

<i>Unit</i>	<i>Quantity</i>	<i>Symbol</i>	<i>Equivalents</i>
Light-year (distance traveled by light in one Earth year)	Length/distance	lt-yr	5,878,499,814,275.88 miles 9.46×10^{12} kilometers
Liter	Volume/capacity	L	1.057 liquid quarts 0.908 dry quart 61.024 cubic inches
Mega-electron volt	Energy	MeV	—
Megahertz	Frequency	MHz	—
Meter	Length	m	39.37 inches
Meter, cubic	Volume/capacity	m ³	1.308 cubic yards
Meter per second	Velocity	m/s	2.24 miles per hour 3.60 kilometers per hour
Meter per second per second	Acceleration	m/s ²	12,960.00 kilometers per hour per hour 8,052.97 miles per hour per hour
Meter, square	Area	m ²	1.196 square yards 10.764 square feet
Metric. <i>See</i> unit name			
Microgram	Mass/weight	mcg <i>or</i> µg	0.000001 gram
Microliter	Volume/capacity	µl	0.00027 fluid ounce
Micrometer	Length	µm	0.001 millimeter 0.00003937 inch
Mile (nautical international)	Length	mi	1.852 kilometers 1.151 statute miles 0.999 U.S. nautical miles
Mile (statute or land)	Length	mi	5,280 feet 1.609 kilometers
Mile, square	Area	mi ²	258.999 hectares
Milligram	Mass/weight	mg	0.015 grain
Milliliter	Volume/capacity	ml	0.271 fluid dram 16.231 minims 0.061 cubic inch
Millimeter	Length	mm	0.03937 inch
Millimeter, square	Area	mm ²	0.002 square inch
Minute	Time	m	60 seconds

ence of carbonate rock and other naturally alkaline materials functions to neutralize the excess acidity, thus maintaining the pH balance of the ocean waters. This physical interaction process is more complex than this description would suggest, however it is the simple neutralization reaction between hydroxide and hydrogen ions that is at its heart.

—Marianne M. Madsen

Further Reading

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See also: Ocean acidification; pH.

ALLEROED OSCILLATION

Category(s): Climatic events and epochs; Cryology and glaciology

The Alleroed oscillation is one of a number of climate swings during which the climate of the northern hemi-

sphere cooled considerably. Evidence for such climate swings is found in terrestrial sediments.

Key Concepts

flora and fauna: the plant and animal life, respectively, that exists in a region during any particular period of time-consuming

oscillation: a period of hundreds to thousands of years during which climates become either significantly cooler or warmer than the overall trend of changing climate

positive feedback: the condition in which the result of a process promotes the process rather than diminishing its effectiveness (negative feedback)

thermohaline circulation: the great world-spanning circulation of ocean currents driven by changes in water temperature and salinity

DEFINITION

The Alleroed oscillation was a temperature fluctuation that occurred near the end of the last glaciation period, about thirteen thousand years ago. For several centuries following the oscillation, Europe, the British Isles, and the northern Atlantic warmed to present-day levels. Other areas remained untouched. The Alleroed oscillation is but one of several climate swings affecting the North Atlantic region over a period from 17,700 years ago to 11,500 years ago. These oscillations, revealed in European terrestrial sediments, are known as the Oldest Dryas, Boelling, Older Dryas, Alleroed, and Younger Dryas oscillations. Some oscillations provided warming conditions to circumscribed areas, as during the Alleroed oscillation, while others—such as the Younger Dryas oscillation, the last major cold event—were probably global in scope.

SIGNIFICANCE FOR CLIMATE CHANGE

The climate of the North Atlantic region underwent a series of abrupt cold/warm oscillations when the ice sheets of the Northern Hemisphere retreated.

