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Earth's Dynamic Systems: Ice Ages

When Glaciers Covered the Earth

Aira Astralis

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Conclusion

This free sample contains the Introduction and Chapter 1. The complete book contains the full contents above.

Introduction

An ice age is a period of time when decreased temperature of Earth's surface and atmosphere results in the prolonged presence or expansion of continental alpine glaciers and polar ice caps. The term is applied in several different senses to very long and comparatively short periods of cooling. An ice age may consist of numerous sub-periods where the global temperature and glaciation fluctuates, with the colder periods called glacials, and relatively warmer periods called interglacials.

Earth's climate alternates between icehouse and greenhouse periods based on whether there are glaciers on the planet, and for most of Earth's history it has been in a greenhouse period with little or no permanent ice. Over the very long term, Earth is currently in an icehouse period called the Late Cenozoic Ice Age, which started 34 million years ago.

There have been colder and warmer periods within this ice age, and the term is also applied to the Quaternary glaciation, which started 2.58 million years ago. Within this period, the Last Interglacial ended 115,000 years ago, and was followed by the Last Glacial Period (LGP), which gave way to the current warm Holocene, which started 11,700 years ago. The most severe cold period of the LGP was the Last Glacial Maximum, which reached its maximum between 26,000 and 20,000 years ago.

The most recent glaciation was the Younger Dryas between 12,800 and 11,700 years ago. In 1742, Pierre Martel (1706-1767), an engineer and geographer living in Geneva, visited the valley of Chamonix in the Alps of Savoy. Two years later he published an account of his journey. He reported that the inhabitants of that valley attributed the dispersal of erratic boulders to the glaciers, saying that they had once extended much farther. Later similar explanations were reported from other regions of the Alps.

When the Bavarian naturalist Ernst von Bibra (1806-1878) visited the Chilean Andes in 1849-1850, the natives attributed fossil moraines to the former action of glaciers. Meanwhile, European scholars had begun to wonder what had caused the dispersal of erratic material. From the middle of the 18th century, some discussed ice as a means of transport.

According to Stephen Barker of Cardiff University, without human interference, the next glaciation of the Earth would "occur within the next 11,000 years, and it would end in 66,000 years' time."

A 2015 report by the Past Global Changes Project says simulations show that a new glaciation is unlikely to happen within the next approximately 50,000

years, before the next strong drop in Northern Hemisphere summer insolation occurs "if either atmospheric CO2 concentration

Chapter 1: The Discovery of Ice Ages

Such explanations could also be found in other parts of the world. The Swedish mining expert Daniel Tilas (1712-1772) was, in 1742, the first person to suggest drifting sea ice was a cause of the presence of erratic boulders in the Scandinavian and Baltic regions. In 1795, the Scottish philosopher and gentleman naturalist, James Hutton (1726-1797), explained erratic boulders in the Alps by the action of glaciers. Two decades later, in 1818, the Swedish botanist Göran Wahlenberg (1780-1851) published his theory of a glaciation of the Scandinavian peninsula. He regarded glaciation as a regional phenomenon.

Only a few years later, the Danish-Norwegian geologist Jens Esmark (1762-1839) argued for a sequence of worldwide ice ages. In a paper published in 1824, Esmark proposed changes in climate as the cause of those glaciations. He attempted to show that they originated from changes in Earth's orbit. Esmark discovered the similarity between moraines near Haukalivatnet lake near sea level in Rogaland and moraines at branches of Jostedalsbreen. Esmark's discovery were later attributed to or appropriated by Theodor Kjerulf and Louis Agassiz.

During the following years, Esmark's ideas were discussed and taken over in parts by Swedish, Scottish and German scientists. At the University of Edinburgh Robert Jameson (1774-1854) seemed to be relatively open to Esmark's ideas, as reviewed by Norwegian professor of glaciology Bjørn G. Andersen (1992). Jameson's remarks about ancient glaciers in Scotland were most probably prompted by Esmark.

In Germany, Albrecht Reinhard Bernhardi (1797-1849), a geologist and professor of forestry at an academy in Dreissigacker (since incorporated in the southern Thuringian city of Meiningen), adopted Esmark's theory. In a paper published in 1832, Bernhardi speculated about the polar ice caps once reaching as far as the temperate zones of the globe.

In Val de Bagnes, a valley in the Swiss Alps, there was a long-held local belief that the valley had once been covered deep in ice, and in 1815 a local chamois hunter called Jean-Pierre Perraudin attempted to convert the geologist Jean de Charpentier to the idea, pointing to deep striations in the rocks and giant erratic boulders as evidence. Charpentier held the general view that these signs were caused by vast floods, and he rejected Perraudin's theory as absurd.

In 1818 the engineer Ignatz Venetz joined Perraudin and Charpentier to examine a proglacial lake above the valley created by an ice dam as a result of

the 1815 eruption of Mount Tambora, which threatened to cause a catastrophic flood when the dam broke. Perraudin attempted unsuccessfully to convert his companions to his theory, but when the dam finally broke, there were only minor erratics and no striations, and Venetz concluded that Perraudin was right and that only ice could have caused such major results.

In 1821 he read a prize-winning paper on the theory to the Swiss Society, but it was not published until Charpentier, who had also become converted, published it with his own more widely read paper in 1834. In the meantime, the German botanist Karl Friedrich Schimper (1803-1867) was studying mosses which were growing on erratic boulders in the alpine upland of

Bavaria. He began to wonder where such masses of stone had come from.

During the summer of 1835 he made some excursions to the Bavarian Alps. Schimper came to the conclusion that ice must have been the means of transport for the boulders in the alpine upland. In the winter of 1835-36 he held some lectures in Munich. Schimper then assumed that there must have been global times of obliteration ("Verödungszeiten") with a cold climate and frozen water.

Schimper spent the summer months of 1836 at Devens, near Bex, in the Swiss Alps with his former university friend Louis Agassiz (1801-1873) and Jean de Charpentier. Schimper, Charpentier and possibly Venetz convinced Agassiz that there had been a time of glaciation. During the winter of 1836-37, Agassiz and Schimper developed the theory of a sequence of glaciations. They mainly drew upon the preceding works of Venetz, Charpentier and on their own fieldwork.

Agassiz appears to have been already familiar with Bernhardi's paper at that time. At the beginning of 1837, Schimper coined the term "ice age" ("Eiszeit") for the period of the glaciers. In July 1837 Agassiz presented their synthesis before the annual meeting of the Swiss Society for Natural Research at Neuchâtel. The audience was very critical, and some were opposed to the new theory because it contradicted the established opinions on climatic history.

Most contemporary scientists thought that Earth had been gradually cooling down since its birth as a molten globe. In order to persuade the skeptics, Agassiz embarked on geological fieldwork. He published his book Study on Glaciers ("Études sur les glaciers") in 1840. Charpentier was put out by this, as he had also been preparing a book about the glaciation of the Alps. Charpentier felt that Agassiz should have given him precedence as it was he who had introduced Agassiz to in-depth glacial research.

Ice Age: Geode Jam! Ice Age Live!

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ABOUT THE AUTHOR

Aira Astralis is a science writer specializing in astronomy and space exploration. Her work spans the full breadth of humanity's relationship with the cosmos -- from the earliest naked-eye observations to the engineering marvels of modern space missions.

Her books are built on a foundation of primary sources: peer-reviewed research, mission archives, and direct engagement with the scientific community. She writes for readers who want to understand not just what we know about the universe, but how we came to know it.

She believes that the most important frontier is not out there but in the gap between what scientists discover and what the public understands. Her books exist to close that gap.