temperatures are very low. In order to be self-sufficient, the stations are provided with accumulators and a solar panel so that during the summer season, the station can operate on the solar energy that is also used to recharge the batteries. When the sun drops below the horizon, the station operates on the energy provided by the batteries only, and the following season, when the sun rises again, the batteries are recharged.
Another activity linked with the study of the meteorological conditions and the dynamics of the atmosphere is the launching of probe balloons, which for obvious reasons is done only from the base. The balloons are equipped with a probe that can record data from the atmosphere, and transmit them back to the base via radio. In this way it is possible to create vertical profiles of the atmosphere.
Chemists too have a lot of work in Antarctica. In fact the chemical composition of the atmosphere, of the sea, of the snow and of the ice are studied in order to better understand what substances are present and what transformations they are subjected to in their cycle. Furthermore it is also possible to study the origin of determined particles and to control the Earth's "state of health", observing if determined substances, which are clearly produced by man, reach the Antarctic.
Other scientists, physicists, are mainly concerned with solar radiation and how it passes across the atmosphere, others exploit the Antarctic as a laboratory to test some types of equipment in extreme environments, etc., and others study the human body's behaviour in extreme environments.
There is truly a multitude of things that can be studied. What is important is to do so without destroying and contaminating the environment, so as to preserve it for the future generations.

Edited by Andrea Strini