What's in a Name?

Biological Classification and Scientific Naming

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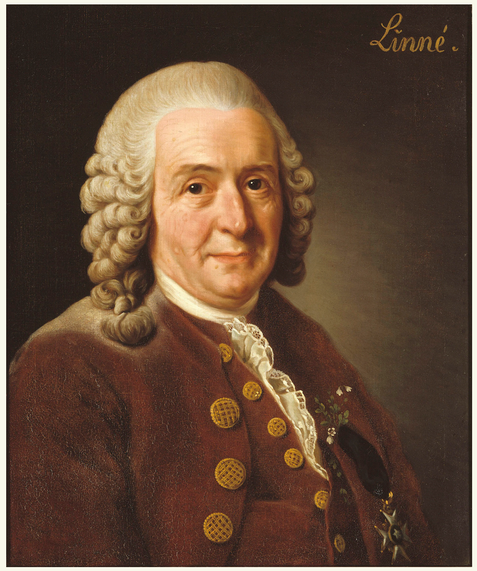




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(Boijmans Museum, Netherlands)

What's in a Name?

An Introduction

Every species known to science has a name, referred to as a scientific name or **binomen**. For example, *Homo sapiens* is the scientific name for humans. There are two main functions of these Latin names: to identify a species and to indicate its evolutionary relationships to other organisms. The first half is the genus name that links an organism to its closest relatives, while the second species name implies their uniqueness.

Why do we use Latin names in addition to **common names**? Species may have several common names, but only one scientific name, or different species may have the same common name. For example, the "robin" in the United States, is a thrush, *Turdus migratorius*, while the "robin" in Europe is a completely different species, *Erithacus rubecula*. Scientific names are not likely to be confused for something else, as there are strict guidelines for naming species. To name a species, a scientist must describe a "**holotype**" which is a specimen used as the basis for the morphology of the species, and follow international codes such as the *International Code of Nomenclature for Algae, Fungi, and Plants*.

Species names are one part of the business of biological taxonomy. Individual genera are also grouped into larger groups in a hierarchy. For example, *Homo sapiens* is in the Order Primates, the Class Mammalia within the Kingdom Animalia. These groups reflect the evolutionary relationships of the species.

While taxonomy acts as a concrete reference system to the natural world, it is also constantly changing as our scientific understanding grows.

The American Robin, *Turdus migratorius*. (Jerry Friedman, CC BY-SA)
Organisms with the same common names are sometimes not very closely related.

The European Robin, *Erithacus rubecula.* (Frank Vassen, CC BY)

Portrait of Linnaeus, by Alexander Roslin,1775.
(Nationalmuseum, Stockholm, Accession #: NMGrh 1053)

Latin or Binomial Nomenclature

Binomial nomenclature, the system used to assign species with their two-part Latin names, originated in the eighteenth century. Carl von Linné (1707–1778), the mastermind of the naming system, established a system of tiered taxonomic classification, which assigned species formal names, all outlined in his book, *Systema Naturae*. This way, all living things would not be confused with multiple common names, but have an agreed upon scientific name. The names were formulated from Latin words; Linné even Latinized his own name, to the name most people know him by today: Carolus Linnaeus.

Lost Pond, Brookline, Massachusetts. (Alex Griswold)

Choosing a Name

Giving an organism a name is no small process and involves following a specific set of rules that governs how organisms are classified. Different types of organisms have their own codes of nomenclature but all generally abide by the following principles:

Principle of Binominal Nomenclature: The scientific name of a species, and not of a taxon at any other rank, is a combination of the genus and species; the use of a trinomen for the name of a subspecies and of uninominal names for taxa above the species group is also accepted.

Principle of Coordination: Within the family group, genus group, or species group, a name established for a taxon at any rank in the group is deemed to be simultaneously established with the same author and date for taxa based on the same name-bearing type at other ranks in the group.

Principle of the First Reviser: The First Reviser determines the relative precedence of two or more names or nomenclatural acts published on the same date, or of different original spellings of the same name.

Principle of Homonymy: The name of each taxon must be unique. Consequently, a name that is a homonym of another preexisting name must not be used as a valid name.

Principle of Priority: The valid name of a taxon is the oldest available name applied to it (starting at 1756), provided that the name is not invalidated by any provision of a Code or by any ruling by a Commission.

Principle of Typification: Each nominal taxon in the family, genus, or species group has a name-bearing type specimen (holotype) fixed to act as a reference for the species.

The Titan Beetle (*Titanus giganteus*) is probably the largest insect in the world. (Bernard Dupont, CC BY-SA 2.0)

The Californian Lady Slipper, ***Cypripedium californicum***. (Bill Bouton, CC BY-SA 2.0)

Naming Species in a Modern Age

Scientists are constantly finding new species and having to name them. In most instances, the new scientific name reflects an attribute of the organism such as its morphology (e.g., the Titan Beetle, *Titanus giganteus*), habitat (e.g., the human head and body louse, *Pediculus humanus*), or geographical distribution (e.g., the Californian Lady Slipper, *Cypripedium californicum*). Organisms are often named in honor of scientists—there are more than 300 taxa named after Charles Darwin and many named after Linnaeus. Names can also be inspired by mythology such as the extinct elephant *Stegodon ganesa*. The Hindu god Ganesa is usually depicted with the head of an elephant.

A female human head louse, ***Pediculus humanus capitis***. (Gilles San Martin, CC BY-SA 2.0)

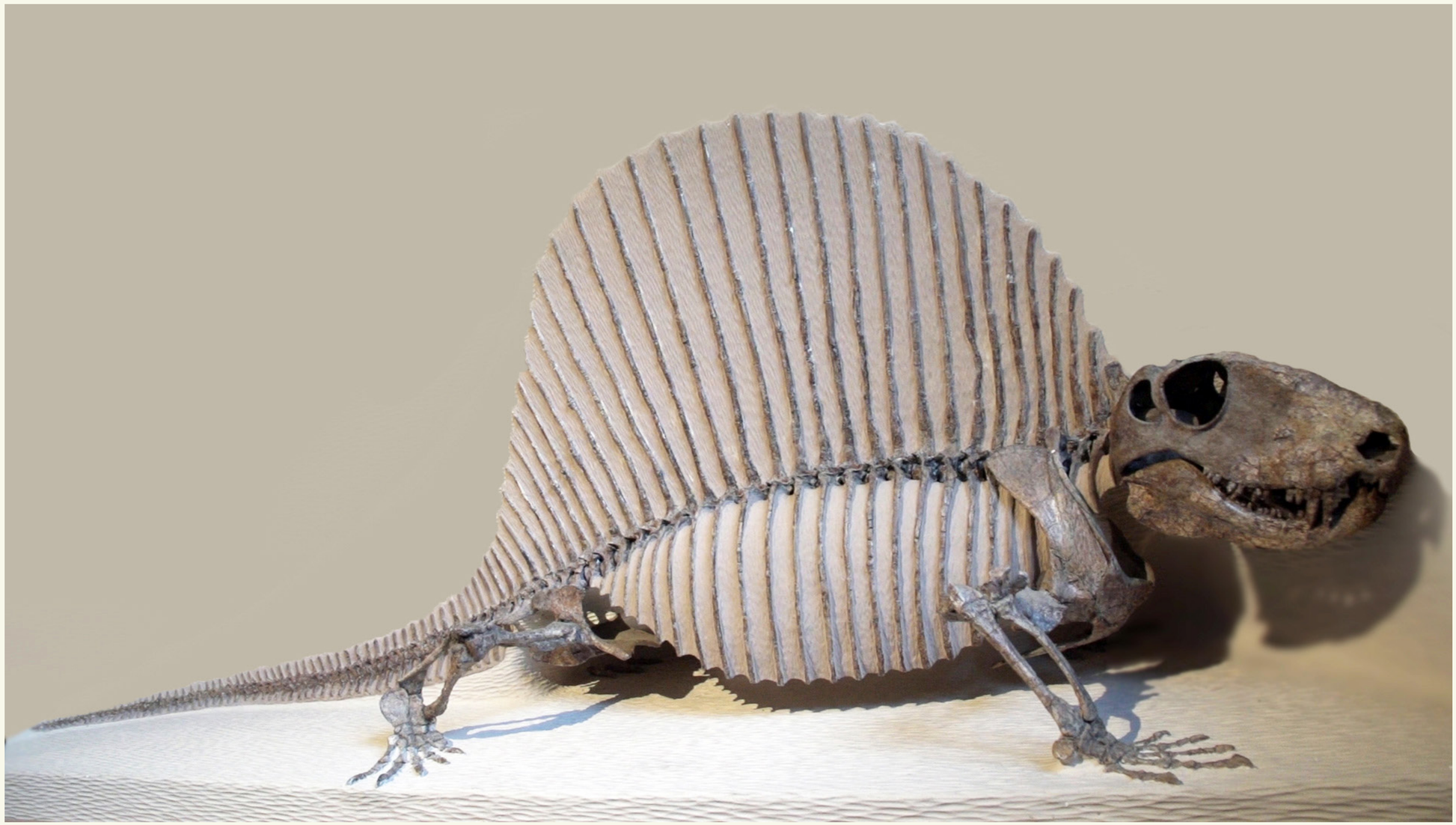
Pheidole harissonfordi was named by Harvard professor Edward O. Wilson in recognition of the actor Harrison Ford's "outstanding contribution in service and support to tropical conservation." (EOL)

A male ***Iandumoema smeagol***. Generations of living in isolated caves have caused this species to lose vision and become pale from lack of pigment. (Ricardo Pinto-da-Rocha, Rafael Fonseca-Ferreira, and Maria Elina Bichuette, CC BY 4.0)

Given that there are so many species already named, and that each name must be unique, scientists have become creative! Pop culture references are now quite commonplace in taxonomy e.g., the polychaete worm *Bushiella beatlesi*.

In 2015, a new species of Daddy Longlegs, *Iandumoema smeagol*, was found in Brazil. This species of arachnid is a cave dwelling creature, which in both appearance and behavior resembles Smeagol (later Gollum) in the *Lord of the Rings* saga. In Central and North America, a genus of fungus beetles goes by a very peculiar name—*"Gelae"* (yes, pronounced like "jelly"). The members of this group all make their homes in different kinds of fungus, but their names are much more appetizing. They include *Gelae baen, Gelae belae, Gelae rol*, and *Gelae donut*.

The tarantula ***Aphonopelma johnnycashi*** was so named because it was found near Folsom Prison, made famous by Johnny Cash's song *Folsom Prison Blues*. (Chris A. Hamilton, Brent E. Hendrixson, Jason E. Bond, CC BY 4.0)



Harvard's ***Dimetrodon milleri*** is on display at the Harvard Museum of Natural History. (HMNH)

What Is a Type Specimen?

When Harvard paleontologist Alfred Romer discovered *Dimetrodon milleri* in 1937, he discovered the first of the species and one of the most complete *Dimetrodon* specimens to date. It became the "type specimen," a true example of the species, and one that scientists use to identify specimens of the same species. A "type" can be a specimen, a culture, an illustration, or a bacterial code, depending on the type of organism.

All scientifically named species on Earth, both living and extinct, have their own type specimen, which contains the defining characteristics of the species. They are usually housed in natural history collections.

Since Harvard's *Dimetrodon milleri* is the specimen for which the species is named, it is known as the name-bearing **"holotype."**

But there are other "types" as well. "Paratypes" are other specimens of the same species collected at the same time as the holotype. "Allotypes" are the member of the opposite sex of the holotype, usually collected at the same time. "Neotypes" are specimens that could assume the holotype's role should the original specimen be lost or destroyed.

Giraffe cow in the Groenkloof Nature Reserve, Pretoria, South Africa. (JMK, CC BY-SA 3.0)

Reflecting Evolution

Linnaeus set up his biological classification system one hundred years before Darwin's publication of his theory of evolution by natural selection. Today, scientific naming also intends to reflect evolutionary relationships, so names change. Scientists continue to investigate those relationships. In particular, the increased availability of genomic and other molecular data has changed our understanding of those phylogenies, which leads to new names.

For example, recent studies of the DNA of giraffe populations have shown that there is significant genetic variation between different populations, suggesting each one is genetically isolated. Instead of one species of giraffe, *Giraffa camelopardalis,* there are four: *G. camelopardalis, G. reticulata, G. tippelskirchi,* and *G. giraffa*. Similarly, some scientists argue that there are three genera of pangolins *(Manis, Phataginus,* and *Smutsia)* rather than one *(Manis)*.

Terms

Binomen: Also known as the scientific name of a species, a binomen is a combination of two names for the genus and species. The generic name must begin with an upper-case letter and the specific name must begin with a lowercase letter.

Binomial nomenclature: The system of scientific names applied to taxonomic units of extant or extinct organisms.

Common name: A colloquial name for a species or taxon that is usually different from the scientific name.

Holotype: The name-bearing specimen from which a species was originally described.

Homonym: A name for a taxon that is identical in spelling to another such name that belongs to a different taxon.

Phylogenies: Phylogenies trace patterns of shared ancestry between taxa.

Taxon: A population, or group of populations of organisms, whether or not named, which are usually inferred to be phylogenetically related and which have characters in common which differentiate.

Taxonomy: The theory and practice of classifying organisms.

Taxonomic classification: A hierarchy of names that identify organisms down to the species level. The order is as follows: Domain, Kingdom, Phylum, Class, Order, Family, Genus, Species.

Trinomen: The scientific name of a subspecies is a combination of three names, the binomen plus the subspecies name. For example, the Nubian Giraffe is *Giraffa camelopardalis camelopardalis* while the West African Giraffe is *Giraffa camelopardalis peralta*.

Learn More

More on *Gelae*: The **Encyclopedia of Life** web page on the round fungus beetles in the genus *Gelae*.

The **Understanding Evolution** website from the University of California, Berkeley, brings together a vast amount of information on the science and history of evolutionary biology.

Taxonomic etymology–in search of inspiration:
A short article on unusual taxonomic names, divided into categories such as mythology, classic literature, and pop-culture characters.

A list of fun species names from BuzzFeed.com.

What's in a Name? a three-minute **video** from the Field Museum, discusses the importance of species names and how they change over time.

Dr. Terry Erwin, Curator in the Department of Entomology at the Smithsonian National Museum of Natural History, has described many new species of beetles in the ***Agra*** genus, including ***Agra vation*** (1983), ***Agra cadabra*** (1986), and ***Agra dable*** (2002). (Smithsonian Institution Archives)

Dodo

Raphus cucullatus

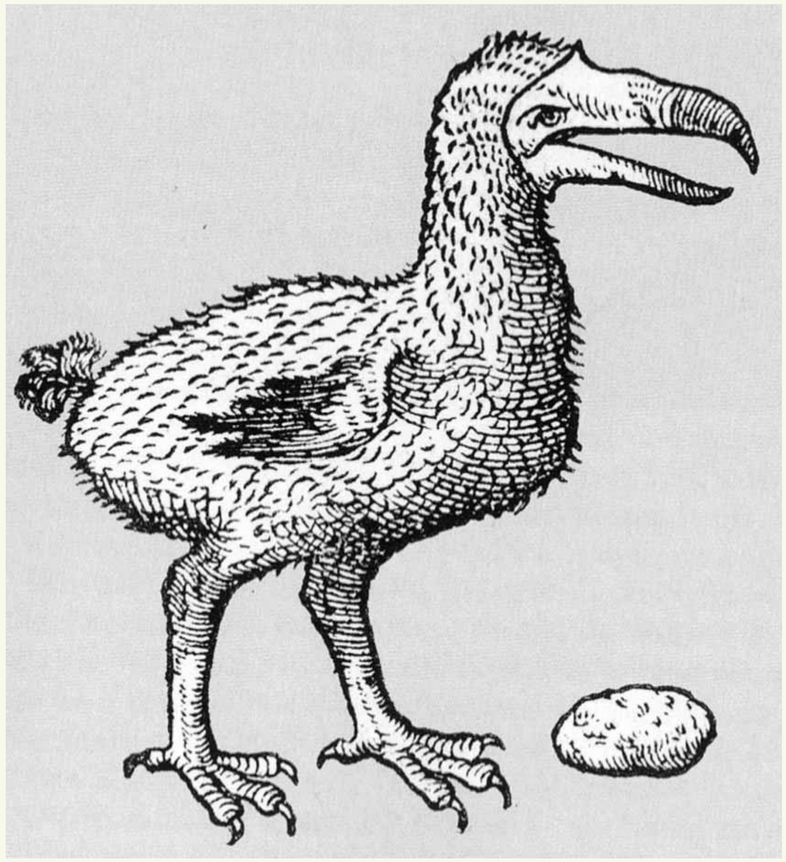


Image of a dodo by Carolus Clusius, based on eyewitness sketches by Dutch seamen on Admiral van Neck's voyage, in ***Atrebatis Exoticorum libri dedcem***, a survey of "exotic" animals and plants, published in 1605. (Source: Julian Hume)

"Revelling (sic) in the abundance of this virgin isle" from the report of the voyage of Admiral van Neck, the first Dutch expedition in 1598. On the left, #2 is an athletic-looking dodo striding off into the distance. (University of Amsterdam)

In 1598, when a Dutch ship arrived on the island of Mauritius in the Indian Ocean, its sailors found a paradise clothed in a dense forest of ebony and bamboo and filled with bewildering wildlife. Many of the animals there were found nowhere else in the world, including a large flightless bird that would eventually be called the Dodo. One hundred years after its discovery, the Dodo had vanished, making it the first documented case of extinction caused solely by human interference.

Because Mauritius is a volcanic island and was never attached to the mainland, it had no mammals other than bats that had flown there. With no natural predators, the Dodo's ancestors lost their ability to fly, adopted a ground-nesting habit, and became larger. Seventeenth-century observers commented on its diet of seeds, fruit and probably tree roots. The Dodo filled the same ecological niche as a wild pig does in many forests.

The Nicobar Pigeon, the Dodo's closest living relative. (Dick Daniels, CC BY-SA 3.0)

Copy of George Edwards, *Dodo with Other Birds*, 1782.
(Oxford University Museum of Natural History)

What's in Its Name?

Today, the Dodo's scientific name is referred to as *Raphus cucullatus*, but this was not always the case. The Dodo's scientific name has changed several times as ideas of its evolutionary relationships shifted.

The first official name given to the unique bird was *Cygnus cucullatus* by Juan Eusebio Nieremberg in 1635. *Cucullatus* means "hooded," and was used in reference to the drawing of the Dodo by the Dutch botanist Carolus Clusius. The use of the genus, *Cygnus*, presumably reflects Nieremberg's idea that the Dodo was related to swans.

In 1758 the Dodo was renamed as *Struthio cucullatus* in the 10th edition of *Systema Naturae* by Linneaus; *Struthio* is Latin for "ostrich."

