

History of Historical Biogeography

By Nick Matzke

Some notes on my style

In addition to science, I was given a “liberal education”, i.e. lots of liberal arts. I can’t seem to shake it!

This means that I like to follow the influences between science and the broader society: history, philosophy, religion, culture, etc.

This can throw some science students, who might be more used to more “cut-and-dried,” “just the facts” presentations.

But: I think it is valuable to be exposed to these broader connections, just so you have some idea what people are doing over in the humanities departments, and why what they are doing might be useful (even to scientists!)

Some notes on my style

To help make these broader issues make sense, I sometimes:

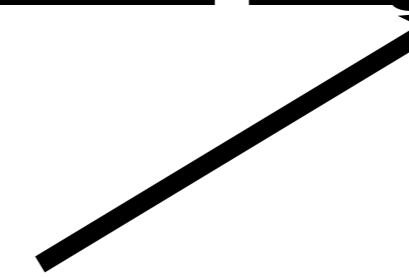
1. Include quotes from key works, in the slides. Do not try to read these “live” during the presentation. They are there so you can go back and read them while reviewing the slides.

(I have found this gets far more people to read a bit of the humanities material, than if I just mention it as supplemental reading that you have to dig up yourself.)

2. I sometimes do “animations”, where each slide adds an image or text. Yes, this makes there be more slides in the presentation, but it makes the presentation more portable to multiple formats than using Powerpoint’s animation functions.
3. I include lots of “background” / context / history. I think this is important as many current debates are actually just versions of ancient debates.

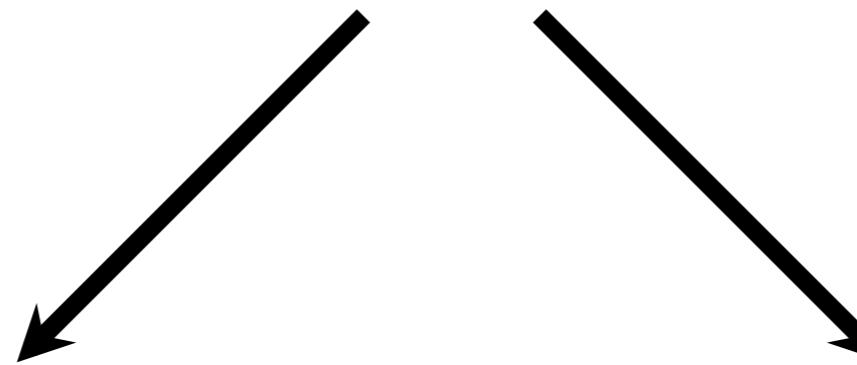
Statistical model choice in phylogenetic biogeography

Biogeography:
The geography of life



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Biogeography:
The geography of life

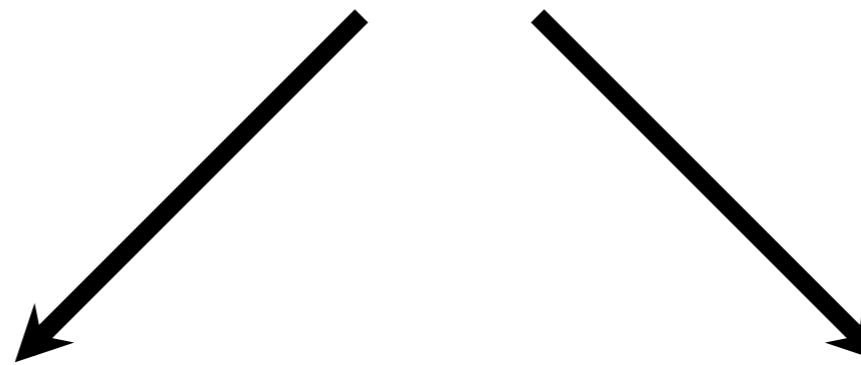


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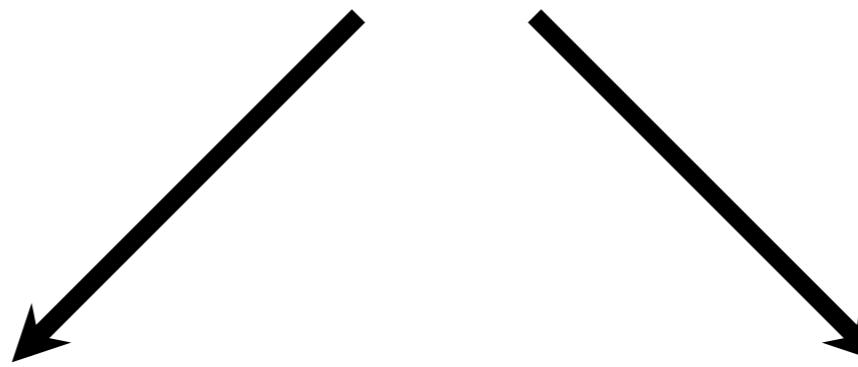
Ecological biogeography