HISTORICAL AND POLITICAL CONTEXT

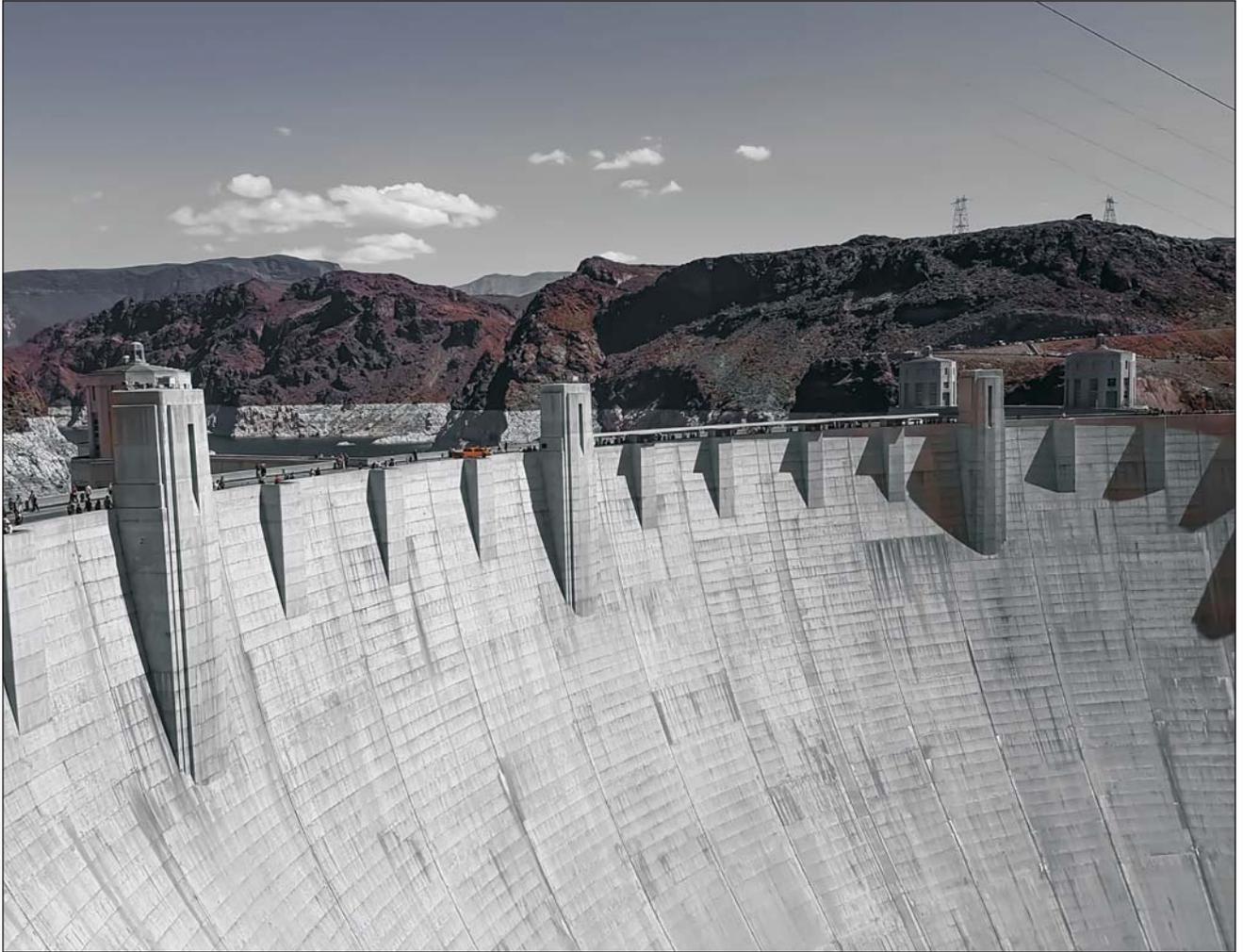
Australia is a federal parliamentary state. Australia achieved federation status in 1901. The British monarch, Queen Elizabeth II, is the chief of state, although constitutional links with Britain were ended in 1968. Prime Minister Malcolm Turnbull became the head of state in 2015, and Scott Morrison became Prime Minister in 2021. Despite the nature of its geography, bound by water in all directions, Australia has eschewed isolationism and fought alongside the British in World Wars I and II and with the United States in the Korean and Vietnam Wars. During the 1960's, the country sought to deal more fairly with its indigenous population of aborigines. In 2001, Australia joined the United States in its response to the September 11 terrorist attacks.

IMPACT OF AUSTRALIAN POLICIES ON CLIMATE CHANGE

When Prime Minister Kevin Rudd was elected, ending the eleven-year ministry of John Howard, he made ratifying the Kyoto Protocol a priority of his ministry. Shortly after his election, Rudd was invited to the United Nations Climate Change Conference in Bali. Australia's pledge to ratify the Kyoto Protocol signaled a policy shift from that of the previous government; Australia had previously signed the protocol but had not ratified it. Industrialized, Annex I parties to the Kyoto Protocol such as Australia were committed to cut their greenhouse gas (GHG) emissions by an average of 5% from their 1990 levels between 2008 and 2012. This goal was achieved in the specified timeline. A heavier burden was placed



Koala. Photo via iStock/Maridav. [Used under license.]