Just two years later, in 1760, the genus was renamed again to *Raphus cucullatus* by Mathurin Jacques Brisson, most likely in reference to the name Raphus used to describe the bustard, by the Greek physician, Galenus. Once more in 1766, the Dodo was renamed, this time to *Didus ineptus* in the 12th edition of *Systema Naturae*. Despite the inherent appeal of a name that meant "inept dodo," the Dodo officially became *Raphus cucullatus* because of the principle of prior naming.

The history of the name gives clues to possible close relatives of the Dodo. Molecular research has shown that the Dodo's ancestors were pigeons from Southeast Asia or Indonesia that arrived on Mauritius probably not long after this volcanic island was formed, about eight million years ago.

There is considerable confusion about the origin of the English common name "Dodo." In the seventeenth century there were a variety of names used in publications about Mauritius, mostly from Dutch accounts. Here are a few names used in the seventeenth century, with their earliest-use dates:

- **Doudo,** 1500s, from Portuguese for "foolish" or "stupid"
- **Dodoor,** 1600s, from Dutch for "sluggard"
- **Walghvögel,** 1601, from Dutch for "nauseous bird" or "disgusting bird"
- **Dodaar (& variants),** 1626, from Dutch word *aers* ("ass"), e.g., dodaersen "fat behind"
- **Dodo,** 1634, from Thomas Herbert's book, *Relation of Some Years of Travels into Afrique and the Greater Asia*, which he attributed to the Portuguese word, but is more likely to be derived from the Dutch

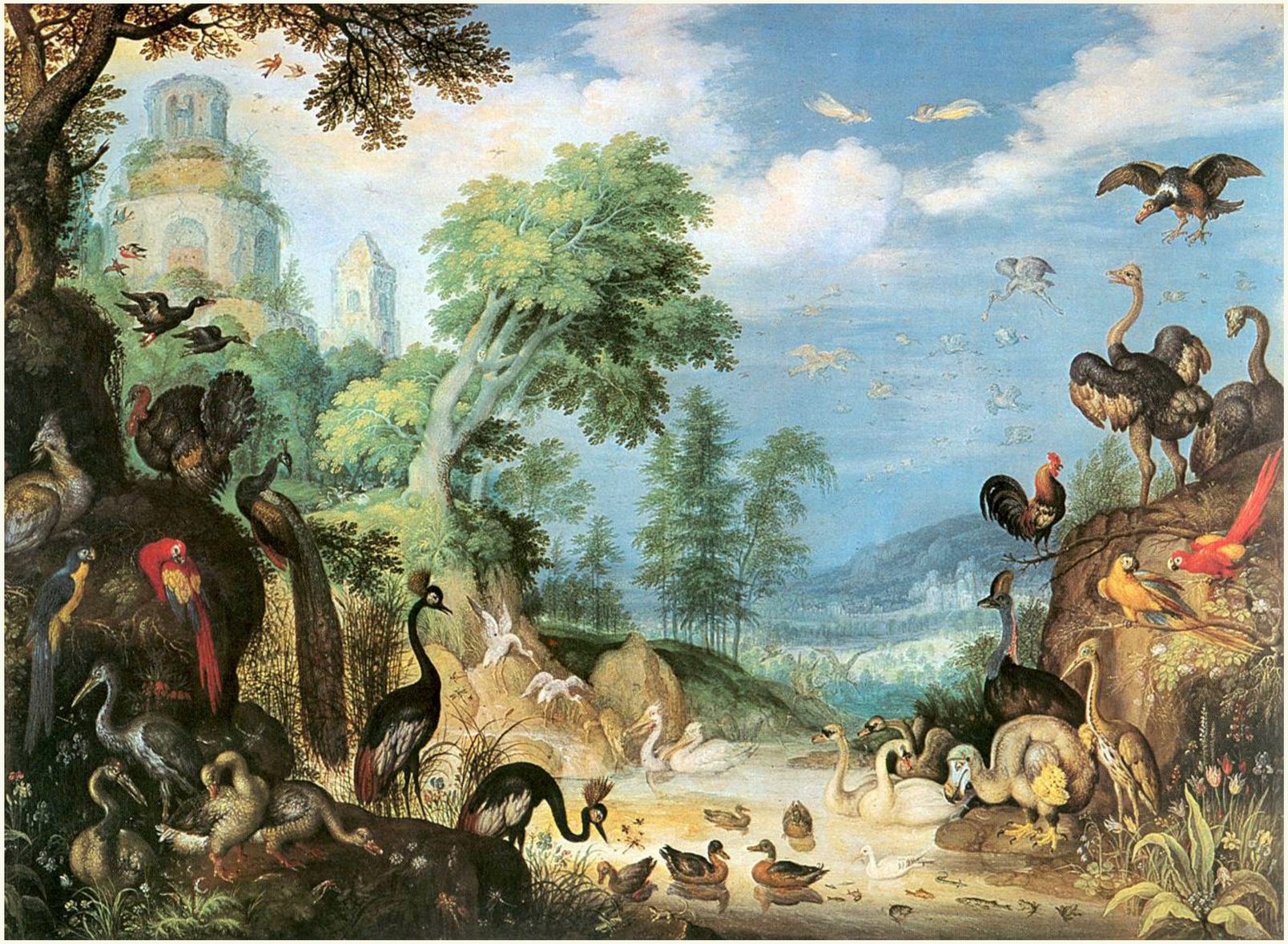
Clearly, with these endearing names, the Dodo was destined to be appreciated and preserved.

A Symbol of Extinction

The Dodo's flightless nature made it vulnerable once humans arrived. It was easily hunted by European sailors and colonists who also began to cut down its forest home. Even more devastating were the effects of the non-native animals brought to the island. The pigs, cats, dogs, rats, and crab-eating macaques that arrived underwent a spectacular population explosion in an environment devoid of other mammals. Roaming dogs killed adult Dodos, while the rats, monkeys, and cats preyed on eggs and chicks.

By the middle of the 1600s, Dodos were extremely rare and the species was almost certainly extinct before 1700. The date of the last sighting is disputed. For a long time, the date was thought to be 1681, from the account of sailor and scientist Benjamin Harry. Yet many commentators now think that Harry may have been referring to another flightless bird, the Mauritian Red Rail, and that the Dodo became extinct earlier.

Roelandt Savery (1576–1639) painted this picture of a Dodo and other birds in the late 1620s. It is possible that the bird on the left is the extinct Red Rail. (Natural History Museum, London)



Landscape with Birds (1628) by Roelandt Savery. The Dodo can be seen at the bottom right of this somewhat fanciful scene. (Kunsthistorisches Museum, Vienna)

Did you know?

Thomas Herbert, 1st Baronet, who gave the Dodo its English name, was an English traveler and historian, as well as an astute politician. He was a "gentleman of the bedchamber" of Charles I, was knighted by Thomas Cromwell after the Civil War, and was then made a baronet by Charles II after the restoration of the monarchy.

What Did it Look Like?

Contemporary descriptions and illustrations of the Dodo are often contradictory. The earliest drawings, including those in the first written account of Mauritius by Admiral van Neck, show slim birds. However, the artist Roelandt Savery (1576–1639), who produced many Dodo paintings shows a fatter, more ungainly animal. This is closer to popular understanding of its appearance, typified in the Rowland Ward model commonly seen in museums, and, of course, from the original illustrations in Lewis Carroll's *Alice's Adventures in Wonderland*.

However, research based on analysis of sub-fossil bones suggests that the Dodo was probably much thinner and more athletic than is commonly depicted. It is possible that over-stuffed taxidermy specimens were the inspiration for many illustrations.

Did you know?

The descriptions of the Dodo by early sailors, who had been at sea for many months, focused on the facet most important to them: what they tasted like. Eyewitness accounts from Admiral van Neck's voyage, stated "We called these birds Walghvogels [in English: "nauseous bird"] partly because although we stewed them for a long time, they were very tough to eat." The Dodo made up for being such a culinary disappointment in one regard—it was extremely easy to catch.

Rowland Ward model, made of chicken feathers, duck wings, and—for the tail—curled ostrich feathers. (Museum of Comparative Zoology, Harvard University)

A newer, slimmer dodo model at the Oxford University Museum of Natural History. (Ballista, CC BY-SA 3.0)

Original illustration (1865) by John Tenniel from *Alice's Adventures in Wonderland.*

Dodo by Roelandt Savery, reproduced as frontispiece in 1848 for *The Dodo and its Kindred*, by H.E. Strickland.

Learn More

Encyclopedia of Life web page

The book by Hugh Strickland ***Dodo and Kindred Birds*** (1848), includes an exhaustive **list** of dodo names.

The end of the fat dodo? A new mass estimate for *Raphus cucullatus*, a short paper by Delphine Angst of the University of Cape Town, tells the story of our changing understanding of the dodo's appearance.

The story of the **Oxford Dodo**, the most complete remains of the bird from the seventeenth century (PDF).

Two short videos by paleontologist and artist Julian Pender Hume describing the world of the dodo and painting a "slimmer" dodo:

Painting the Dodo (Video, two minutes)

Restoring the Mauritian ecosystem
(Video, two minutes)

Heads of a Dodo and a Hoopoe Hen, 1650–70, Cornelis Saftleven. (Boijmans Museum, Netherlands)

Naval Shipworm

Teredo navalis

If it looks like a worm and its name sounds like a worm, is it a worm? The Naval Shipworm, or *Teredo navalis,* is not actually a worm at all. This marine mollusk has a very elongated body with a tiny, reduced shell, which covers its anterior end and is often compared to a helmet. It is a bivalve mollusk, meaning two-shelled, like clams and mussels. But unlike other bivalves, shipworms do not need hard shells to shelter their bodies because they bore into pieces of wood, which protect them.

The shipworm uses its helmet-like shell to scrape wood particles off the wood surface, which are then moved by cilia to the shipworm's mouth. They have a symbiotic relationship with nitrogen-consuming bacteria, that live within specialized cells in their gills and help digest the cellulose in the wood. (They may also filter feed on plankton in addition to their rigorous woody diet.) A single Naval Shipworm lives to be around three years old, growing to about 25 cm/10 inches in length. The earliest fossils of wood-boring clams are from the Jurassic Period, some 170 million years ago, although trace fossils showing evidence of wood-boring organisms can be found from much earlier.

An individual ***Teredo***, removed from its home in a mangrove trunk.
(Deplewsk, CC BY-SA 3.0)

An example of boreholes by ***Teredo navalis***.
(Michael C. Rygel via Wikimedia Commons, CC BY-SA 3.0)

Termites of the Sea

This surprisingly tough mollusk has had a significant impact on human history. Since the earliest mariners, ships have sunk as a result of shipworm activity weakening their structure. In 1503, some of the vessels on Columbus' fourth voyage to the Americas sank due to shipworm damage. In 1731, shipworms did so much damage that they caused floods in the Netherlands when dike gates there became so weak that they failed in strong storms. The introduction of copper sheathing in the eighteenth century slowed the destruction of ships, but between 1919 and 1921 a succession of wharves, piers and ferry slips collapsed in San Francisco Bay following infestation with *Teredo navalis*—at a cost of hundreds of millions of dollars in today's prices.

Even today, with chemical and other treatments (many of which damage the life in nearby ecosystems), the economic cost of shipworm damage amounts to tens of millions of dollars a year.

The geographic origin of the Naval Shipworm is unclear as they have spread around the globe in the hulls of ships. They are most abundant in the Atlantic and Pacific Oceans.

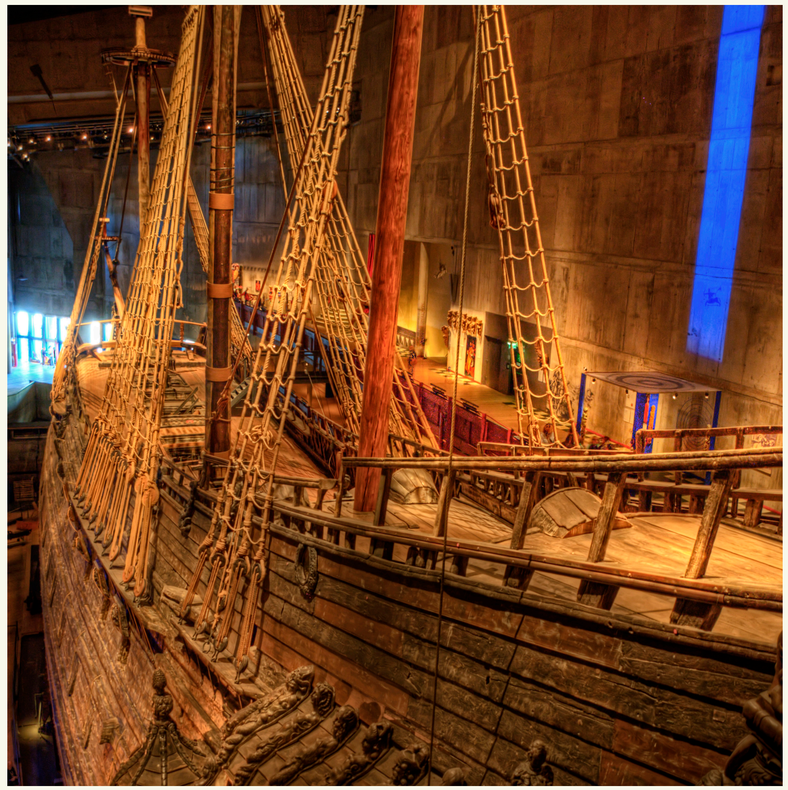
Recent DNA work has confirmed that *Teredo navalis* has spread into the shallow waters of the Baltic Sea, threatening the thousands of archaeologically important and well-preserved shipwrecks in that area.

Teredo navalis is also an invasive species and often outcompetes the native shipworm species in a new ecosystem.

Did you know?

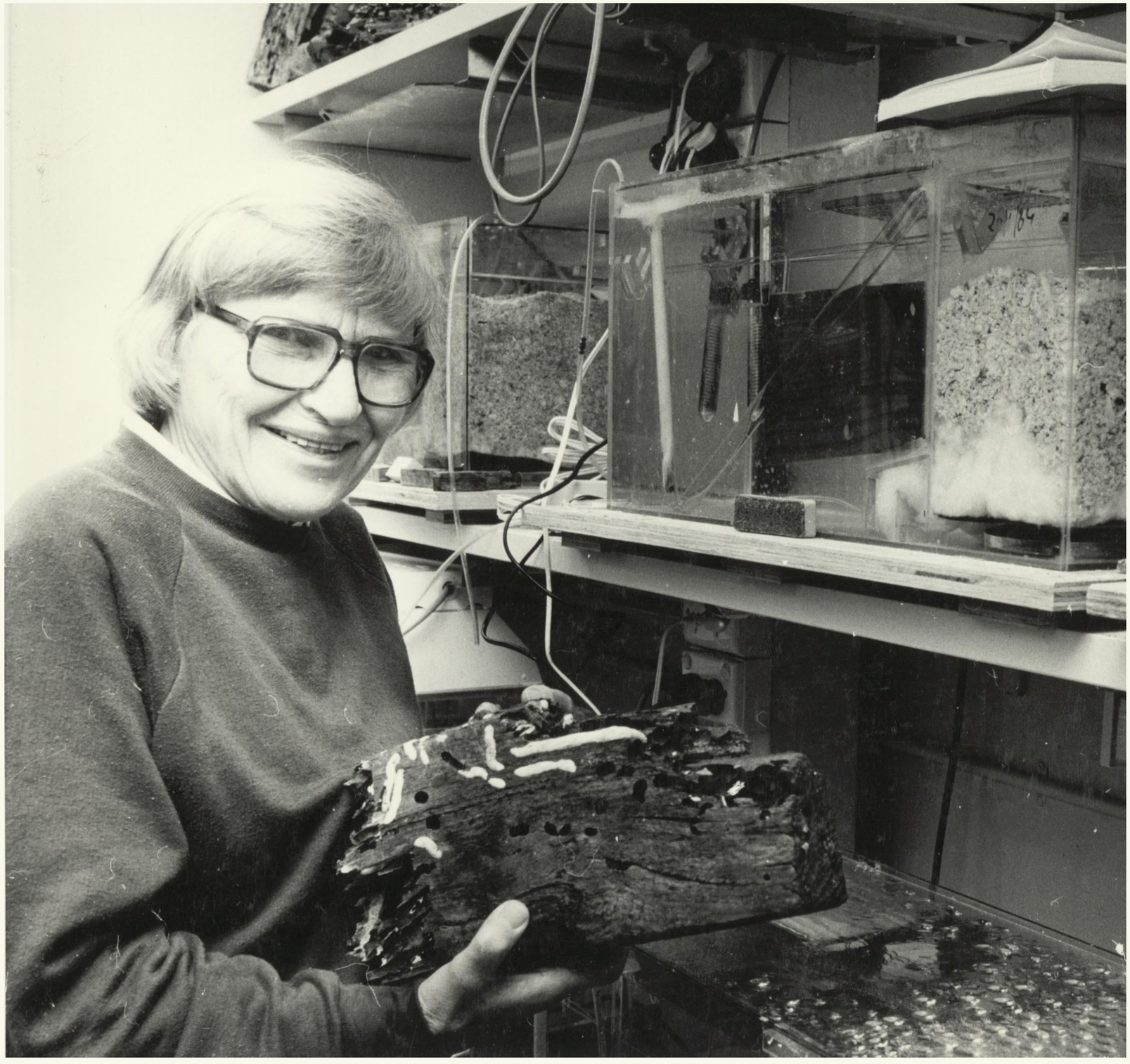
More than 3,000 years ago, the ancient Phoenicians and Egyptians covered their boats with pitch and wax to prevent shipworm incursions. The Greeks and Romans used lead, pitch, and tar for the same reason.