Historical biogeography



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Biogeography:
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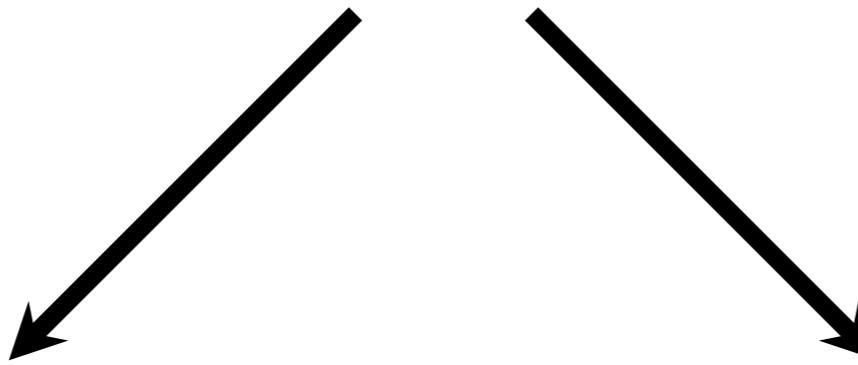
Ecological biogeography

- Focus: Environmental controls on distribution
- Ecological interactions
- Timescale: the Recent

Historical biogeography

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Biogeography:
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Ecological biogeography

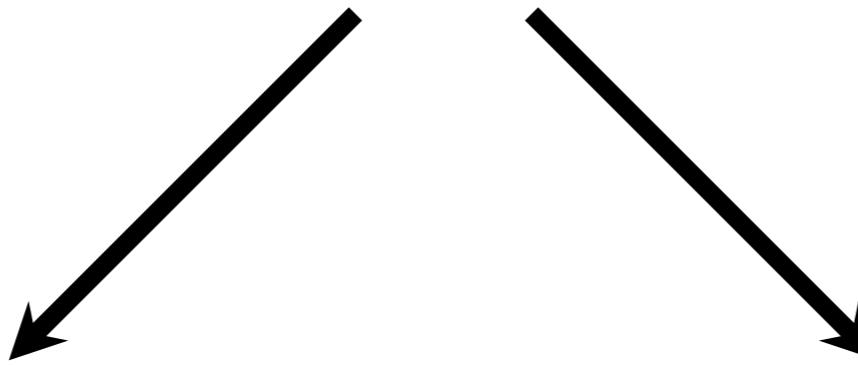
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Historical biogeography

- Focus: Evolutionary history of distributions
- Dispersal/vicariance events
- Timescale: Millions of years

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Ecological biogeography

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- **2000s: PHYLOGENIES**

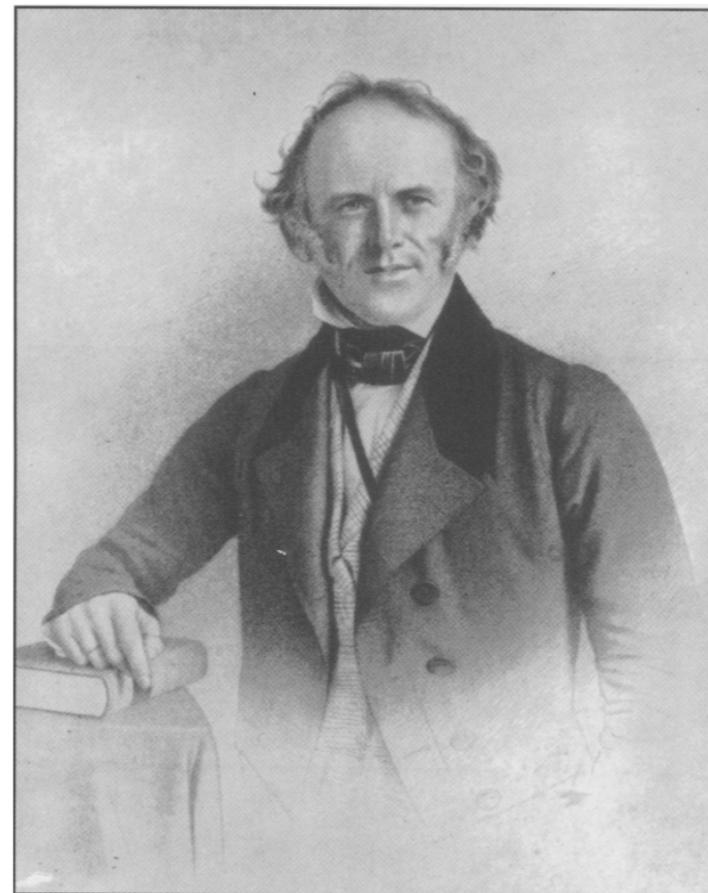
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Biogeography:
The geography of life

What is historical biogeography good for?