A vast concrete structure—The Hoover Dam. Photo by Arjun R, via Wikimedia Commons.

strong cement that hardens underwater (hydraulic) and is impervious to salt water.

Natural cement is produced by low-temperature burning of clay- or magnesium-rich limestone; upon completion of the burn, the limestone is crushed into smaller fragments, then pulverized, producing very strong cement.

Portland cement, patented by Joseph Aspdin in Portland, England, in 1824, combines limestone and clay, then grinds them with water into fine slurry. The dried slurry is burned in a kiln and the calcined material is again ground to a fine powder. By the

1850's, the strength and setting qualities of Portland cement were improved by burning the mixture at very high temperatures—close to the fusion point within the kiln. This improvement and the ability to chemically analyze successful cement products allowed the Portland cement industry to grow. Portland cement began production in the United States between 1875 and 1890, with mills in Texas, Oregon, Michigan, New York, Maine, and the Lehigh District of Pennsylvania. Canadian production began in Hull, Québec, in 1889 and in Vancouver, British Columbia, in 1893.

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See also: Albedo Feedback; Climate Feedback; Cryosphere; Glaciations; Glaciers; Ground Ice; Ice Shelves; Interglacials; Sea Ice; Sealevel Change.

DESALINATION OF SEAWATER

Category(s): Water resources; Science and technology

Desalination of water is an often-disputed subject where climate change is concerned. Scientists are unsure whether desalination will have a major effect on Earth's climate.

Key Concepts

distillation: use of evaporation and condensation to remove solutes from a liquid; one of the earliest forms of artificial desalination

passive vacuum technology: method that utilizes gravity and atmospheric pressure, rather than pumps, to create a vacuum, which enables evaporation to occur at lower temperatures, requiring less energy

reverse osmosis: forced passage of a liquid through a membrane to remove solutes

BACKGROUND

The removal of salt from seawater is an ages-old process that has become a multimillion-dollar industry. The demand for freshwater, especially in arid regions, has driven people to create and implement new and more effective ways to remove salt from water. Desalination occurs naturally as part of the hydrologic cycle. The Sun evaporates water from the ocean. The vapor, condensed by cooler air in the atmosphere, forms rain clouds. The rain from these clouds reaches the ground as pure liquid water. Earth's ecosystems are dependent upon this process.

All artificial desalination processes are based on the natural hydrologic cycle. For the most part, the energy requirements to desalinate seawater are heavy, making the process expensive. Still, it is estimated that 30% of the world's irrigated areas suffer from salinity problems that prevent crops from flourishing as they would if freshwater were available. The need for desalinated water for human and crop consumption is critical in the Middle East and other regions where freshwater is not abundant.

DISTILLATION

The most fundamental form of desalination is distillation, one of the earliest forms of water treatment. Ancient mariners used this process to convert seawater into drinking water on long voyages. By heating salt water and capturing the vapors, then letting them condense back into a liquid, they removed salt and other impurities. The same process is used to separate alcohol from fermented grains.

PASSIVE VACUUM TECHNOLOGY

Passive vacuum technology is used to decrease the energy requirements of desalination. By elevating a container, a partial vacuum can be created by the difference between air pressure inside and outside the container. The vacuum in turn allows water directed through the container to evaporate at a lower temperature, making it feasible to heat the water to



The dodo of Mauritius, shown here in a 1626 illustration by Roelant Savery, is an often-cited example of modern extinction. Image via Wikimedia Commons. [Public domain.]

tious disease, or severe weather caused the extinction. Habitat loss represents the ultimate, underlying cause, although additional proximate stressors subsequently eliminated the species. Relative to single-species extinctions, extinction events typically involve far more complicated chains of causation. Global warming is thought to have contributed to numerous extinctions—including the Permian-Triassic and Triassic-Jurassic events, as well as less severe events during the early Jurassic (around 183 million years ago) and the Paleocene-Eocene bound-

ary (around 55 million years ago). If global warming were to occur again, it would likely contribute to future extinctions via several main mechanisms.

First, warming conditions would reduce or degrade the habitats of high-latitude, high-altitude, and temperate species. For example, polar bears rely for food on the formation of winter ice in which their seal prey dens, so they would be threatened by a decrease in such ice formation. Similarly, rising sea levels resulting from melting glaciers would flood coastal areas and reduce Earth's overall island