The Barmouth Railway Bridge in Wales has been closed for 20 years because destruction by shipworms has rendered the bridge unsafe. (Trevor Rickard, CC BY-SA 2.0)



The *Vasa*, a salvaged seventeenth-century Swedish ship which sank in Stockholm Harbour in 1628. The ship's woodwork is in excellent condition because shipworms had not yet reached the Baltic Sea before it was raised and preserved in 1961. (Flickr/Neil Howard, CC BY-NC 2.0)

Shipworms in their boreholes in a mangrove trunk. (Alamy)



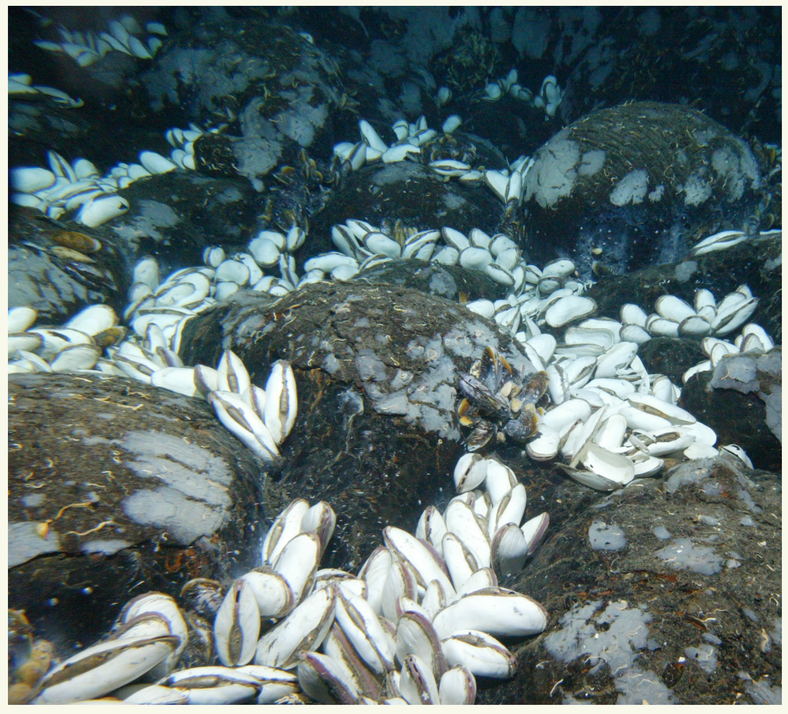
Professor Ruth Dixon Turner (1914–2000) in her laboratory (undated).
(Museum of Comparative Zoology, Harvard University)

Harvard's "Lady Wormwood"

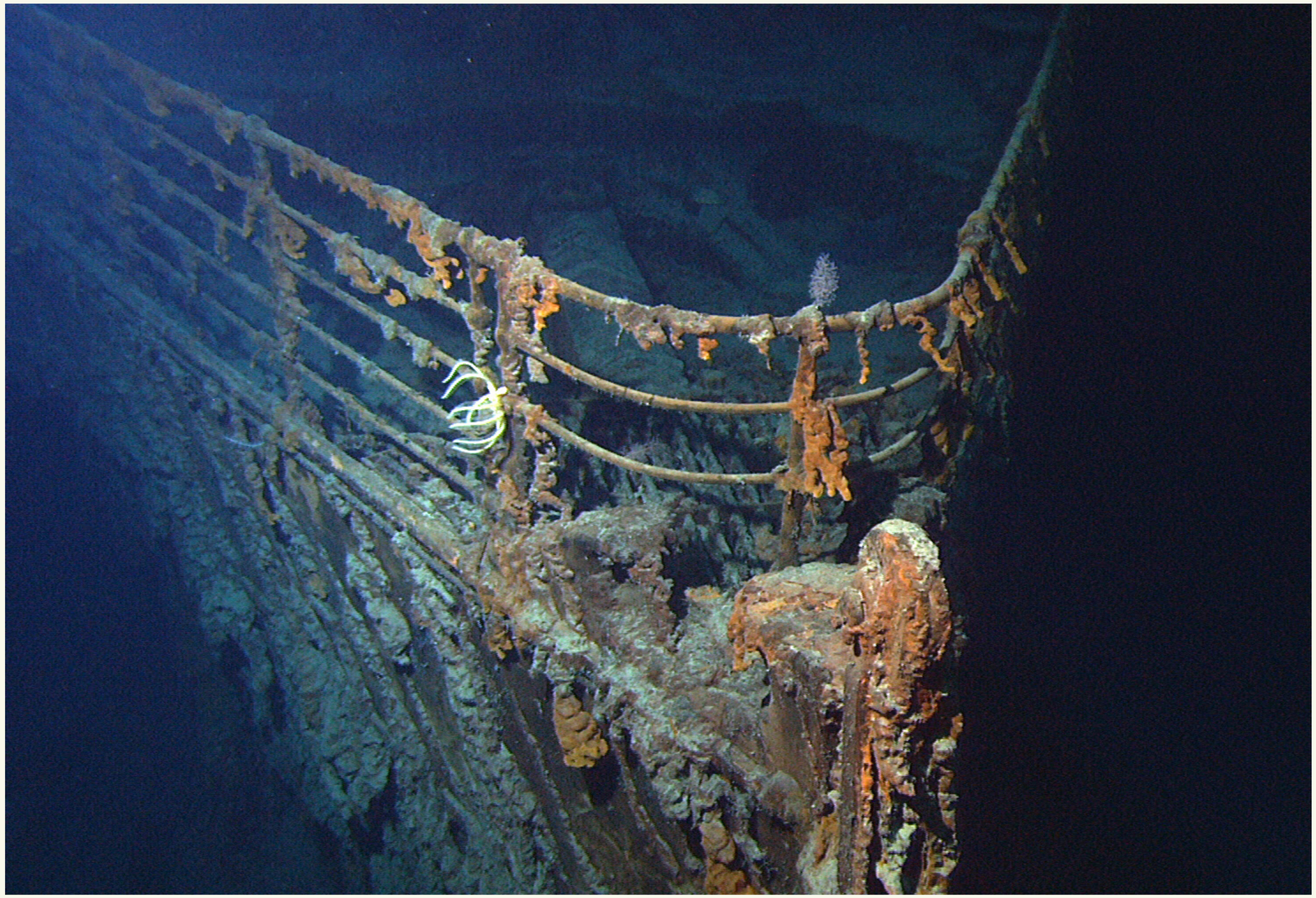
One of the world's leading twentieth-century experts on shipworms was Ruth Dixon Turner, one of Harvard's first tenured women professors, and sometimes called "Lady Wormwood" by fellow researchers. Supported by the Office of Naval Research, Turner spent many decades studying wood-boring mollusks and published more than 100 scientific papers on every aspect of their biology.

Her 1966 book, *A Survey and Illustrated Catalogue of the Teredinidae*, was widely acclaimed and provides information fundamental to shipworm research today. In particular, she worked on deep-sea wood-boring clams, the xylophagaines, which decompose wood that has fallen to the sea floor.

She worked with Robert Ballard on his discovery of the *Titanic* in 1985, to identify the shipworms that had caused the substantial loss of wood in the wreck.



Calyptogenia magnifica. Ruth Turner, together with Kenneth Boss, described this species of giant clam living in deep-sea hydrothermal vents.
(Woods Hole Oceanographic Institution Archives)



The bow of the sunken RMS *Titanic* photographed in June, 2004. The luxury liner would have been full of elaborate woodwork, but virtually none was found as it had been destroyed by shipworms. (NOAA/Institute for Exploration/University of Rhode Island, Public domain)

Did you know?

Shipworms can survive for prolonged periods in anoxic environments, staying in their sealed tunnels and utilizing sugars stored in their bodies.

Learn More

Encyclopedia of Life web page

Species **information** from the Smithsonian Institution

Further **information** on Ruth Turner
from the Harvard Library

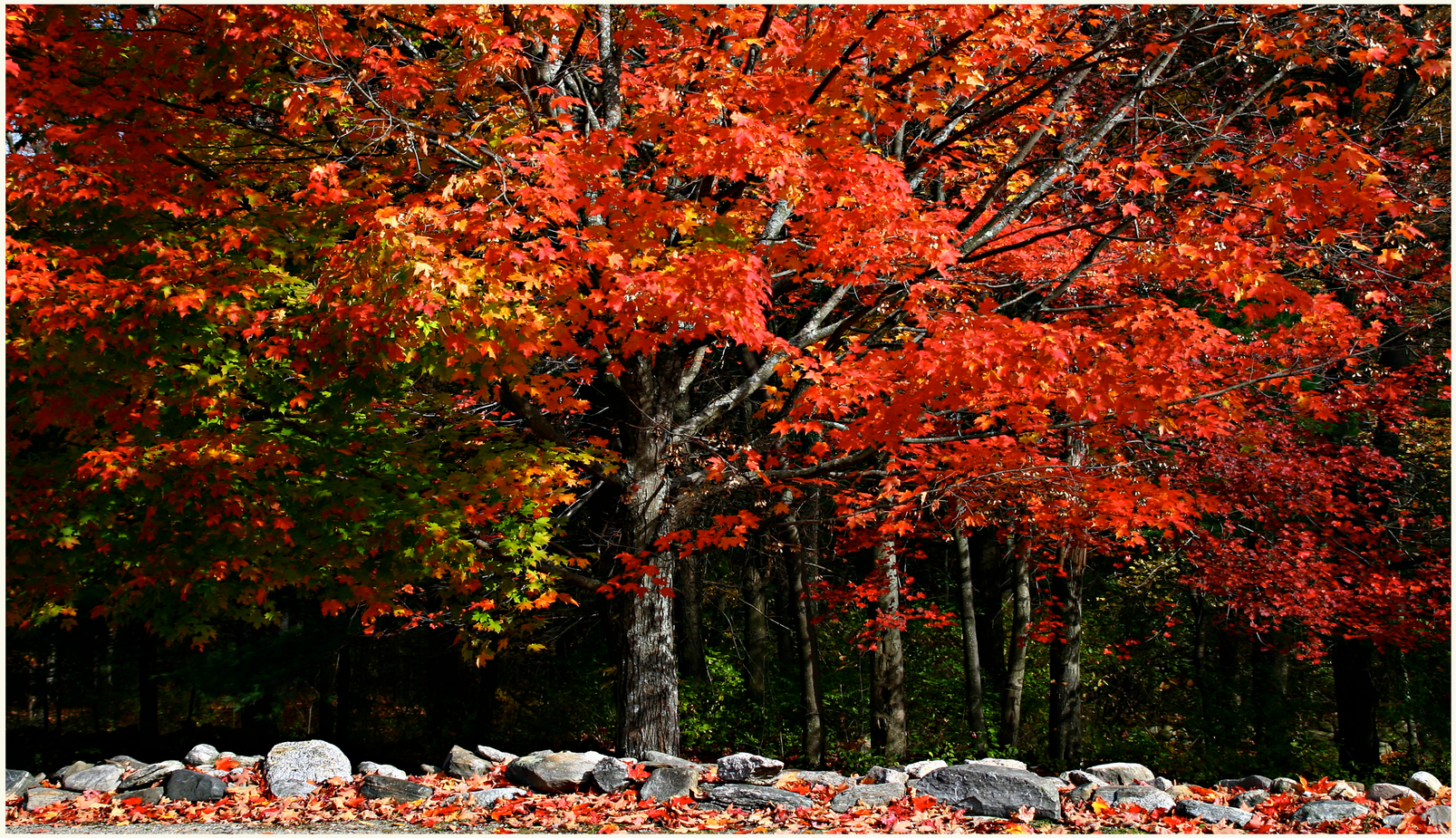
Ruth Turner's **obituary** from the
New York Times, May 9, 2000)

Did you know?

Like so many other invertebrate animals, shipworms have larvae that are different from their adult body plans. Shipworm larvae are called veligers and move by swimming using cilia. They are just one millimeter in diameter and enter wood by boring tiny holes.

Sugar Maple

Acer saccharum



Sugar maple, ***Acer saccarum***, in autumn, Marlborough, Massachusetts. (Flickr/Muffet CC BY 2.0)

Maple leaf showing the characteristic five lobes.
(Flickr/Ann Baekken, CC BY 2.0)

Want to know something sweet? *Acer saccharum*, commonly known as the sugar maple tree, has been a natural source of maple syrup for many centuries. This hardwood deciduous tree is native to the Northeastern United States and Eastern Canada and is especially important to the history, culture, economy, and foliage of these regions.

Sugar maples can reach up to 30 m/100 feet in height and collectively grow on approximately 31 million acres of land. Many mammals and insects use the sugar maple as a food source, while woodpeckers and other birds nest in its branches. The leaves of a maple tree have five lobes and turn brilliant shades of yellow to red in the fall.

What's in Its Name?

The Latin name *Acer saccharum* means "sharp sugar." The "sharp" genus name refers to the shapes of the leaves, which have numerous, pointed tips. The "sugar" species name is a tribute to the tree's sweet, delicious maple syrup product, made by refining its sap. The high sugar content of the sugar maple's sap has made it a popular resource in North America for centuries.

The sugar maple is known by other names. It can sometimes be called the "rock maple" or the "hard maple" as maple trees also produce some of the densest and hardest wood known. As well as producing syrup, they are an important source of firewood, lumber, and pulpwood for paper production.

Sugar maple Leaves. (National Forest Service/Superior National Forest, CC BY 2.0)

Did you know?

All maple syrup sold contains 66% sugar. Different species of maple trees produce varying amounts of sugar and all of these can be processed. However, sugar maples are noted for their high-sugar levels. They also have a longer tapping season than red maples do.

Sugar maple, *Acer saccharum.* Fully grown, a sugar maple can be over 30 m/100 feet in height. (Bruce Marlin, CC SA 2.5)

A Sweet History

Native Americans processed sugar maple sap long before Europeans arrived in the northeast region of the U.S. They made maple candies, maple drinks, and used maple syrup as a cooking ingredient. Myths and legends about maple trees and syrup were widespread among the tribes. It is unknown whether Native Americans or European settlers were the first to boil sugar maple sap, but both were using the process by the eighteenth century.

French explorers and fur trappers who came to North America traded for these maple syrup products. In the late eighteenth and early nineteenth centuries some people, including Thomas Jefferson, thought that maple sugar could become an alternative to cane sugar. Indeed, Jefferson had his own maple plantation at Monticello. However, processing maple sap is extremely labor-intensive, and thus far more expensive to produce.

Sap processing has not changed much over the centuries. Improvements in technology have made boiling sap more efficient, but it still takes 40 or more gallons of maple sap to boil down to just one gallon of maple syrup. A single tree can produce about 75 L/20 gallons of sap in the short season for maple sugaring. “Tapping” the trees occurs in spring when nights are below freezing, and the daytime sunshine brings temperatures above freezing. This creates unique thawing and freezing cycles that increase pressure inside the tree’s vasculature and force sap out of the tap.

Did you know?

The process of tapping sap from trees does not harm maples. Even when using a vacuum-tubing system to increase the amount of sap exiting the tree, maple-sugaring takes only a fraction of the tree’s available carbohydrates.

Maple sap buckets (Dave Pape, Public domain)

Did you know?

A young sugar maple leaf. (Captain-tucker CC SA 2.0)

Sugarers know to stop tapping their trees when the buds of maple trees “break,” giving rise to spring’s new leaves. At this time, the syrup produced will have a funny taste, and most of the sap will be recruited to the leaves so that the water and sugar can be used in biological processes.

Modern plastic taps, attached to tubing, produce a higher yield of cleaner sap than the traditional bucket method. (Shutterstock/Lurin)

A sugar maple catches last rays of the sun in Maynard, MA. (Neil Pederson)

A Changing Climate

Eastern North American sugar maples support a multibillion-dollar syrup industry. Climate change threatens to severely impact the growth of sugar maples in New England, which depend on the region's springtime cycles of freezing nights and mild, sunny days for sugar-producing processes. Warmer weather stresses the trees and the period during which tapping occurs in more southern states, such as Virginia, has already shifted because of seasonal climate changes. Increases in New England's temperatures will push maple sugar growth further north, into Canada. Because the trees depend on unique springtime fluctuations in temperature from day to night, shorter winters are disruptive for the maple sugaring season.

Studies by scientists from the Harvard Forest in Petersham, Massachusetts suggest that, in the last few decades, some maple sugar trees have been exhibiting reduced productivity and growth. The stressors and causes for maple decline are not precisely clear, but include acid deposition in soils from rains and climate change. This is a major concern for sugar maples and the organisms that depend on this keystone species.

Learn More

Encyclopedia of Life web page on sugar maples

A comprehensive subject guide on the sugar maple and maple syrup from the University of Vermont

Information about the Harvard Forest's study on the decline of Adirondack sugar maples

A variety of maple leaf colors, shown with their corresponding color chips from the Pantone™ color system. (Chris Glass, CC BY 2.0)

Poison Ivy

Toxicodendron radicans

Typical growth of poison ivy. (D. Gordon E. Robertson CC BY-SA 3.0)

Most people living in eastern North America have had at least one unpleasant encounter with poison ivy. While best known for the skin rash produced by contact with an oil that is found in every part of the plant, poison ivy is also an important source of food and cover for wildlife. The oily substance is known as urushiol and typically produces an intensely itchy skin rash.

Poison ivy is a ubiquitous species that thrives in a variety of habitats from woodlands, to fields, beaches, and gardens, and on trees, telephone poles, signs, and fences. The plant has no strong soil preferences and, as long as there is sufficient water and sun, it will grow and thrive. This pervasive plant is extraordinary in its ability to adapt to a variety of environmental conditions and habitats and is flourishing in the face of climate change.

Detail of John Smith from an illustration in *The Generall Historie of Virginia, New-England, and the Summer Isles; with the names of the Adventurers, Planters, and Governours from their first beginning, Ano: 1584, to this present 1624.* As far back as 1609, English Captain John Smith, known for his association with Jamestown and Pocahontas, noted the presence of a plant found in the New World that was similar in appearance to English ivy, but that caused redness, itching, and blisters. (Houghton Library, Harvard University)

What's in Its Name?

Botanists have assigned this plant the scientific name *Toxicodendron radicans*, a name that itself warns of Poison Ivy's toxic effects. The genus, *Toxicodendron*, translated from Greek, means "poison tree." It is derived from two words–*toxikos*, or "poison," and *dendron*, meaning "tree." The species ending, *radican*s, comes from the Latin radicor, "to take root."

The name, "Poison Ivy" highlights the potential toxic effects of contact with the plant's leaves. The name also refers to one of the plant's common growth habits–that of an ivy-like trailing vine. However, from a scientific perspective, the comparison with ivy is misleading, as poison ivy is not an ivy at all. True ivies are in the genus *Hedera* in the plant family Araliaceae, which also includes Ginseng. Poison ivy is in the family Anacardiaceae, which includes sumacs, mangos, pistachios, and cashews. Many members of this family, like poison ivy, contain urushiol, and contact with these plants can also provoke allergic skin reactions.

The cashew is a member of the plant family Anacardiaceae, which also includes poison ivy. (Abhishek Jacob, CC BY-SA 3.0)

A typical growth of poison ivy. (Public domain)

Poison ivy growing up a tree in the form of a woody vine.
(Melissambwilkins, CC BY-SA 3.0)

Shiny, young, reddish poison ivy plant growing in Fairfax County, Virginia.
(Famartin, CC BY-SA 4.0)

Poison ivy plant in autumn with red leaves.
(Zen Sutherland, CC BY-NC-SA 2.0)

Poison Ivy or Not?

Poison ivy shows a variety of growth habits depending on its environmental circumstances. It can appear as a low-growing herb, a vine that creeps along the ground, or a thick, hairy woody plant that climbs up the trunk of a tree. Its leaves can vary from smooth and round, to narrow and sharp. The leaves are often shiny and reddish in color when they are young. In the fall, they turn yellow or deep red like other fall foliage.

Poison ivy can be confused with other harmless plants that show some superficial similarities. Virginia creeper, Box elder seedlings, and young Jack-in-the-Pulpit plants have sometimes been mistaken for poison ivy.