Charles Lyell:

“The present is
the key to the
past.”



Lithograph of Charles Lyell made in Philadelphia by J. E. Mayall during Lyell's visit to America in the 1840s.

Flip it around:

“The past is the
key to the
present.”

www.nickmatzke.net

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HOME ABOUT/CV SCIENCE ED. RESEARCH FOCI RESEARCH (GRAPHICAL) BIOGEOBLOG

Nicholas J. Matzke, Ph.D.

Answering the Big Questions in Biogeography

by integrating ecological and evolutionary biogeography with statistical phylogenetics

(About my banner: Global dispersal of angiosperms)

Overview

Nick Matzke, speaking at Darwin Day at Valparaiso University (see [About](#) page)

Biogeography is the study of where species live, and why. Traditionally, the "why" has been divided into "Ecological Biogeography" and "Historical Biogeography." Ecological Biogeography has focused on environmental and ecological controls on distribution, such as temperature and precipitation. "Historical Biogeography" has focused on how geographic ranges evolve on geological timescales and across phylogenetic trees, primarily dealing with rare dispersal and vicariance events.

I believe that it is high time that these two traditions were re-integrated, not just in verbal models and interpretation, but with formal probabilistic models, using the computational tools of statistical phylogenetics. My work focuses on building these tools, and using them to answer Big Questions in evolution and biogeography. (For an example, [see my banner](#).)

Please click the links above and below to find out [more about me](#), [the work I have done](#), and [the work I am doing](#).

Please check out my website: <http://www.nickmatzke.net>

What are Big Questions in Biogeography?

1. Relative importance of dispersal versus vicariance



Nick at “Darwin’s Forest” (petrified *Araucaria* forest), 2017
Discovered by Darwin in Argentina, 1835

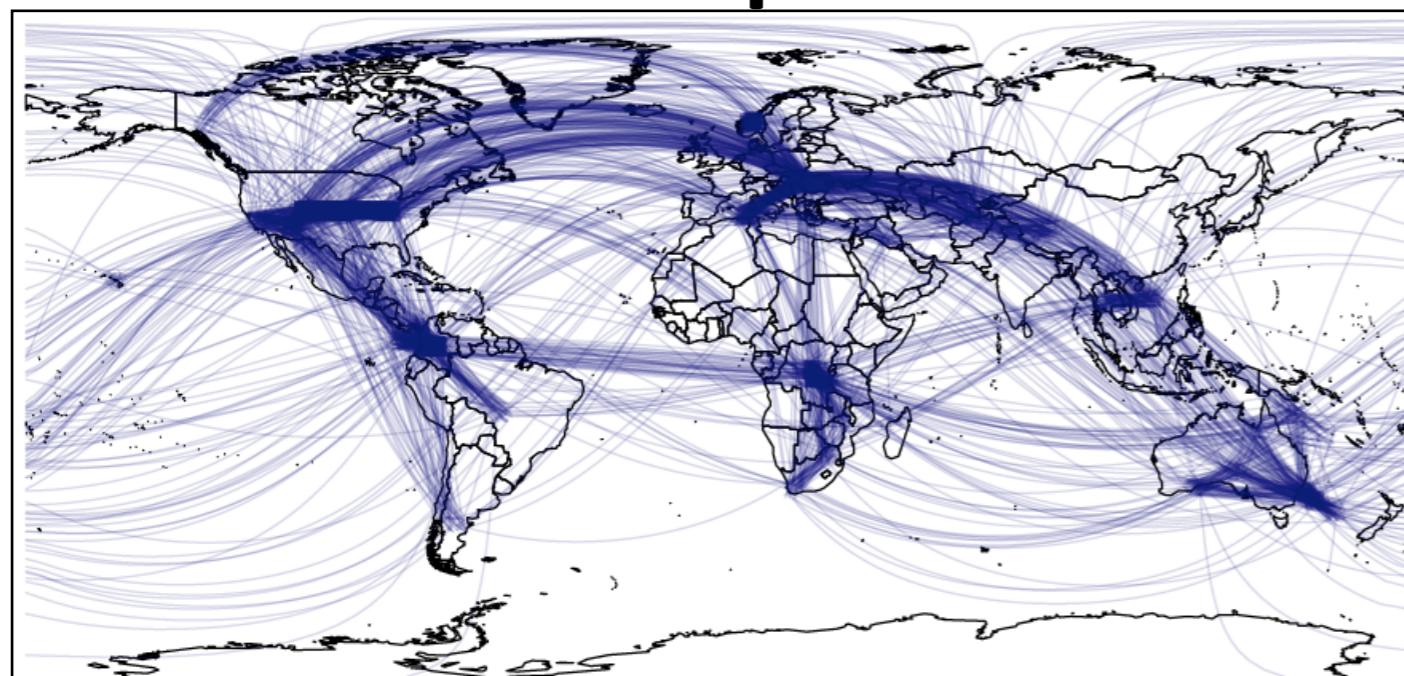
What are Big Questions in Biogeography?