Virginia creeper, *Parthenocissus quinquefolia.*
(Sesamehoneytart, CC BY-NC-SA 3.0)

Young box elder.
(Robert Stevenson, CC BY-NC 2.0)

Getting under Your Skin

After making contact with poison ivy, most people (85%) will have an allergic response in the form of itchy contact dermatitis (skin rash). This reaction is caused by the plant's release of urushiol, which is absorbed by the skin and provokes redness and blistering within 12–48 hours. The severity of the reaction depends both on the size of skin area exposed to urushiol and on an individual's sensitivity to the substance.

The small white fruits of poison ivy are eaten by fruit-eating birds and mammals, which then distribute the poison ivy seeds to new habitats. (Wendell Smith, CC BY 2.0)

From the human perspective, poison ivy might appear to lack any redeeming qualities. However, humans are almost unique in their sensitivity to this plant. Many other animals, such as white-tailed deer, eastern cottontail rabbits, muskrats, and a variety of insects rely on poison ivy leaves as a food source. Birds, raccoons, and fruit-eating animals feed on the plant's small white fruits.

Poison Ivy rash. (Bruce Blaus, Wikiversity Journal of Medicine, CC BY 3.0)

Did you know?

The popular rhyme, "Leaves of three, let them be" refers to the leaves of the plant, drawing attention to the distinctive three leaflets that make up poison ivy's compound three-part leaf.

(Steven Russell Smith, Shutterstock)

Poison oak, *Toxicodendron diversilobum*, is a woody vine or shrub widely distributed in western North America. (Chuck Abbe, CC BY 2.0)

Two of poison ivy's closest relatives are poison oak, *Toxicodendron diversilobum*, and poison sumac, *Toxicodendron vernix*, both of which contain urushiol and cause adverse skin reactions.

Poison sumac, *Toxicodendron vernix*, is a relatively rare shrub or small tree found in southeastern swamps and northeastern peat bogs. (James H. Miller & Ted Bodner, CC BY 3.0)

Poison ivy in Perrot State Park, Wisconsin. (SWMN PoliSci Project, CC BY 3.0)

Did you know?

Global climate change is stimulating poison ivy to grow better and increasing the allergenic properties of urushiol. The rise of carbon dioxide in our atmosphere enables poison ivy to grow about 150% faster, and rising global temperatures are increasing the fluidity of urushiol, allowing it to be more readily absorbed by human skin.

Poison ivy bush. (James Burke, CC BY 2.0)

Learn More

Encyclopedia of Life web page

A short article from the Missouri Botanical Garden describes how to deal with poison ivy in your yard.

A scientific paper in *Proceedings of the National Academy of Sciences* (2006) by Harvard scientist Jacqueline E. Mohan and her collaborators describes how climate change is impacting the growth of poison ivy.

In this video, the National Institute for Occupational Safety and Health (NIOSH) explains how poison ivy causes a rash.

Honeybee

Apis mellifera

A colony of honeybees is its own kind of creature. A single hive can contain up to 60,000 bees, each performing small but critical functions, much like the cells in our bodies. They perform life's basic physiological processes—processing food, circulating resources, regulating temperature, moisture, and airflow within the hive, triggering behaviors, and responding to stimuli. Together, they function as one mighty superorganism. Their collective function surpasses the hive. Nearly all bees, including honeybees, are crucial pollinators who have evolved an alliance with nectar-rich plants over millions of years.

Worker bee gathering nectar. (John Severns, Public domain)

Honeybees maintaining honeycomb in their hive. (© President and Fellows of Harvard College)

Queen bee (center) surrounded by worker bees inside a hive. (Waugsberg, CC BY-SA 3.0)

Drone bee (side view). (Sue Boo, CC BY 2.0)

Honeybees are said to be eusocial because they live in complex societies where thousands cooperate to find food, defend the group, and reproduce. Eusocial insects, like honeybees, are organized into castes, each of which has a different function.

The vast majority of bees in a colony are members of the worker caste. Workers are sterile females that carry out all tasks involved in finding food, caring for the young, and maintaining the hive. The queen is the hive's only sexually productive female and is the mother of all other members of the hive, including any future queens.

Drones are male honeybees produced from unfertilized eggs. They neither feed themselves nor contribute to the hive. Their only function is to mate with new queens.

What's in Its Name?

Carl Linnaeus gave the European Honeybee its name, *Apis mellifera*, which is Latin for "honey-bearing bee." By some accounts, Linnaeus later became dissatisfied with the name he bestowed and argued to change it from *Apis mellifera*, to *Apis mellifica*, or "honey-making bee." His mistake, he argued, was that bees make honey within the hive; they do not bear it from the flower. His argument was presumably unsuccessful as the bee still bears the erroneous name.

Sweat bees, like this species, *Augochlora pura*, comprise nearly a quarter of all bee species. (© Sam Droege, USGS Bee Inventory and Monitoring Lab)

Honeybees and Their Relatives

Though *Apis mellifera,* and the other species of honeybees from the *Apis* genus, are perhaps the most well-known worldwide, the word *Apis*, which is Latin for "bee," might also be a bit of a misnomer. In fact, honeybees are only one minority among roughly 20,000 total species of bees, the overwhelming majority of which do not make honey and have very different lifestyles. There are a total of seven species and 44 subspecies of honeybees in the genus *Apis*, which the fossil record indicates emerged 150 million years ago.

All bee species are members of the Apoidea superfamily. That includes honeybees, stingless bees, carpenter bees, orchid bees, cuckoo bees, bumblebees, and other lesser-known bees. Bees are characterized by their long tongues, which are often used to collect pollen. Along with sawflies, wasps, and ants, bees are members of the third-largest group of insects, hymenopterans, named for their characteristic membranous wings. *Hymen* means "membrane" in Ancient Greek. Unlike honeybees, most species of bees are not social, but solitary.

Did you know?

Bees are the only insect in the world that make food that humans can eat. The earliest record of beekeeping was found in a painting in an Egyptian temple Kintsugi, erected in 2400 BC. Since then, the use and cultivation of honey has been an important part of human culture, from Ancient Greece where it was deemed "celestial nectar," a drink fit for the Gods, to today, where it is produced by the majority of cultures and countries around the world. The U.S. alone produces 178 million pounds of honey every year.

Ancient honey gatherer: This depiction of a honey seeker was found in an 8,000-year-old cave painting at Araña Caves in Spain. (© Free Software Foundation, Inc.)

A European Honeybee, *Apis mellifera*, visiting a flower that is dusting it with pollen. (JJ Harrison, CC BY-SA 3.0)

Essential Pollinators

Nearly every ecosystem on Earth with flowering plants is equipped with its own set of insect pollinators. Most wild plants rely on animals such as bees to pollinate them, and cannot reproduce successfully without the pollinators. Now, wild bee species are facing dire threats from pesticide use, mite infestations, and viruses potentially spread by the introduction of non-native honeybees. The loss of wild bees will likely mean the loss of the many native plants that rely on them.

The honeybee is also threatened. Since 2007, colonies of honeybees have died off at an unprecedented rate. Dubbed “colony collapse disorder,” it is unclear what might be causing it. Some suspect it is a result of changing conditions due to global warming, pesticide use in agriculture, or a combination of the two. Harvard scientists have identified one commonly-used variety of pesticide, neonicotinoids, as a possible culprit. Exposed colonies not only pollinate flowers less frequently, they also become less social within the nest and less productive.

This extinct stingless bee, which lived between 15–20 million years ago, is covered in ancient pollen. Preserved in amber, and housed in the Museum of Comparative Zoology Collections at Harvard, it is the first direct fossil observation of the relationship between plant and pollinator. Molecular analyses of the pollen by Harvard scientists found it to be that of an orchid, the first of its kind in the fossil record. (Santiago Ramirez)

Learn More

Encyclopedia of Life web page

Information about wild bees from the University of Minnesota’s **BeeLab**, including how to build a Bee House (**PDF**)

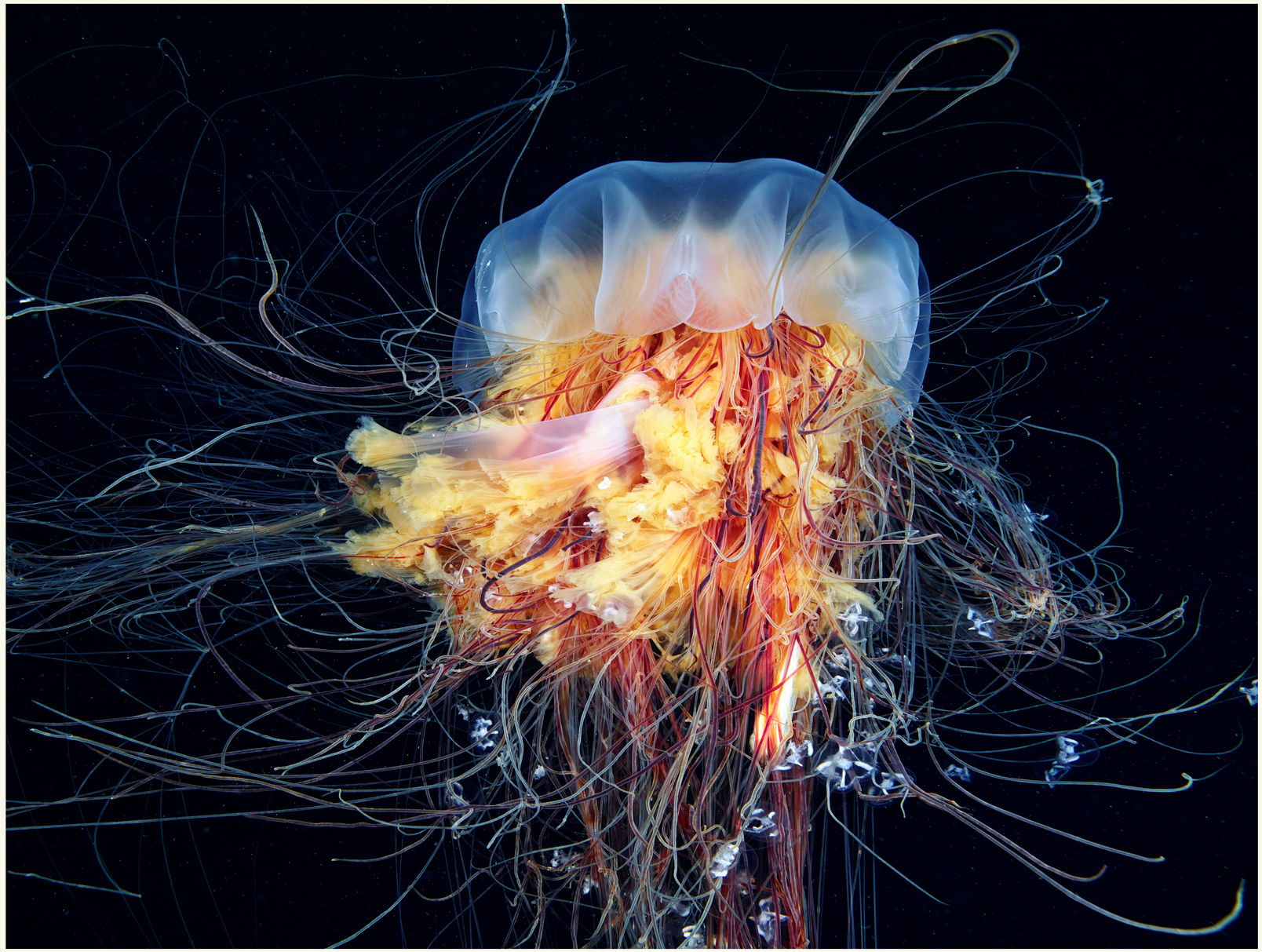
An **article** about the Harvard-based research on the role of pesticides in colony collapse disorder

The Harvard Museum of Natural History has an observation hive in its galleries. In this **video,** watch what happens when the queen leaves with some of the workers to form a new colony. (Filmmaker: Jennifer Berglund)

The Lion’s Mane Jelly

Cyanea capillata

The Lion’s Mane Jelly—Latin name, *Cyanea capillata*—is elegant and mesmerizing as it moves through the ocean. It is made of a transparent, pulsing bonnet of reds, oranges, purples, and blues, which drags a flowing skirt of colorful, stinging tentacles. This is the largest jelly in the world, reaching sizes up to 2.1 m/7 feet wide, and 37 m/120 feet long—longer than a Blue Whale.
Some of the oldest living animals, jellies, like these ghostly behemoths, have thrived in the world’s oceans for more than 500 million years.



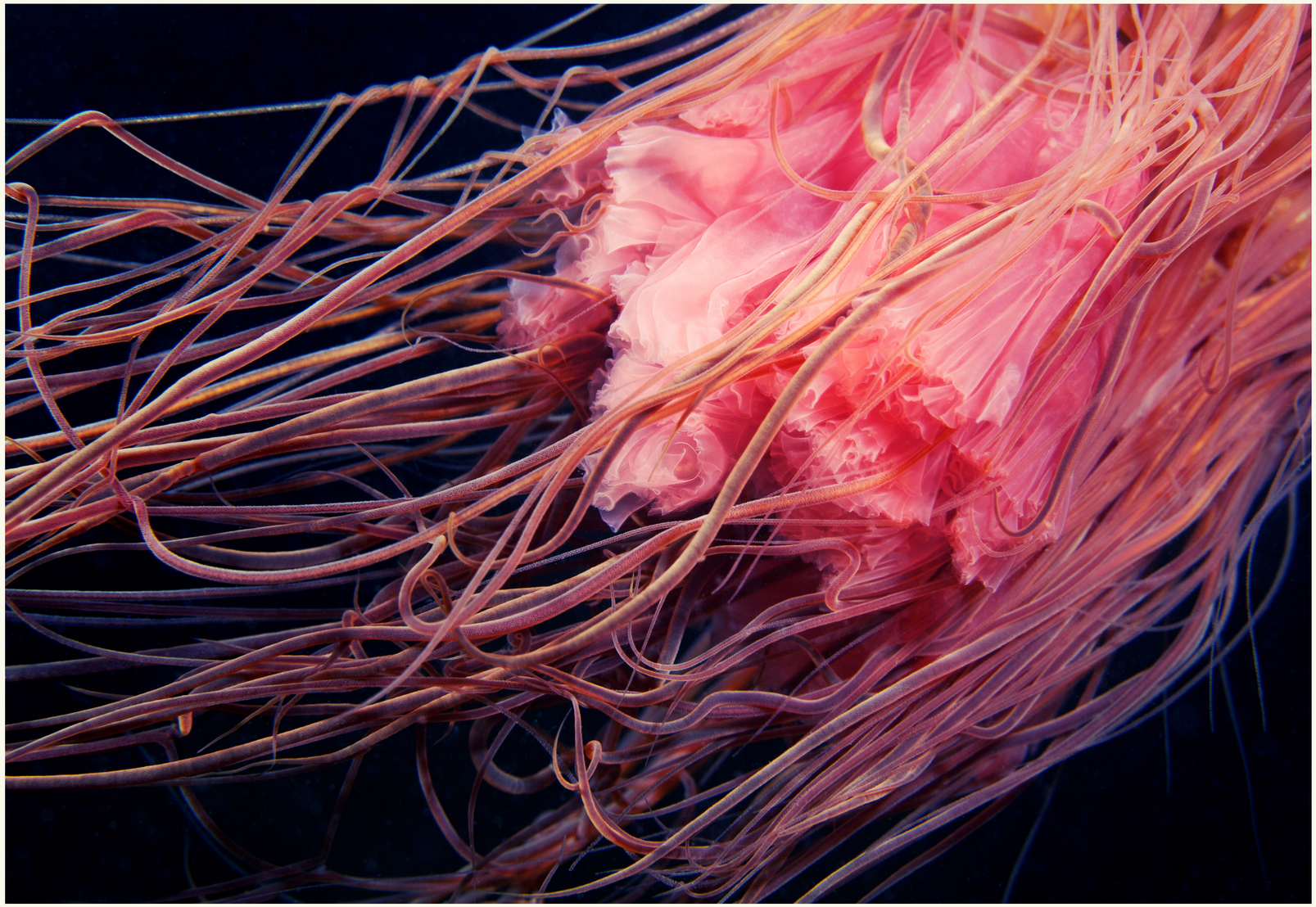
The Lion’s Mane Jelly, *Cyanea capillata*, is the largest jelly in the world. (© Alexander Semenov)

What's in Its Name?

The Lion's Mane Jelly, *Cyanea capillata*, is also known as the giant jelly or hair jelly. *Cyanea* means "blue in color" in Greek, a descriptor for the color of many of its close relatives, and *capillata*, means "long hair." There are at least 14 other species of jellies in the *Cyanea* genus. Most are found in the colder waters of the Pacific and Atlantic Oceans.

Like the Lion's Mane Jelly, many other jellies have descriptive common names. The cannonball jelly, *Stomolophus meleagris*, for instance, is also known as the cabbage head jelly because of its resemblance to both an exploding cannonball and a head of cabbage.

The Purple People Eater, *Pelagia noctiluca*, (right) is named for its purple color and potent sting. While descriptive and fun, multiple common names for a single species of jelly can be confusing. Scientists use scientific names to avoid this confusion.



The Purple People Eater, *Pelagia noctiluca*, so named for its purple color and potent sting, is also called the Purple Stinger. (Hectonichus, CC BY-SA 3.0)

(left) The Lion's Mane Jelly gets its scientific name, *capillata* ("long hair") from the visual appearance of its tentacles, which can grow to 37 m/120 feet. (© Alexander Semenov)

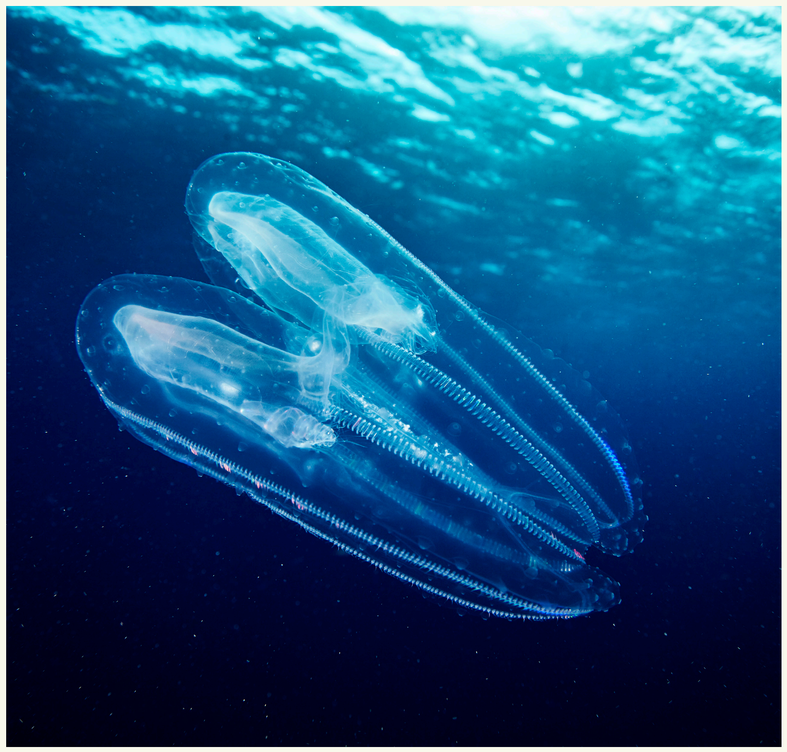
Jellies and Jelly-like Creatures

Gelatinous forms are common in the ocean, but only a few, like the Lion's Mane Jelly, are considered "true" jellies. The majority of jelly-like animals are part of the phylum Cnidaria, which also includes anemones and corals. All true jellies are from the class Syphozoa, which is derived from the Greek word *skyphos*, a kind of drinking cup that resembles the jellies. As adults, true jellies have bell-shaped bodies that trail numerous stinging tentacles. Comb jellies from the phylum Ctenophora have slimy transparent bodies and tentacles, but are not true jellies because they do not have stingers or a bell-shaped body and their life cycles are quite different.