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2. What is the distance-dispersal relationship over Deep Time?



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BioGeoBEARS inference of dispersal events for 14,000 plant species

What are Big Questions in Biogeography?

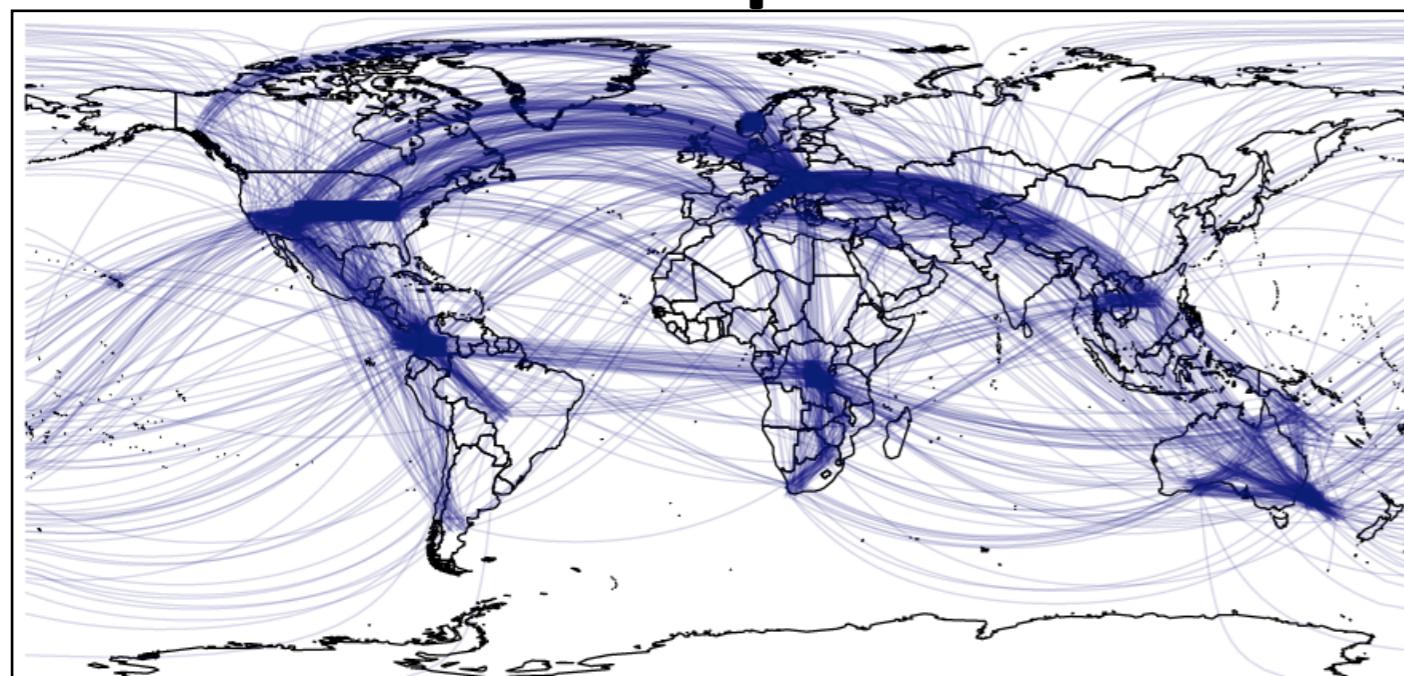
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3. Measuring importance of traits for dispersal



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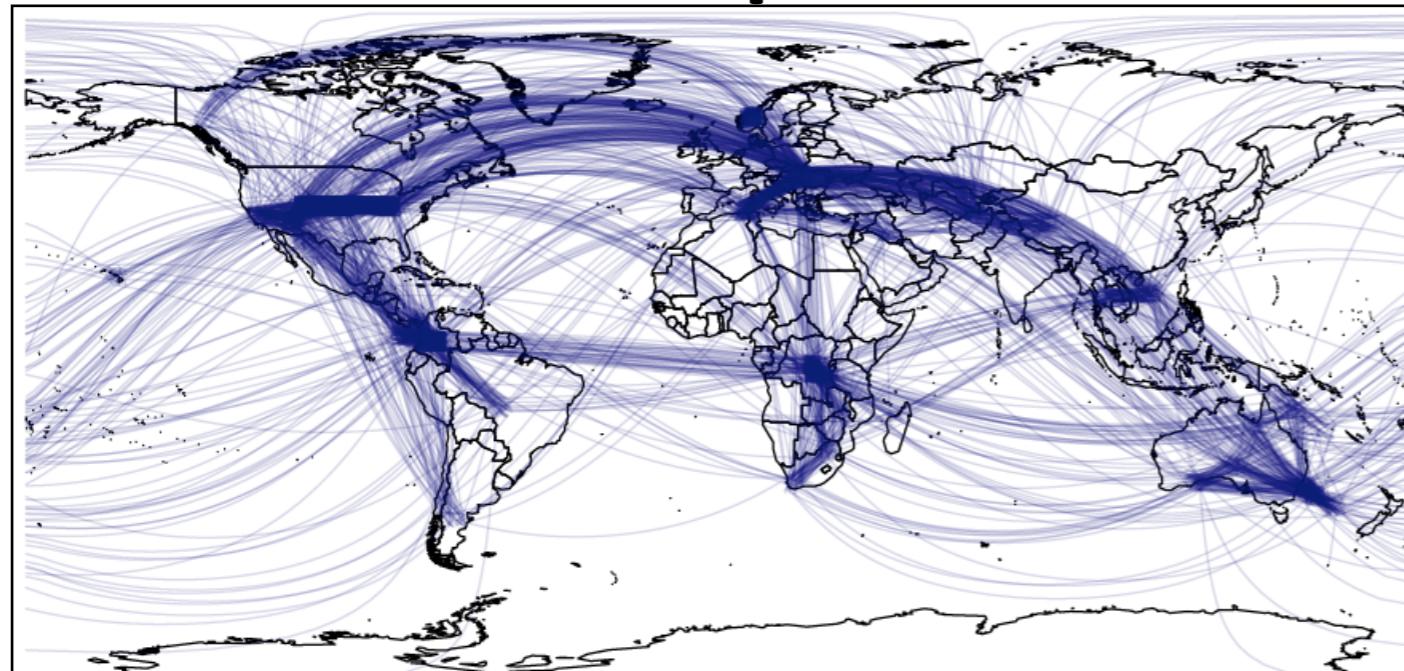
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BioGeoBEARS inference of dispersal events for 14,000 plant species

3. Measuring importance of traits for dispersal
Matzke: WITH MODEL-BASED INFERENCE!

Major themes in (macro-scale) biogeography

Why do species live where they do?

- adapted vs. history
- dispersal vs. constraint/dispersal limitations

Pattern vs. process

- What (if anything) do patterns tell us about process?
- Equilibrium vs. non-equilibrium conditions