Cyanea capillata, like all true jellies, has stinging tentacles for capturing prey. (© Alexander Semenov)

More closely related to true jellies, are Siphonophores, which means "sea serpent animal" in ancient Greek. They live in the open ocean and have stinging cells called nematocysts, but are quite different in that they are colonial. Individuals within the colony perform a different function within the whole. For example, some perform reproductive functions and others capture and digest prey. Their colonies can grow to more than 30 m/100 feet long and take many forms. The most well known is the Portuguese man-of-war, which has stinging tentacles that can extend dozens of yards, and will sting even if detached from the colony.

The Portuguese man-of-war is comprised of four separate polyps. Its name comes from the uppermost polyp, a gas-filled bladder, or pneumatophore, which sits above the water and resembles an old warship at full sail. (Biodiversity Heritage Library)



Comb jellies have transparent, jelly-like bodies with bright, iridescent color bands, made up of tiny hairs called combs. (© Alexander Semenov)

Did you know?

The term "jellies" is becoming more frequently used than the term "jellyfish" because the latter term implies that a jelly is a fish. Jellies are not closely related to fishes, which are vertebrates.

There is no environment on Earth that is too hostile for jellies. Scientists found hot-pink jellies 2,600 m/8,500 feet below the surface near Costa Rica in one of the deep sea vents, and other species have been found in Antarctica in waters below —1˚C/30°F.

Jellies in a Changing Ocean

In the face of climate change, the fate of life in the world's oceans is uncertain, but the Lion's Mane Jelly and other jelly animals will probably fare well. Warm water holds less oxygen than cold water, so as oceans warm, less oxygenated water will not be able to support as much life. Jellies dissolve oxygen in their watery tissues, which provides them with a built-in oxygen supply. This allows them to survive in the ocean's most polluted and oxygen-deprived environments—"dead zones" for other organisms. Without predators and ecological competitors, and with an abundance of plankton to eat, jellies dominate these areas, reproduce rapidly, and often produce jelly "blooms" in which massive numbers of jellies appear in an area at one time.

The number of dead zones and stressed ocean ecosystems around the world are increasing. In the U.S. alone, there are already known dead zones in the Gulf of Mexico, the Chesapeake Bay, the Narragansett Bay, Long Island Sound, and the Pacific Ocean, off the Oregon coast. As well as impacting tourism, jelly blooms wreak havoc on fishing operations by overwhelming fishing nets with their weight, poisoning and crushing captured fish, and clogging the engines of fishing boats. They are also notorious for clogging intake pipes in marine facilities such as desalination plants and nuclear power plants.

Did you know?

A glowing protein found in the bodies of many jellies is currently being used to power small nanodevices for medical purposes.

Jelly blooms, though they do occur naturally, are already occurring at staggering rates and the consequences of this are being felt around the globe. (Stephanie Booth, CC BY-NC-SA 2.0)

Lion's Mane Jellies, called Nomuras in Japan, have been blooming off the coast of Japan since 2002, crowding the nets of fishermen, and even overturning trawlers. (Niu Fisheries Cooperative, CC BY-NC 2.0)

But jellies are also an important resource in the world's oceans. Many animals like leatherback sea turtles depend on them as a food source. They are eaten by humans, particularly in Asian countries such as China, Japan, and Thailand. With their rapid reproduction rate, many people think they should become a new sustainable food source throughout the world.

Did you know?

Box Jellies, which are some of the most toxic animals in the world, bloom in tropical waters, and are extremely dangerous, and often fatal, to humans.

Learn more

Encyclopedia of Life web page

Fun jelly facts from JellyWatch, a non-profit that encourages the public to report their jelly sightings

An article from *Smithsonian Magazine*:
"Jellyfish: The Next King of the Sea"

This video of a Lion's Mane Jelly swimming was taken by marine biologist and underwater photographer Alexander Semenov.

Raw jellies in the U.S. state of Georgia are dried, packaged, and preserved before being shipped to seafood distributors overseas.
(Philip Graitcer, Voice of America, Public domain)

Common Rock Tripe

Umbilicaria mammulata

The rock tripe is an edible lichen. There are 65 species of rock tripe, found in rocky or mountainous environments worldwide, especially where other organisms are scarce. The Common Rock Tripe grows on shaded rocks in the forests of eastern North America.

Lichens are complex life forms that comprise at least two separate organisms, primarily a fungus and a photosynthesizing organism or “photobiont,” either an alga or cyanobacterium. They are able to live in a wide range of environments, including some of the most hostile on the planet such as the arctic tundra and hot, sandy deserts.

The symbiotic nature of lichens was discovered in 1867, by the Swiss botanist Simon Schwendener. Since that time, and especially with the advent of new molecular technologies, research has shown that the nature of the symbiosis is far from the simple picture of one algal species in partnership with a single fungus.

Common Rock Tripe, *Umbilicaria mammulata.* (Andrew Khitsun, *Mushroom Observer*, CC BY-NC-SA 3.0)

What's in Its Name?

The genus name *Umbilicaria* refers to the lichen's single attachment point in the middle, like a navel. The species name *mammulata*, literally means "small breasted" but is more accurately translated as bumpy, describing the papillae or bumps on the black lower side of the lichen. The name of the lichen is usually the same as that of its unique fungus, but the algae have their own species names as some can be part of more than one lichen. The algal partner in *Umbilicaria* is from the genus *Trebouxia*, which is a common partner in many lichen species.

The common name, rock tripe, relates to their habitat of rocky surfaces and their resemblance to the food stuff "tripe," which is eaten around the world. Some lichens have common names that include the word "moss," for example, "reindeer moss," as they may superficially look like and grow with mosses. However mosses are a different group of organisms that are not closely related to lichens.

Cladonia rangiferina, also known as Reindeer Moss, has a growth habit similar to true mosses. (Virginia State Parks, CC BY-A 2.0)

Umbilicaria mammulata growing on a rock near the summit of Pratt Mountain. (New Ipswich, New Hampshire). (J. Carmichael, Public domain)

Umbilicaria mammulata growing in Wisconsin. (Andrew Khitsun, http://www.wisconsinmushrooms.com/)

Agricultural Fungi?

A lichen is not a simple plant or fungus but a partnership of at least two organisms growing together. Lichens combine a fungus and a "photobiont," either algae or cyanobacteria, which together form a new organism such as the rock tripe lichen. While ordinary fungi get nutrition by decomposing dead organic material, such as rotting wood, the fungi in lichens are fed by the carbohydrates produced by their photobiont. According to lichenologist Trevor Goward, "Lichens are fungi that have discovered agriculture."

Recent research has shown that lichen symbiosis is not as clear-cut as it first seemed. For example, the same lichen species can involve different algal partners, depending on its geographic location. Recently, molecular techniques enabled scientists to discover a third partner in many lichen species: single-celled basidiomycete yeasts embedded in the lichen's cortex ("skin"). This other species most likely produces chemicals that help lichens ward off predators and repel microbes.

Did you know?

Many (but not all) lichens are very sensitive to air quality as they have no roots and very efficiently absorb contaminants from the air. Lichens have been used to monitor air quality since the late nineteenth century when the increase in industrial pollutants, particularly sulphur dioxide, led to the decline of lichens around urban areas.

Evernia prunastri, or "oakmoss" is a lichen species that is highly sensitive to air pollution. (Dendrofil, CC BY-SA 3.0)

George Washington at Valley Forge, Pennsylvania. Image from "Our Patriots" by W.F. Gordy, 1918. (New York Public Library, Public domain)

Uses

Food is the primary use for rock tripe lichens, although some species are also used for fabric dye. However, rock tripe and other lichens are not considered an agricultural product. Because they grow very slowly, they are not commercially farmed but rather are "foraged" from the wild.

In North America, rock tripe lichens are viewed as an emergency survival food, but in other countries they are viewed as a delicacy. "Tripe" is the culinary name for a ruminant's stomach (typically beef) and is usually cooked by boiling for several hours.

George Washington's troops were said to have gathered and boiled rock tripe for soup at Valley Forge, Pennsylvania, during the winter of 1777–78.

The common name in French is *tripe-de-roche*, the exact translation of the English. It was eaten as survival food by French Canadian settlers and traditionally boiled in soups by the Cree and other Native Canadians.

In Japanese, rock tripe (*Umbilicaria esculenta*) is called *iwa-take*, or "rock mushroom." They are harvested by foragers then either deep-fried or added to salads.

Watercolor of the fungus *Flammulina velutipes* by Beatrix Potter, probably painted in London in 1892. (Courtesy of the Armitt Trust)

Did you know?

The author Beatrix Potter (1866–1943) was also a naturalist who was particularly interested in fungi and lichens. She was one of the first to recognize the lichen's symbiotic nature. Although it was never published, her paper on fungi "On the Germination of the Spores of Agaricineae" was presented to the Linnean Society in London in 1897. Because the Linnean Society did not admit women to meetings at that time, it was read on her behalf by George Massee, a mycologist at the Royal Botanic Gardens at Kew.

Learn More

Encyclopedia of Life web page

Detailed information on lichens, written for hikers on the **Hiker's Notebook** website

Biodiversity Heritage Library Rock Tripe Resources

Maria Popova's *Brain Pickings* blog: ***Beatrix Potter, Mycologist: The Beloved Children's Book Author's Little-known Scientific Studies and Illustrations of Mushrooms***

A **podcast** about lichens featuring Harvard mycologist, Anne Pringle

Beatrix Potter as a young woman. (A.F. Mackenzie, National Trust, United Kingdom, Public domain)

Pangolins

Manus, Phataginus, and Smutsia, sp.

Indian Pangolin (*Manis crassicaudata*). (© Gerald Cubitt, IUCN SSC Pangolin Specialist Group)

There are eight species of pangolin, all of which comprise the mammalian order Pholidota or “scaled animals,” referencing the keratinous scales that cover their bodies. The group has a long fossil history of more than 80 million years, but only one family, Manidae, remains today, with four species in Africa and four in Asia. They are solitary and shy animals, and most species are nocturnal.

All species of pangolin are *myrmecophagous*, meaning that they feed on ants and termites. They have many specialized adaptations for this lifestyle, including sharp claws for breaking into termite mounds, tough skin to prevent ant bites, and extremely long tongues. Pangolins have poor hearing and eyesight, so they rely heavily on their sense of smell to find food. Once they find a termite mound or anthill, they use their long tongues to lap up hundreds of insects. Though the ants or termites try to fight back, the pangolin’s tough skin and ability to close its nostrils and ears while feeding leave the insects unable to defend their homes.

Tree Pangolin (*Phataginus tricuspis*).
(© Darren Pietersen /African Pangolin Working Group)

What's in Its Name?

The genus name *Manis* come from the Latin word for "ghost" or "underworld," which may refer to their solitary, nocturnal habits. The African species have different genus names, *Smutsia* and *Phataginus*. *Smuts* is from the German term for dirt, which is logical as the two species in this genus are referred to as ground pangolins. *Phata* is Latin for "crack" and likely refers to the "cracked" look of their scales.

Their common name, pangolin, comes from the Malay word for pangolins, *pëngulin*. This translates to "roller," which describes their ability to roll into a tight ball. With their hard scales, this works as an excellent defense mechanism against predators. Their lifestyle gives them their other common name: scaly anteater.

While most pangolin names come from an aspect of their ecology, geography, or physiology, one pangolin is named after a naturalist. Temminck's Pangolin (*Smutsia temminckii*) is named after Dutch zoologist, Coenraad Jacob Temminck. He was the first director of the National Museum of Natural History in Leiden, Sweden, and a member of the Royal Swedish Academy of Sciences. During his life (1778–1858), he wrote several books on ornithology, in addition to naming several species. In addition to Temminck's Pangolin, eight species of mammals, sixteen birds, eight fish, and two turtles have *temminckii* as part of their species name.

Temmick's Ground Pandolin, *Manis temminckii,* is named after the Dutch zoologist, Coenraad Jacob Temminck. (Masteraah, Public domain)

(Above, left) A Bengal tiger attempts to eat a rolled-up Indian Pangolin, Tadoba Tiger Reserve, India. (Dibyendu Ash, CC BY-SA 3.0)

Did you know?

Pangolins were thought to be closely related to anteaters, aardvarks, sloths, and armadillos, as all of these animals have either no teeth or a much-reduced number. However, molecular data has shown that these animals are not closely related, so pangolins were classified into their own group. It is now thought that their closest living relatives are the Carnivora, a group that includes cats, dogs, and bears.

The Tail of the Pangolin

All species of pangolin have exceptionally strong tails. The tails of ground pangolins are important for stabilizing the animal while it uses its front claws to rip into ant and termite mounds. The tail also serves an important role in their locomotion. It is heavy enough to act as a counterweight for the cranial part of their body, so that they can walk bipedally. This gait allows them to keep their front claws sharp for digging as they are not worn down as they move around. Pangolins often carry their offspring, known as “pangopups,” on top of their tails until the young can move around independently.

Two pangolin species in Africa (*Phataginus tricuspis* and *Phataginus tetradactyla*) and two of the Asian species (*Manis javanic*a and *Manis culionensis*) have prehensile tails. These prehensile tails increase maneuverability and stability for the Pangolin while climbing. The Long-tailed Pangolin (*Phataginus tetradactyla*) has a tail that is almost double its body length. Its tail is so long that it holds the record for the mammal with the most vertebrae, 46–47 caudal vertebrae alone.

A Chinese Pangolin (*Manis pentadactyla*) carries her young on her tail. (EOL, CC-SA-NC)

Manis pentadactyla hanging upside down. (Verdammelt, CC BY-SA 2.0)

Chinese Pangolin. (*Manis pentadactyla*). (© Michael Pitts)

Mounted specimen of the Long-tailed Pangolin, *Manis tetradactyla*. (Hectonichus, CC BY-SA 3.0)

Earth's "Most-hunted Animal"

Pangolins are the most trafficked animals in the world. It is estimated that more than one million pangolins have been taken from the wild from 2004 to 2014. Sales are estimated to account for 20% of the entire wildlife black market. Traditional Asian medicinal practices use pangolin meat, scales, and fetuses as cures for many common ailments. Their meat can cost hundreds of dollars per pound.

Pangolins do not fare well in captivity, and therefore it is often hard to rehabilitate them even if they are confiscated before they can be butchered. Many pangolins suffer injuries and missing limbs from poachers, making their release back into the wild very difficult. Today, all four African pangolin species are considered vulnerable to extinction, and the four Asian species are endangered or critically endangered, according to the International Union for the Conservation of Nature (IUCN).

Manis temminckii at Madikwe Game Preserve, South Africa. (Masteraah, Public domain)

Coat of pangolin scales, on display at the Royal Armouries, Leeds, UK. (Photo: Gaius Cornelius, Public domain)

Close-up of pangolin scales. Dried scales are used as traditional remedies in China and Vietnam. (Joxerra Aihartza, Free Art License)

Did you know?

A pangolin's tongue can be up to 40 cm/18 inches long when fully extended, so it can burrow deep into anthills to lap up hundreds of ants. The tongue is so long that it is anchored near the pelvis. The tongues are also coated in an extremely sticky saliva, guaranteeing that once a pangolin attacks, ants have no chance. It is estimated that a single pangolin can eat 70 million insects in a year!

Learn More

Encyclopedia of Life web page

The **IUCN Pangolin Specialist Group**

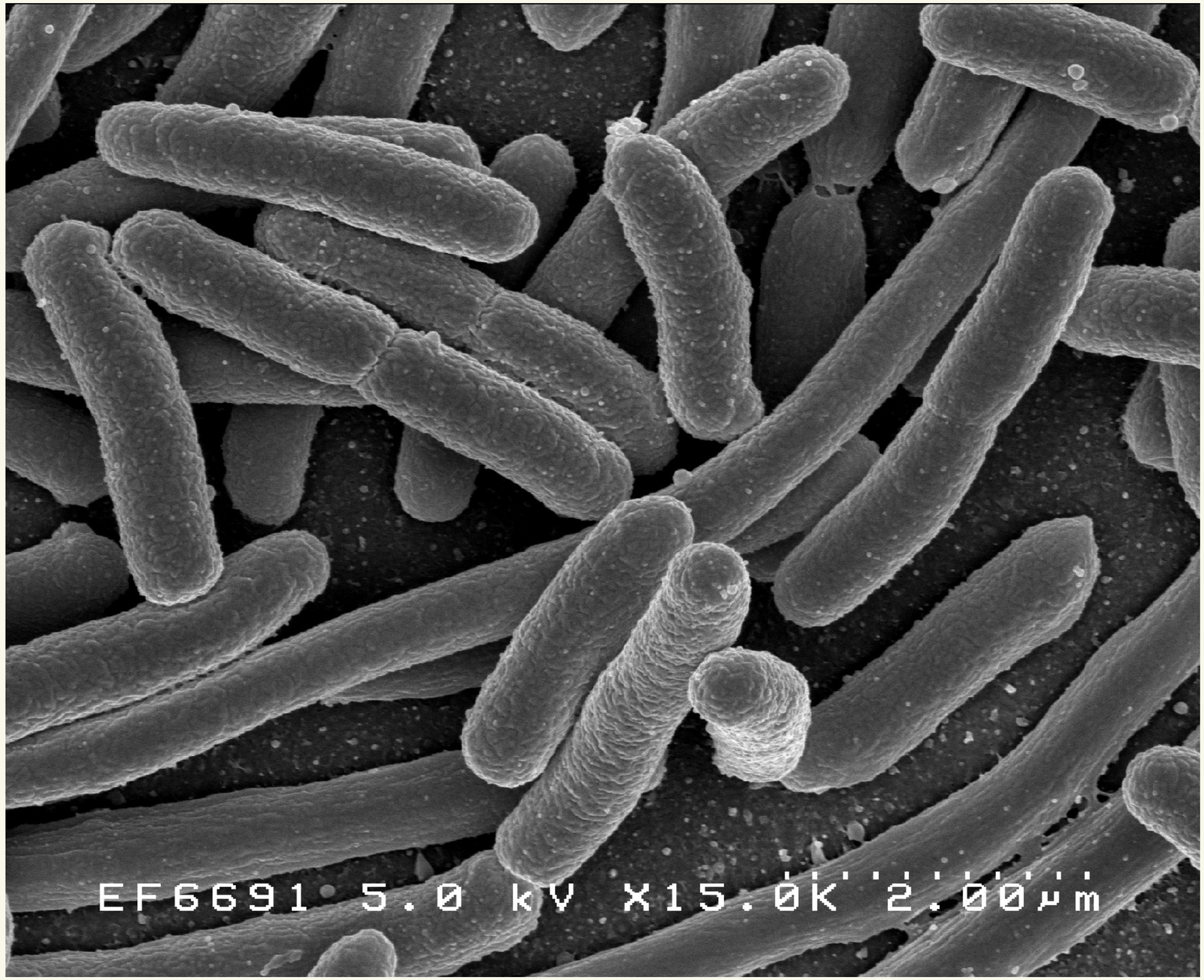
A **video** by the non-profit WildAid on pangolins and the threats to their survival.