Distribution of diversity

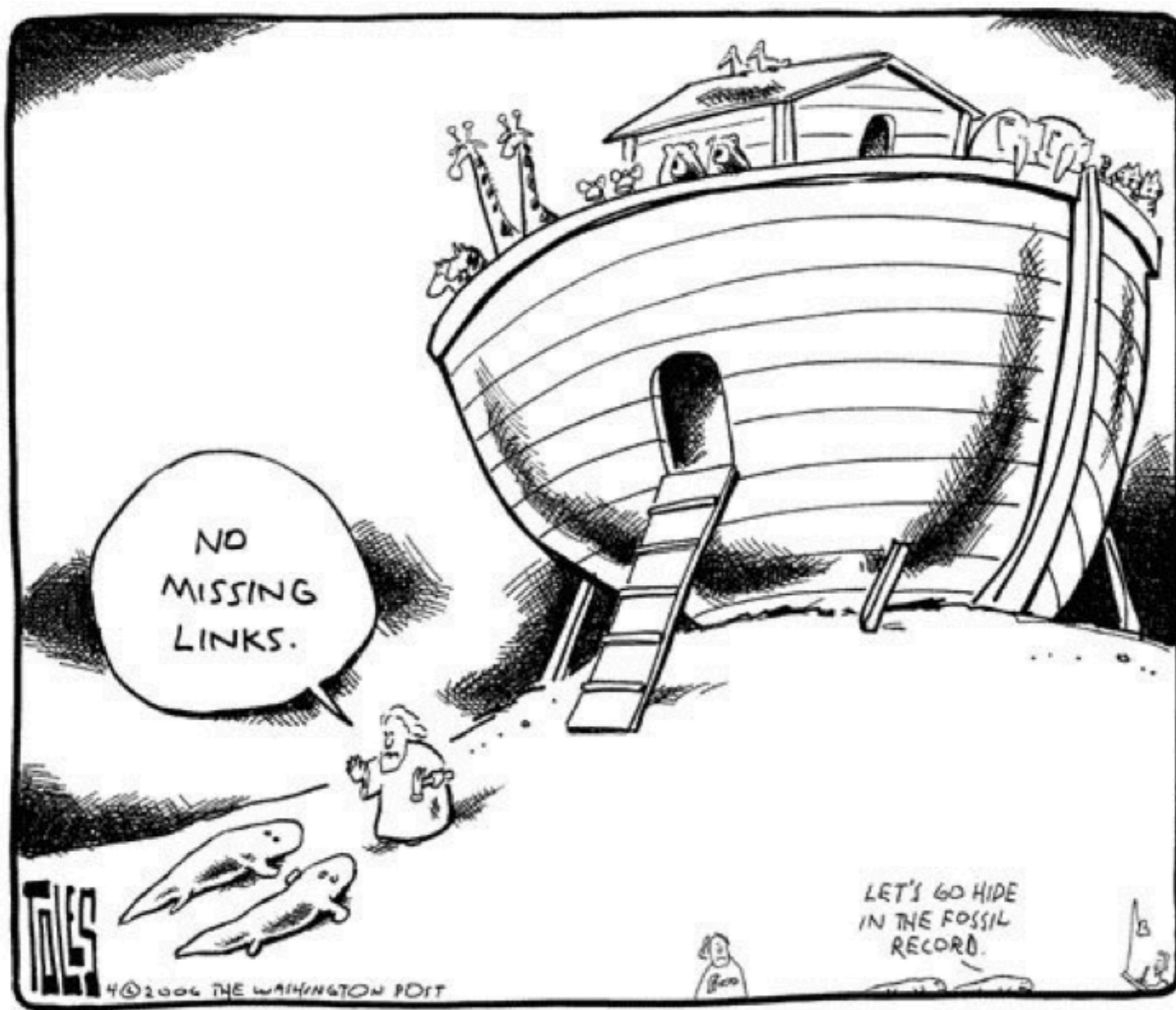
- Why is there a latitudinal diversity gradient?
- speciation/extinction variation in time & space

What is the link between space and time?

- Can we learn about change in time from change in space?

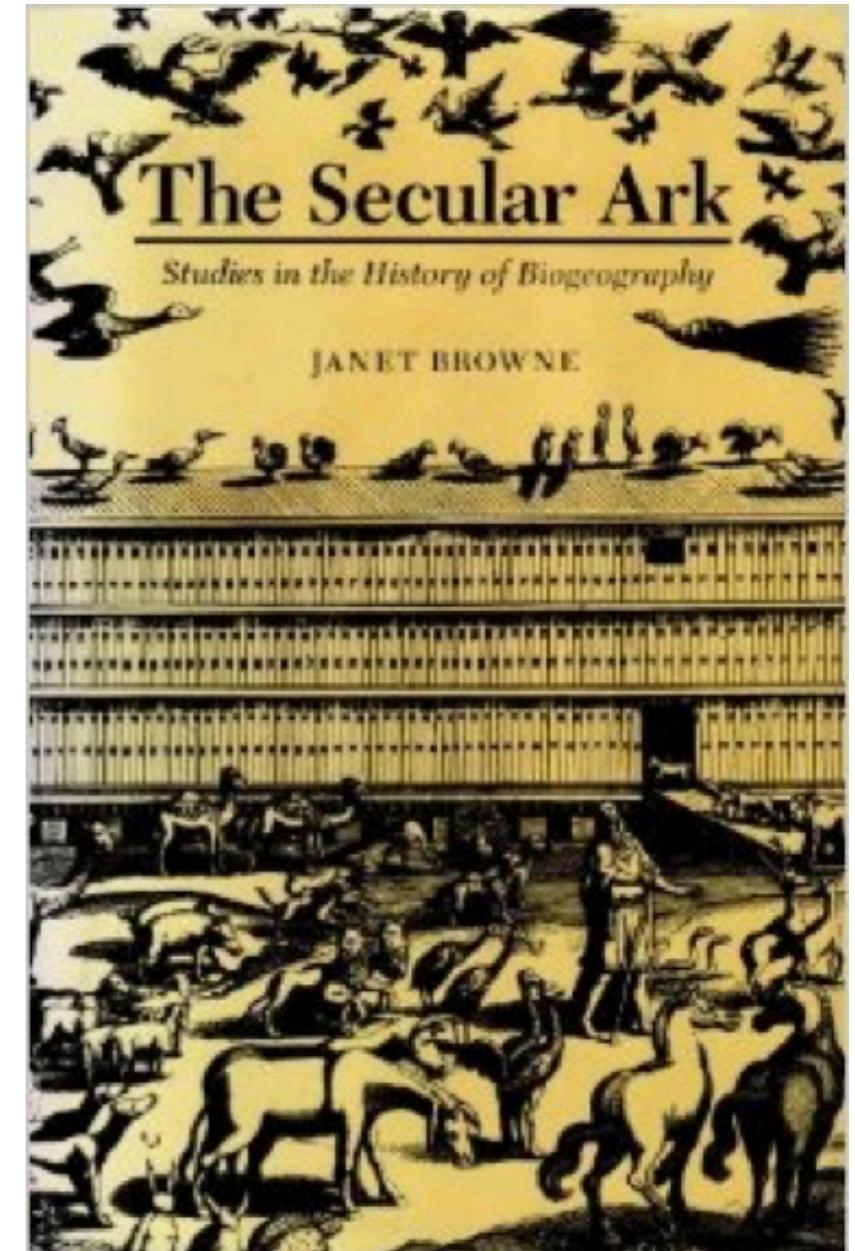
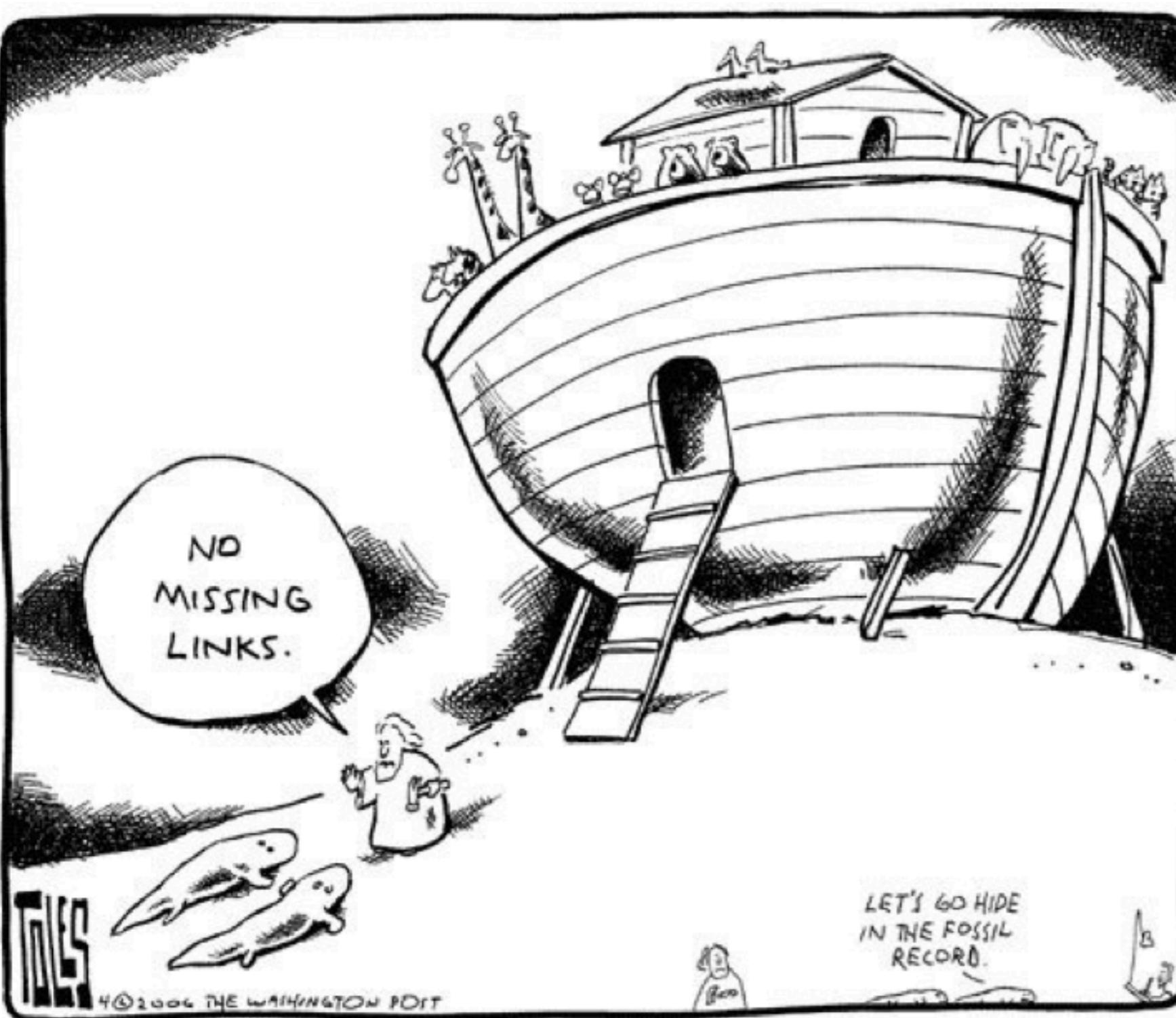
Organisms as active (e.g. dispersalism) vs. passive (vicariance)

In the Beginning...