E. coli

Escherichia coli

Escherichia coli is one of the most well-known microbes in the world and the species includes diverse strains of bacteria. Most of these strains are harmless and occur widely in nature as well as in the gastrointestinal tracts of humans and other vertebrates. They help synthesize vitamins K and B complex and also assist in food digestion and absorption. However, other strains cause infections that can lead to serious consequences.

E. coli is also used as a model organism in scientific research and is very important in the development of modern molecular biology. Its fast growth rates and genetic simplicity (*E. coli* has only 4,400 genes compared to ~25,000 genes in human cells) has led to its widespread use in laboratories. Colonies are easy to start and maintain and are even used to sustain another model organism, the roundworm *Caenorhabditis elegans*. Major discoveries in our understanding of bacterial physiology and genetics, DNA replication, and genetic engineering have been enabled by *E. coli*.

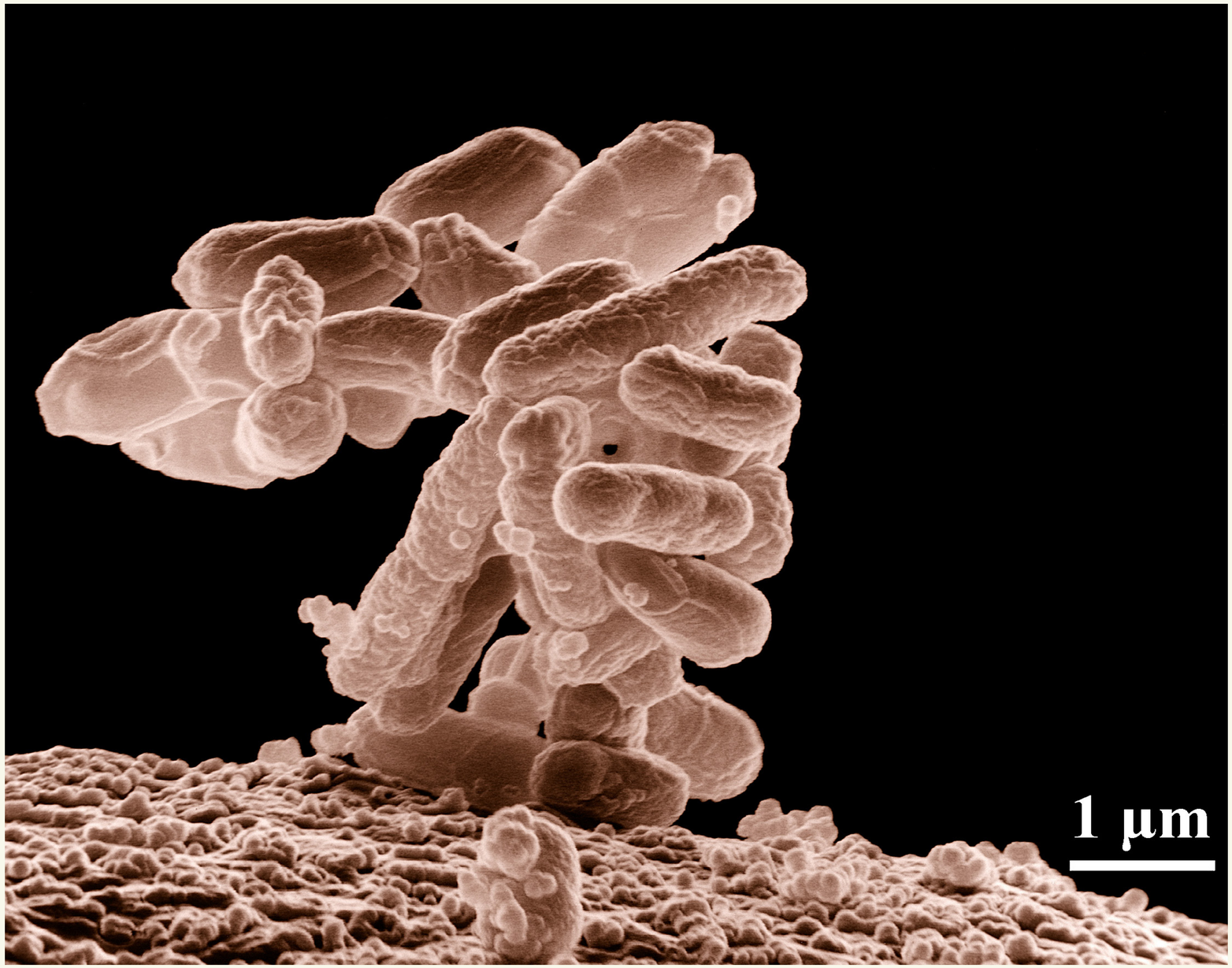


A scanning electron micrograph of *E. coli.* (NIAID, CC BY 2.0)

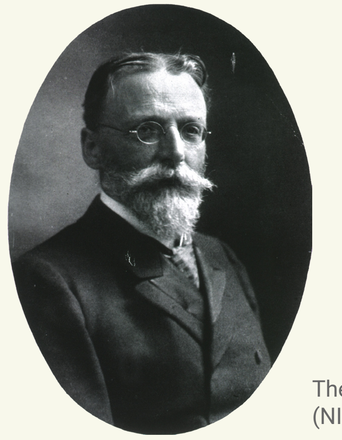
What's in Its Name?

The bacterium was discovered in 1885 by Theodor von Escherich, who named it *Bacterium coli commune*. *Coli* refers to where Escherich found the organism, in the colon, and *Bacterium* is a genus name that is no longer used. In 1919, the bacterium was renamed *Escherichia coli* to honor its discoverer, though this was not officially endorsed until 1958. The genus *Escherichia* has many other species that are found in the gastrointestinal tracts of vertebrates.

The vast majority of bacteria do not have common names but *E. coli* is so important to human health and scientific research that the term has become used as a common name as well.



An electron micrograph of a cluster of *E. coli*, magnified 10,000 times. (Eric Erbe, ARS/USDA)



Theodor Escherich (1857–1911). (NIH/U.S. National Library of Medicine)

The Man behind the Bacterium

Theodor Escherich (1857–1911) was a pioneering German pediatrician, who worked to improve childcare by focusing on hygiene and nutrition. In 1884, while living in Munich, Escherich began research on the bacteria of infant intestinal tracts and how they change after birth. He used these studies to investigate diseases in infants. He learned how to characterize and culture bacteria, conducting experiments in laboratories, institutes, and even dairy-industry facilities. He demonstrated that bacterial colonization in infants was attributable to their environment 3–24 hours after birth. It was also at this time that Escherich officially presented his work on *Bacterium coli commune* to the Society for Morphology and Physiology on July 14, 1885.

In 1890, Escherich was offered a position as a professor and director of a children's hospital in Graz, Austria. He discovered that coliform bacteria are associated with intestinal infections in infants. He also noted the *B. coli* commune was frequently found in urine samples of young girls, which shed light on the significance of urinary tract infections. Escherich's success in Graz led him to be nominated as Chair of Pediatrics at the University of Vienna and Director of the St. Anna Children's Hospital of Vienna in 1902. While there, he modernized the hospital and founded the Austrian Society for Children's Research. Today he is remembered as a pioneer in pediatrics and the first pediatric infectious disease physician.

E. coli *and Disease*

Some types of *E. coli* cause disease by making a “Shiga toxin.” The bacteria that produce this are often referred to as STEC (Shiga toxin-producing *Escherichia coli*) and in North America the most common form that causes infections is *E. coli* O157:H7. While common symptoms are stomach cramps, diarrhea, and vomiting, more severe complications include hemolytic-uremic syndrome, a condition in which red blood cells are destroyed at an abnormal rate, leading to renal failure and death.

STEC live in the guts of ruminant animals, including cattle, goats, and sheep. Sources of illness-inducing *E. coli* often come from contaminated, uncooked food such as raw beef, fruits, vegetables, and unpasteurized dairy products. Water can also be contaminated with *E. coli*. Handling and working with livestock, especially cattle, is an additional risk factor for contracting an *E. coli*-related illness.

E. coli has also been used to fight diseases as it can be genetically altered with relative ease. It has been used to make antibiotics, manufacture insulin, and treat cancer.

Cows on a small dairy farm in western Maryland. (Scott Bauer/USDA)

Did you know?

Professor Richard Lenski, at Michigan State University, has been studying the genetic changes in twelve (originally) identical populations of *E. coli* since 1988. The experiment has now produced more than 65,000 generations, making it the world’s longest-running study in experimental evolution. The goal is to study the dynamics of evolution, particularly the rate of evolutionary change.

Flasks of *E. coli* from Professor Lenski’s long-term experiment. (Brian Baer and Neerja Hajela, CC BY-SA 3.0)

Professor Richard Lenski in his laboratory. (Zachary Blount, CC BY-SA 4.0)

Learn More

Encyclopedia of Life web page

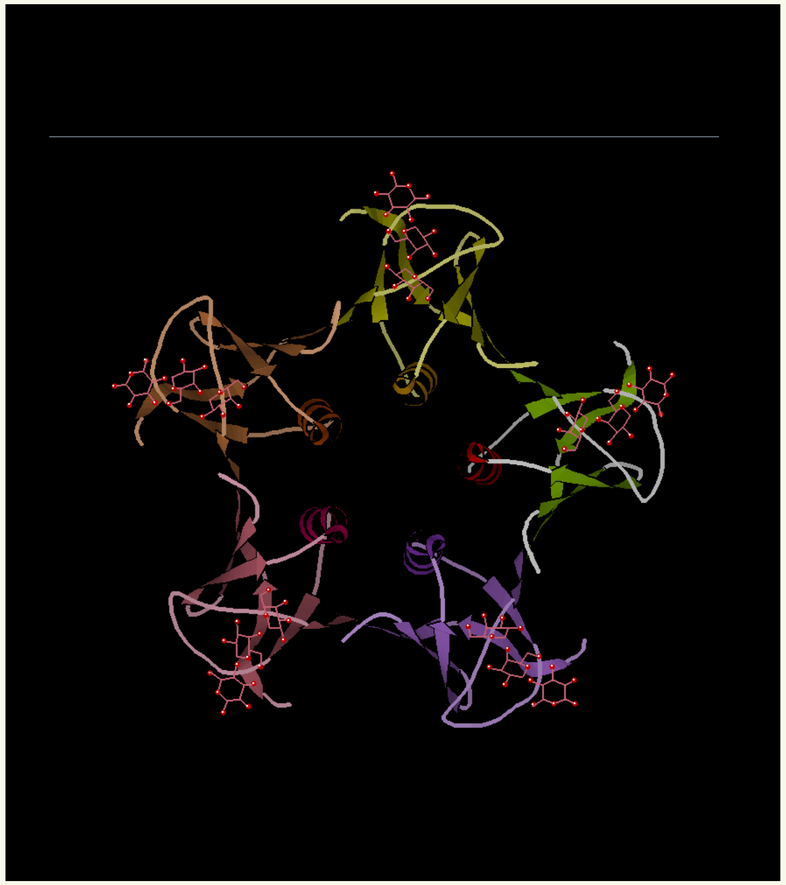
Information on *E. coli* from the U.S. Centers for Disease Control and Prevention

An **article** on Richard Lenski’s experiment: “The Man Who Bottled Evolution”

An **animation** from the Howard Hughes Medical Institute on how an infectious strain of *E. coli* causes serious illness

Did you know?

While *E. coli* is one of the most commonly used bacteria in science, its function goes far beyond simple experimentation. Studies are being conducted to see if *E. coli* can be used to make a fossil fuel replacement. Ideally, the bacteria would produce fats similar to gasoline molecules.

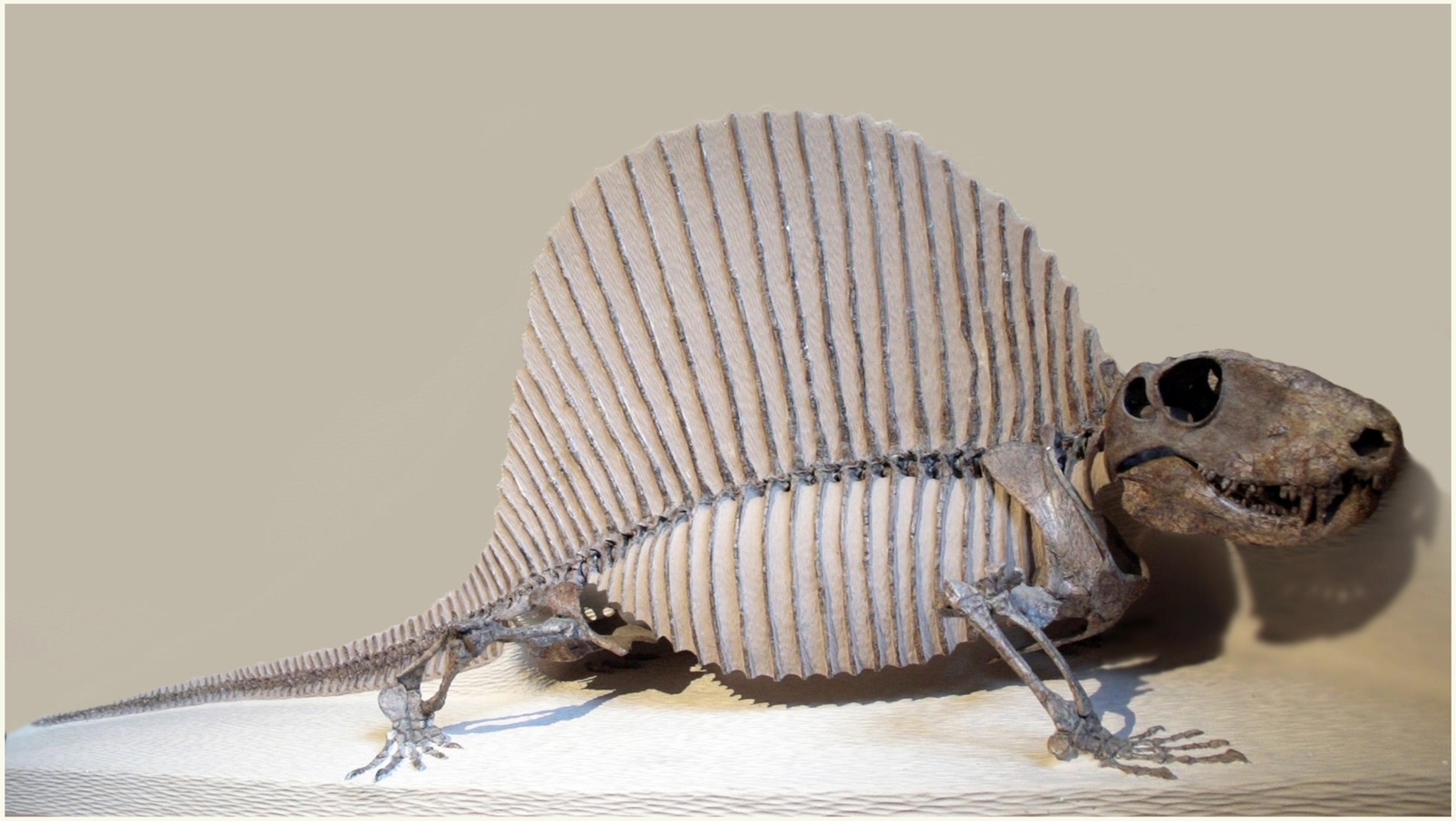


Crystal structure of a Shiga-like toxin from *E. coli.* (InfoCan, CC BY-SA 3.0)

Dimetrodon

Dimetrodon milleri

A tributary of the Brazos River, in West Texas. (Leaflet, CC-BY-SA 3.0)



Harvard University's *Dimetrodon milleri* fossil specimen is the oldest known *Dimetrodon* specimen in the world. (© President and Fellows of Harvard College)

Nearly 300 million years ago, in a vast, sprawling swamp, one of the world's first great predators exhaled its final breath and perished in the mud. It was the beginning of the Permian Period and the planet was starkly different from what it is today. All the world's landmasses were joined together in a massive supercontinent called Pangea. Earth was in the grip of an ice age, its polar regions were covered by massive glacial sheets, and its equatorial girdle was mostly dry due to extreme seasonal fluctuations between wet and dry seasons, that filled and drained massive landscapes like the predator's swamp.

In 1937, Harvard paleontologist Alfred Romer (1894–1973), was trekking across the ancient swamp, now a mountainous red desert known as the Red Beds of Texas, when he discovered the fossilized remains of the fallen predator. Its decayed bones had been replaced by solidified minerals from the mud in which it had fallen. It was a species of *Dimetrodon*, a genus of large carnivores that were Earth's top land predators for more than 20 million years. Romer named the specimen *Dimetrodon milleri* and housed it in the collections at the Harvard Museum of Comparative Zoology.

What's in Its Name?

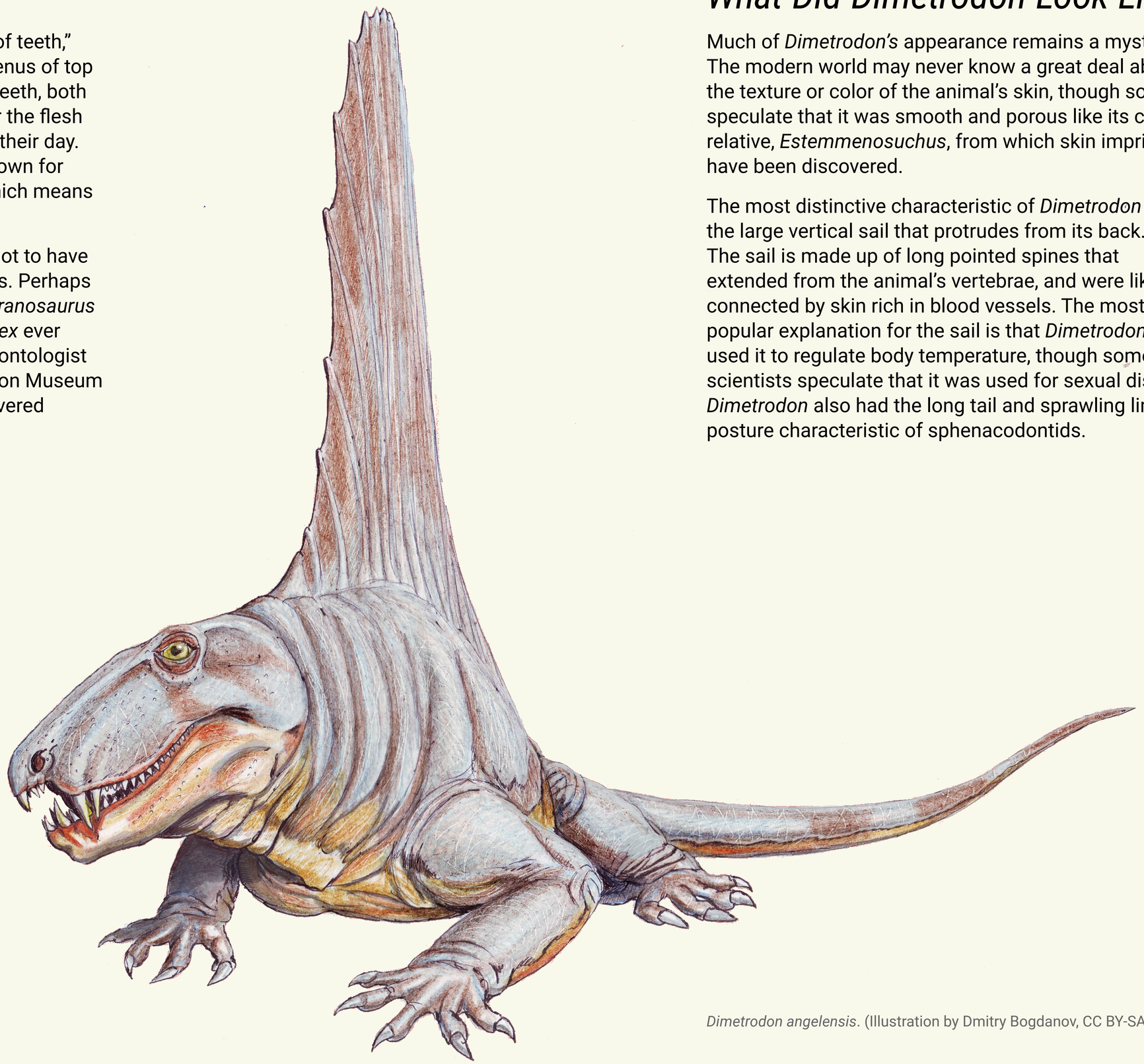
Dimetrodon, which means "two measures of teeth," was aptly named for its toothy grin. This genus of top predators used their mouth full of conical teeth, both large and small, to grab, grip, stab, and tear the flesh of its prey, usually the large amphibians of their day. *Dimetrodon* species are part of a family known for their dentition—the Sphenacodontidae—which means "wedge-point tooth."

Dimetrodon and other fossil species tend not to have common names, but some have nicknames. Perhaps the most famous fossil nickname is the *Tyranosaurus rex* specimen "Sue," the most complete *T. rex* ever found, and named after its discoverer, paleontologist Sue Hendrickson. Curators from the Houston Museum of Natural Science named a recently-discovered *Dimetrodon loomisi*, "Laslow."

What Did Dimetrodon Look Like?

Much of *Dimetrodon's* appearance remains a mystery. The modern world may never know a great deal about the texture or color of the animal's skin, though some speculate that it was smooth and porous like its close relative, *Estemmenosuchus*, from which skin imprints have been discovered.

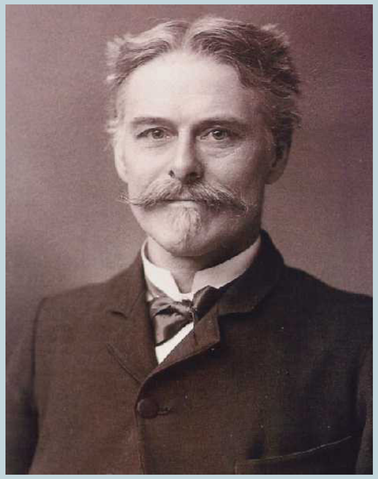
The most distinctive characteristic of *Dimetrodon* is the large vertical sail that protrudes from its back. The sail is made up of long pointed spines that extended from the animal's vertebrae, and were likely connected by skin rich in blood vessels. The most popular explanation for the sail is that *Dimetrodon* used it to regulate body temperature, though some scientists speculate that it was used for sexual display. *Dimetrodon* also had the long tail and sprawling limbs posture characteristic of sphenacodontids.



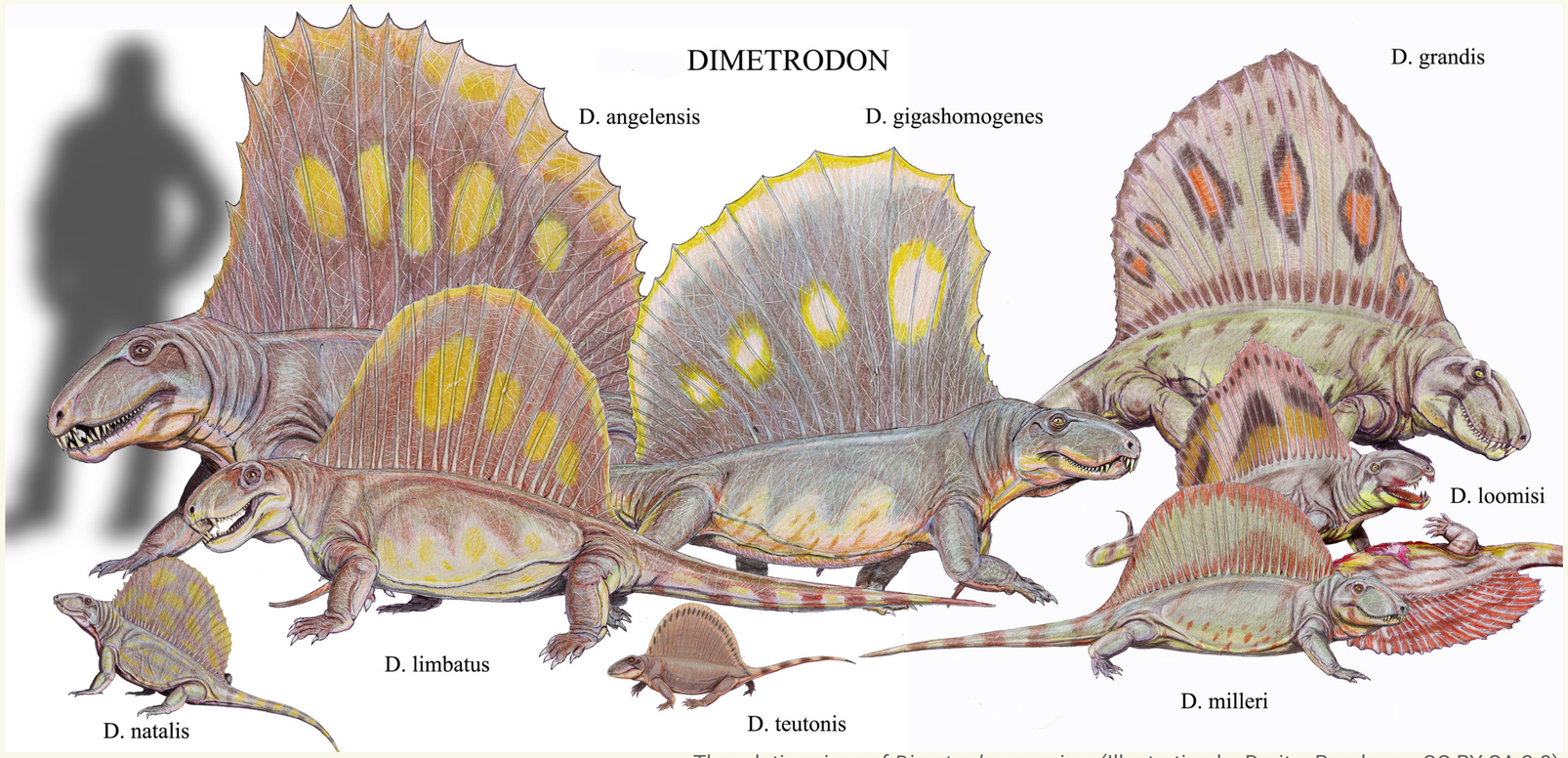
Dimetrodon angelensis. (Illustration by Dmitry Bogdanov, CC BY-SA 3.0)

Did you know?

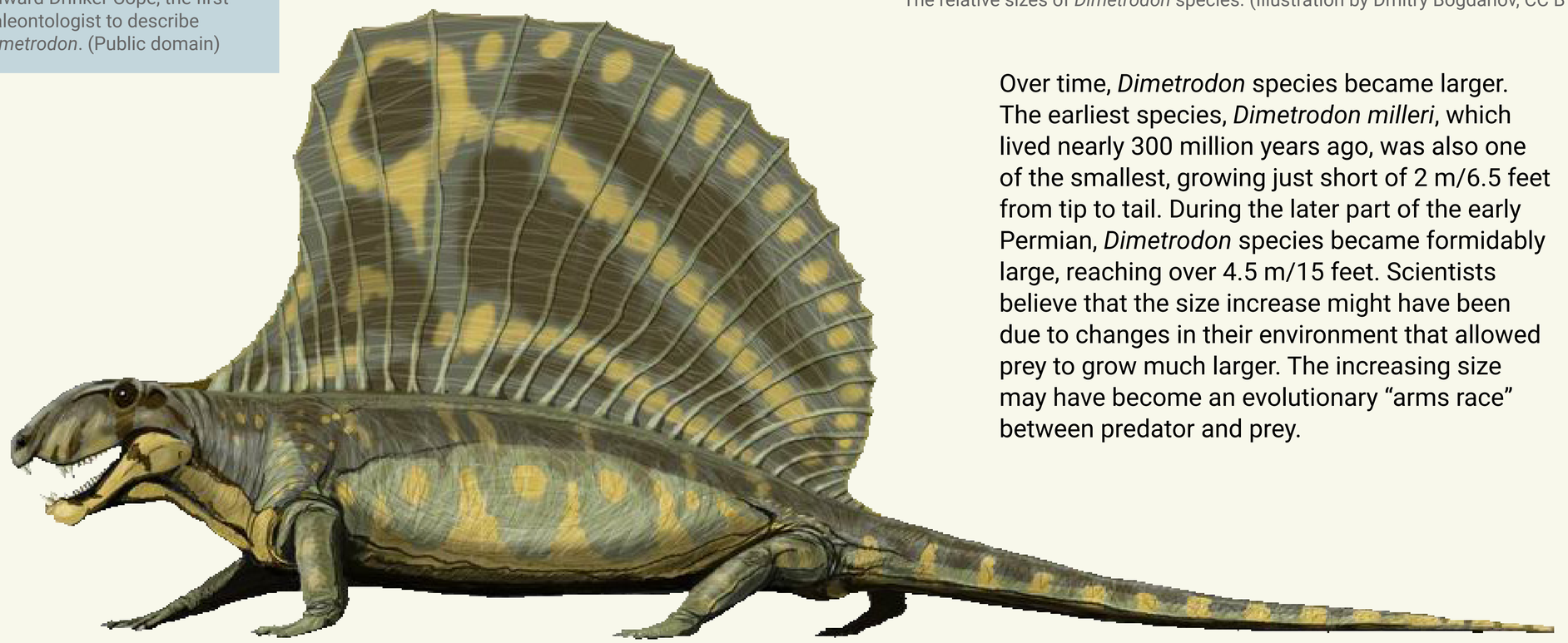
Dimetrodon was first described in the 1870s by legendary paleontologist Edward Drinker Cope. Cope was responsible for naming over 1,000 fossilized vertebrate species and was one of the strongest driving forces behind the “Great Dinosaur Rush,” a significant period of advancement in the field of paleontology.



Edward Drinker Cope, the first paleontologist to describe *Dimetrodon*. (Public domain)



The relative sizes of *Dimetrodon* species. (Illustration by Dmitry Bogdanov, CC BY-SA 3.0)



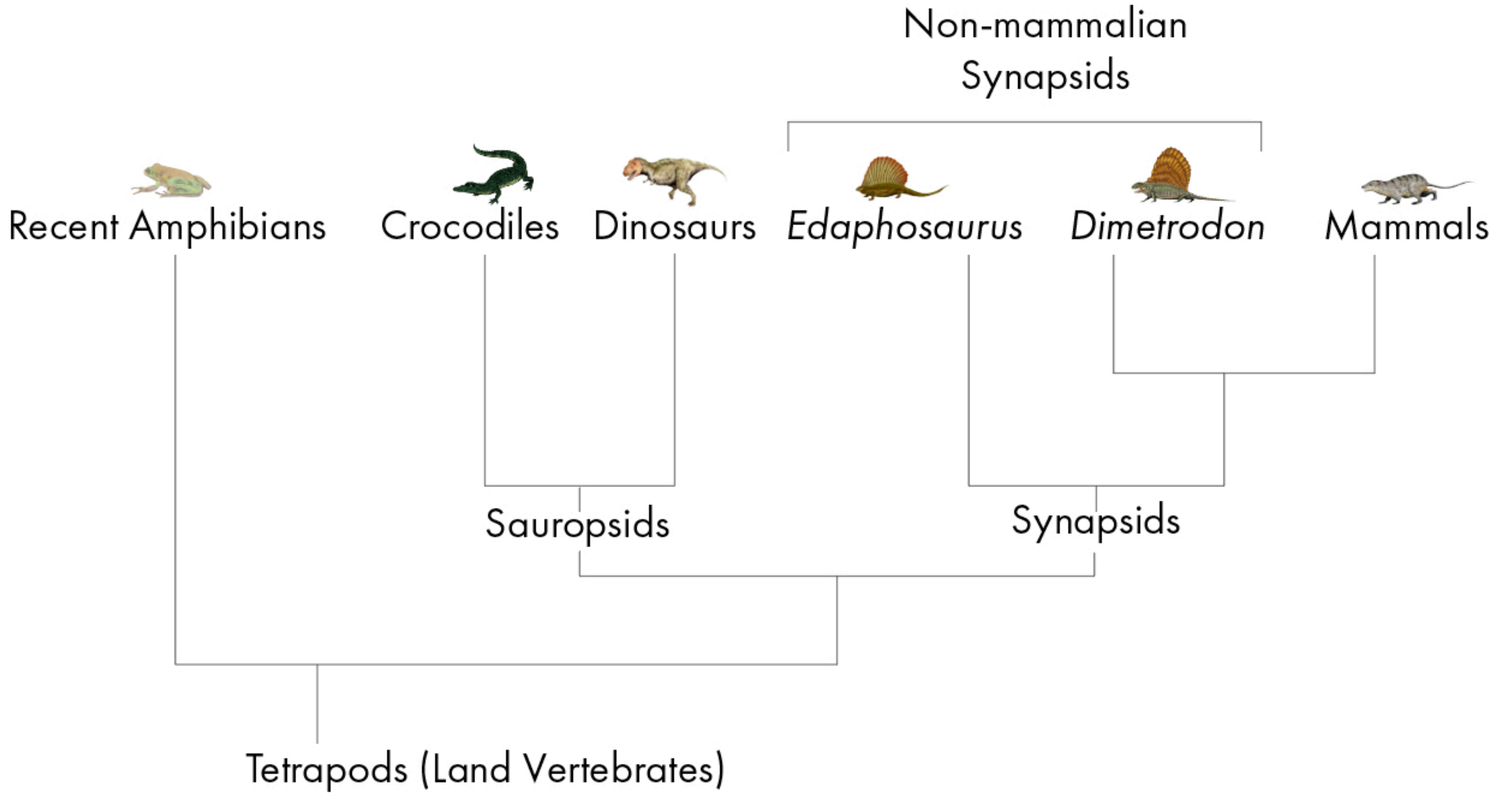
Over time, *Dimetrodon* species became larger. The earliest species, *Dimetrodon milleri*, which lived nearly 300 million years ago, was also one of the smallest, growing just short of 2 m/6.5 feet from tip to tail. During the later part of the early Permian, *Dimetrodon* species became formidably large, reaching over 4.5 m/15 feet. Scientists believe that the size increase might have been due to changes in their environment that allowed prey to grow much larger. The increasing size may have become an evolutionary “arms race” between predator and prey.

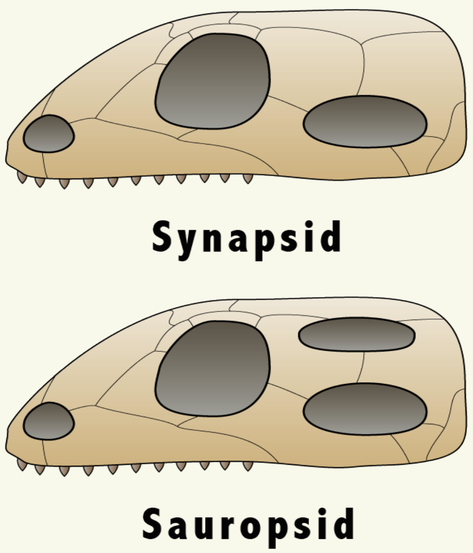
Dimetrodon giganhomogenes. (Illustration by Dmitry Bogdanov, CC BY-SA 3.0)

Why Isn't Dimetrodon *a Dinosaur?*

Despite its almost crocodilian stature, *Dimetrodon* was neither a reptile, nor a dinosaur. *Dimetrodon* appeared 60 million years before the first dinosaurs and is only distantly related to reptiles. Reptiles, including crocodiles, dinosaurs, and birds belong to a group known as the Sauropsida, or "lizard faces," while *Dimetrodon* belongs to a group known as Synapsida, which includes mammals. These two major groups split from a common ancestor about 320 million years ago. *Dimetrodon*, in fact, is more closely related to humans than it is to dinosaurs.

Synapsids can be distinguished from sauropsids by their skulls. In Greek, *synapsida* means "fused arch," which refers to a bony arch formed by an opening in their skull behind each eye. Mammals also have this arch. *Dimetrodon* and its relatives are most often referred to as non-mammalian synapsids—the predecessors to mammals. Fossil evidence indicates that they flourished as the dominant terrestrial vertebrates in Permian ecosystems, but were also quite successful during the Triassic period.





Sauropsids have two openings behind each eye while synapsids only have one. (Derivative work from Peter Bockman, CC BY-SA 3.0)

Did you know?

The *Dimetrodon milleri* specimen housed at the Harvard Museum of Natural History is the oldest and most complete *Dimetrodon* specimen known. Scientists come from all over the world to Harvard to study this special "type" specimen, even though it has been a part of the scientific record for more than 80 years.

Dimetrodon wasn't the only species of this period that had large sails. The *Edaphosaurus* was an herbivorous synapsid that lived at the same time and evolved the sail independently. One easy way to tell the two sails apart, is that the spines of *Dimetrodon* are smooth, while those of *Edaphosaurus* have humps.

Learn More

Encyclopedia of Life web page

The story of the discovery of "Laslow"

A video from the Field Museum, Chicago, on why *Dimetrodon* was NOT a dinosaur.

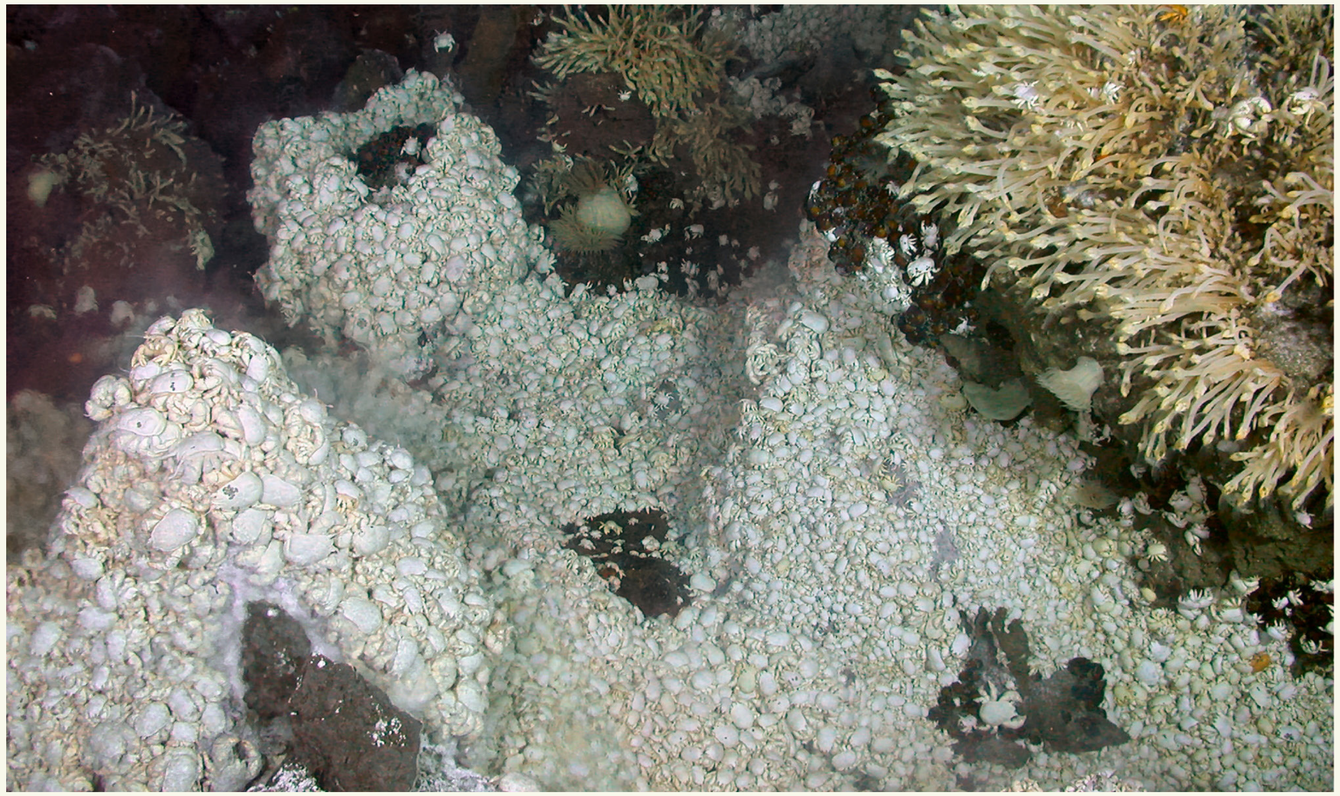
A video featuring Harvard Professor Stephanie Pierce's work on the origins of mammal movement.

Yeti Crab

Kiwa species

Depths away from the furry legend of the Himalayas, the Yeti crab is a crustacean that dwells in deep-sea hydrothermal vents, at depths of thousands of feet. Hydrothermal vents form when hot larva rises up beneath the seafloor causing Earth's crust to split apart. The fluids carry minerals that are rich in sulfur and other metals that bacteria can synthesize to support a unique ecosystem of deep-sea animals.

Generally, large crustaceans like crabs and lobsters cannot survive in cold ocean regions, such as the waters surrounding Antarctica. As hydrothermal vents warm the surrounding water with geothermal heat, they provide a habitat for the Yeti crabs in their immediate environment. There can be as many as 700 Yeti crabs in a square meter in a hydrothermal vent, so they are extremely successful and well adapted to these warm water "oases."



Yeti crabs are very successful in their hydrothermal environments and populations can grow to great densities. The mass of white in this photograph comprises hundreds of Yeti crabs on the seafloor of the Southern Ocean. (A. D. Rogers, et al., CC BY 2.0)

A specimen of *Kiwa hirsuta*, collected by the deep sea submersible *Alvin*.
(A. Fifis/Ifremer, CC BY-NC 3.0)

What's in Its Name?

A Yeti is a fabled creature with wild white fur, and Yeti crabs have a striking white, fuzzy-looking external morphology, which resembles their beastly namesake. As they are crabs, this texture is certainly not fur, but instead bristles called setae that cover their chelipeds (claws). Yeti crabs are, of course, much smaller than the fabled Yeti and grow to only about 15 cm/6 inches in length. To add to this crab's sensational namesake, the genus name *Kiwa* comes from Polynesian mythology. *Kiwa* alludes to a goddess of shellfish in Polynesian culture.

Three Yeti crab species have been documented. *Kiwa hirsuta* was the first species to be discovered and is found in the Pacific-Antarctic Ridge. The specific name *hirsuta* is the Latin word for "hairy." The morphologically similar *Kiwa tyleri* lives in the coldest waters of any Yeti crab species in the Southern Ocean. Scientists nicknamed it the "Hoff" crab because the bristles reminded them of the hairy-chested *Baywatch* actor, David Hasselhoff.

The third species, *Kiwa puravida,* has only been found living near a vent off the coast of Costa Rica and is named for the Costa Rican saying *pura vida* that means "pure life."

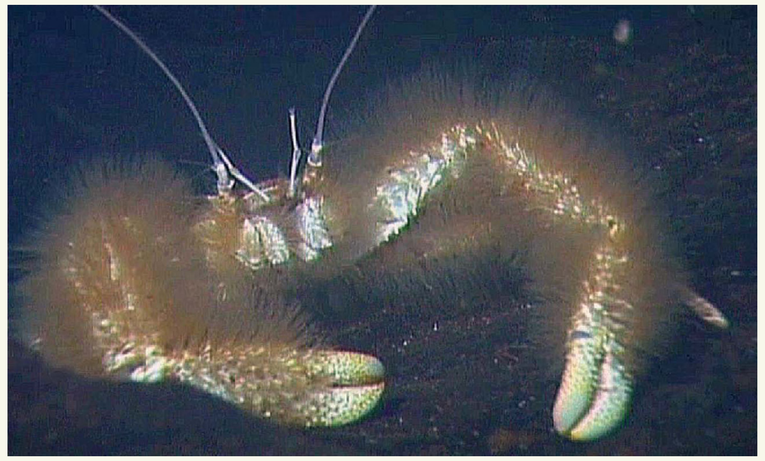
It is thought that the divergence between different species of Yeti crab occurred around the Miocene (23–25 million years ago), when the Drake Passage opened between Cape Horn and the Antarctic Peninsula, lowering the Southern Ocean's temperatures.

(Above) David "Hoff" Hasselhoff in 1986. (Rex Gutierrez, CC B-Y 2.0)

Two Yeti crabs on vent site Annie's Anthill (Southern East Pacific Rise)
(R. Vrijenhoek © MBARI, CC BY-NC 3.0)

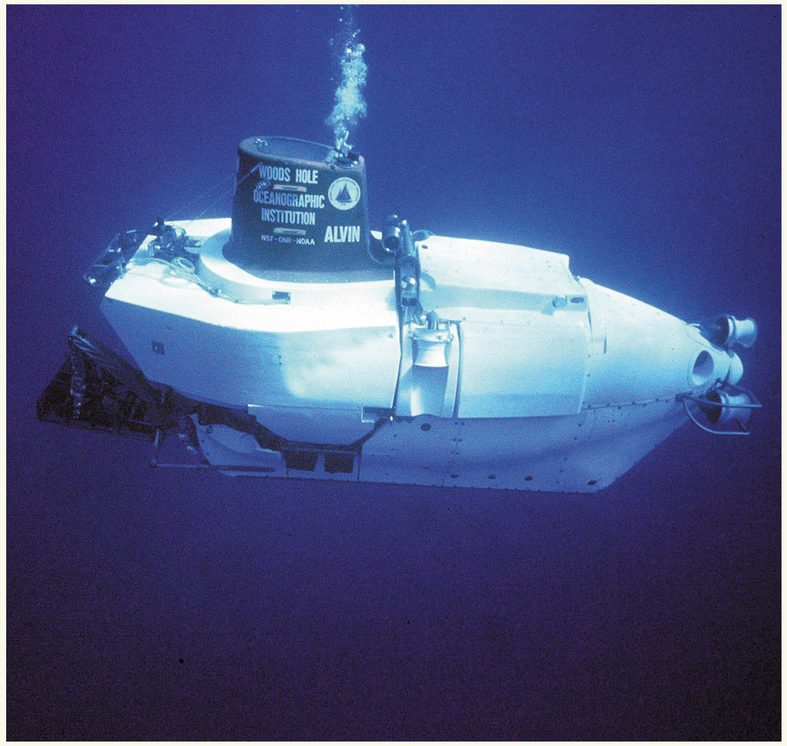
Did you know?

Because hydrothermal vents are so dark, Yeti crabs have no need for sight. They are completely blind!



Kiwa hirsuta photographed from the Alvin at the Southern East Pacific Rise.
(R. Vrijenhoek © MBARI, CC BY-NC 3.0)

Discovering a Yeti



Deep submersible vehicle, *Alvin*. (Woods Hole Oceanographic Institution)

Remarkably, thermal vents had been the subject of scientific research for about 30 years before Yeti crabs were discovered. In 2005, a group of marine biologists, led by Robert Vrijenhoek, first observed Yeti crabs in the Southern Ocean using a deep-sea submersible named *Alvin* that is owned by the United States Navy and operated by the Woods Hole Oceanographic Institution in Massachusetts.

The research vessel carrying *Alvin* was exploring the ridge near the Easter Island tectonic microplate. At the depth of 2,200 m/7,200 feet, Vrijenhoek and his team observed Yeti crabs squeezed between the crevices of rocks.

One of the questions they hoped to answer, and it remains a mystery today, is how animals that live in deep sea hydrothermal vents can migrate from one hydrothermal vent to another, across vast oceans of icy water.

Did you know?

Artists have been an integral part of scientific expeditions since the eighteenth century; Captain James Cook is credited with starting the tradition. Previously, images were drawn from participants' oral and written accounts but drawing and painting from life provided far more accurate information. The artist's role is to help interpret new discoveries and present the research to a broader public. This tradition continues today. Lily Simonson has been the expedition artist on voyages around the polar seas and has made several paintings of the Yeti crab.


Portrait of a Yeti, 2007, Oil on canvas, 61 x 91 cm/24 x 36 inches. (© Lily Simonson, http://lilysimonson.com/yeticrab)

Learn More

Encyclopedia of Life web page

A summary of the Yeti crab discovery from the Woods Hole Oceanographic Institute

The Woods Hole Oceanographic Institute's *Alvin* website

A video of *Kiwa puravida* from: Thurber, A. R., et al. (2011). Dancing for Food in the Deep Sea: Bacterial Farming by a New Species of Yeti Crab. suggests the crab is harvesting the chemoautotrophic bacteria living on its "fur"

A National Geographic video showing swarms of *Kiwa tyleri*

The first video footage of a Yeti crab, taken in 2005 from the submersible *Alvin*, showing a 15 cm/6-inch male crab. (Video by Woods Hole Oceanographic Institute, National Deep Submergence Facility, *Alvin* Operations Group, and *R/V Atlantis* crew, WHOI)

Epilogue

A New Snail from Vietnam: Vargapupa biheli

(Encyclopedia of Life/Dr. Barna Páll-Gergely)

What's in Its Name?

What do snails have in common with the **Biodiversity Heritage Library** (BHL)? There are many pages of information available about snails that have been digitized and that can be found in the BHL, but the newly discovered *Vargapupa biheli* honored the BHL in its name ("*bi-he-li*"). Not only is *V. biheli* a new species, but the genus is also new! This work was completed by a team of biologists. The lead author on the published study, Dr. Barna Páll-Gergley, is a biologist at Shinsu University in Japan. He is a frequent and appreciative user of BHL. He is so appreciative that in naming the new snail, he wrote:

> The new species is named after the Biodiversity Heritage Library to thank the multitude of rare literature made available to us. The name ***biheli*** is an acronym derived from the name **Bi**odiversity **He**ritage **Li**brary.

While the species name honors the BHL, the genus is dedicated to András Varga, a Hungarian malacologist, and friend of the authors. Varga's contributions to Vietnamese malacofauna are very substantial. The genus *Vargapupa* is the combination of his last name, *Varga*, and *pupa*, which refers to the snail's shell. *Pupa* is derived from Latin and refers to the way that ancient people used to swaddle their infants.

Discovering a New Species

The discovery of *Vargapupa biheli* began when Páll-Gergely's friend, András Hunyadi, brought him *Pseudopomatias* specimens that had been collected in Vietnam. Hunyadi thought they might be a new species, so Páll-Gergely began his investigation on the genus. It led him to a text written in 1953 by Edmond Saurin, a French geologist and archaeologist. The only information in the text was that Saurin had collected *Pseudopomatias fulvus* from Laos. There was little written about the snail, so the next step was to view the *P. fulvus* specimen from the Muséum national d'Histoire naturelle. Once Páll-Gergely saw the snail, he knew that it was a new species. *Vargapupa* differs from *Pseudopomatias* in that it has unique keels on its shells. These keels are absent in *Pseudopomatias*, which warranted the new genus.

Much work remains to be done to learn more about this new species. Because all of the information used to define the species was from museum specimens, the ecology of this animal still has to be explored.

(Encyclopedia of Life/Dr. Barna Páll-Gergely)

The Discoverer

Lead author Dr. Barna Páll-Gergely is a biologist at the Shinshu University in Japan. His love of mollusks began at a young age. When he was five he collected shells. By secondary school, he had already begun studying land snails, on which he has continued to focus to this day.

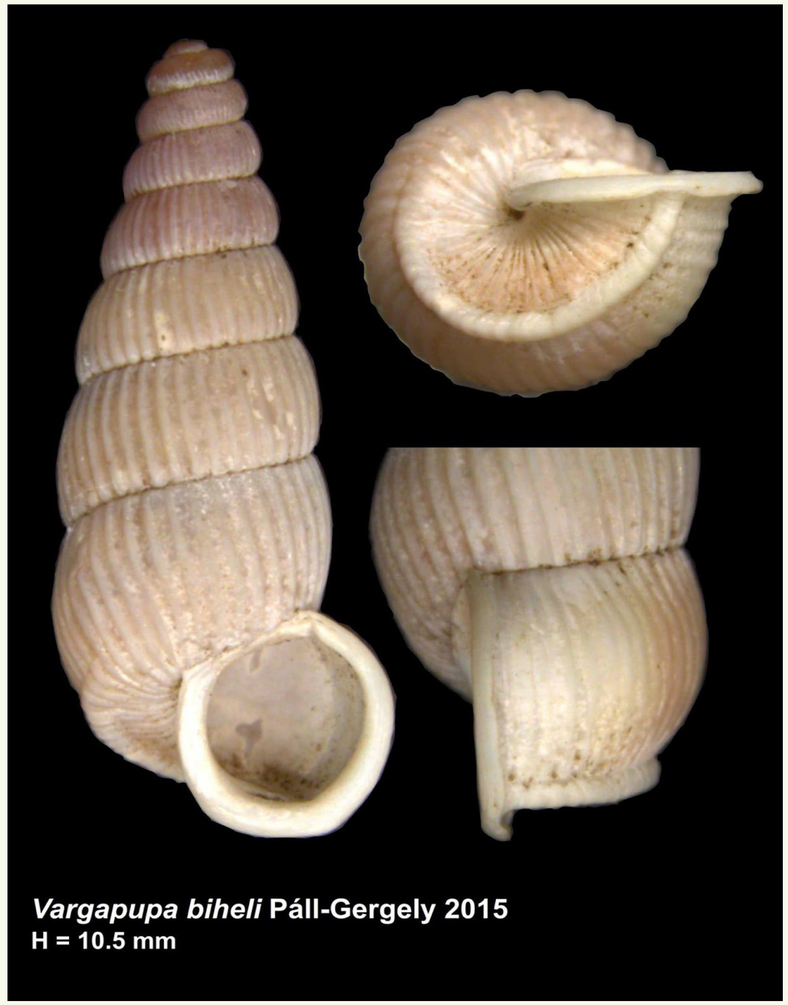
[Muséum national d'Histoire naturelle, Paris.](#)
(Benh Lieu Song, CC BY 2.0)

Did you know?

The snail from the Muséum national d'Histoire naturelle that was used to describe the new genus and species has a story of its own. The writings of Edmond Saurin were not only helpful to Páll-Gergely, but also to Dr. Philippe Bouchet in the 1970s. Bouchet came across some of Saurin's articles that described 210 new species of *Pyramidellidae*, but the holotypes were nowhere to be found.

Bouchet—eventually finding an old address of Saurin's—wrote to the address inquiring about the specimens. He received a response from Madame Saurin who told him that her husband had passed away, but that he was welcome to come by and look through the attic for the specimens.

A few months later, Bouchet paid Madame Saurin a visit. The mansion's attic was filled with many boxes and cabinets; there was no guarantee that the snails would be there. Nevertheless, Bouchet was able to find the specimens in only a few minutes. Along with those specimens were a collection of land snails—the very ones that led to the new species! All the specimens were wrapped in newspaper that was scribbled with place names and other information. Madame Saurin graciously donated all of the specimens to the museum. Without them, Páll-Gergely would not have been able to name a snail after the BHL!



(Encyclopedia of Life/Dr. Barna Páll-Gergely)

Learn more

[Biodiversity Heritage Library](#) (BHL)

[A New Snail Species Named in Honor of BHL!](#)
BHL blog, April 16, 2015

[Taxonomic Research on Southeast Asian Land Snails](#)
BHL blog, October 13, 2013

[Scientific description:](#) Páll-Gergely, B., et al. (2015). "Revision of the Genus *Pseudopomatias* and its Relatives (Gastropoda: Cyclophoroidea: *Pupinidae*," *Zootaxa*: 3937(1).

What's in a Name?