In the Beginning...

In the Beginning...



Janet Browne (1983).
The Secular Ark: Studies in the History of Biogeography

Available free on JSTOR at:
[http://dx.doi.org/10.2307/
j.ctt1xp3sq3](http://dx.doi.org/10.2307/j.ctt1xp3sq3)

In the Beginning...

It is pretty literally true to say that (Western, academic) speculation about historical biogeography (as with origins generally) began with the book of Genesis in the Bible

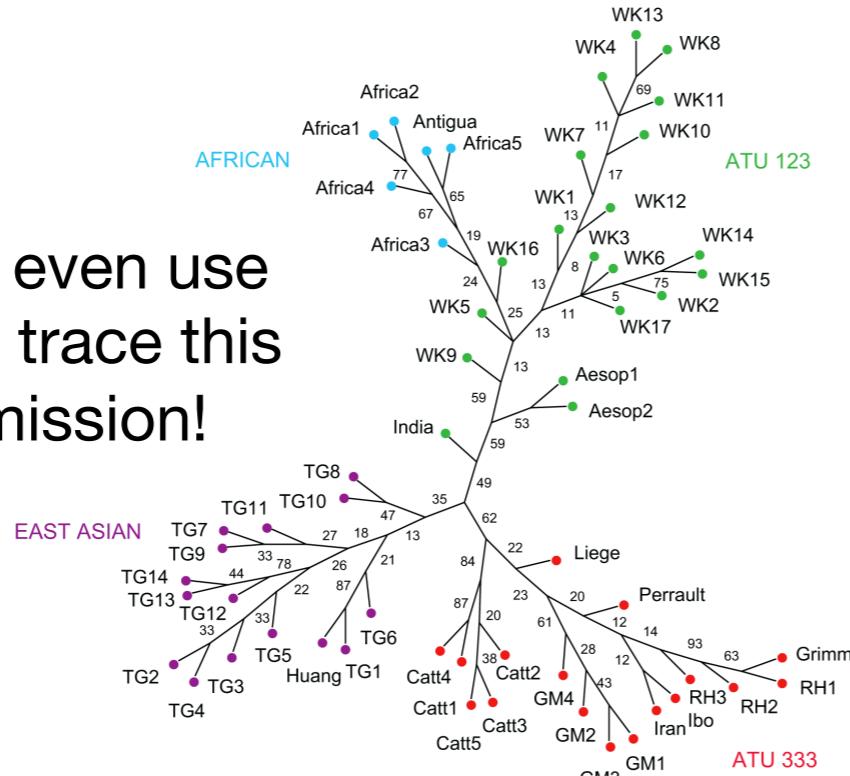
Of course, every culture has origins stories; whether stories like Noah's Flood are even “western” can be debated, as they trace back to the middle east (similar, “homologous” stories are found in the Epic of Gilgamesh, from ancient Mesopotamia). Stories, especially significant ones, circulate across cultures, languages, etc.

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Some scientists even use phylogenetics to trace this cultural transmission!



OPEN ACCESS Freely available online

PLOS ONE

The Phylogeny of Little Red Riding Hood

Jamshid J. Tehrani*

Department of Anthropology and Centre for the Coevolution of Biology and Culture, Durham University, Science Site, South Road, Durham, United Kingdom

Abstract

Researchers have long been fascinated by the strong continuities evident in the oral traditions associated with different cultures. According to the 'historic-geographic' school, it is possible to classify similar tales into "international types" and trace them back to their original archetypes. However, critics argue that folktale traditions are fundamentally fluid, and that most international types are artificial constructs. Here, these issues are addressed using phylogenetic methods that were originally developed to reconstruct evolutionary relationships among biological species, and which have been recently applied to a range of cultural phenomena. The study focuses on one of the most debated international types in the literature: ATU 333, 'Little Red Riding Hood'. A number of variants of ATU 333 have been recorded in European oral traditions, and it has been suggested that the group may include tales from other regions, including Africa and East Asia. However, in many of these cases, it is difficult to differentiate ATU 333 from another widespread international folktale, ATU 123, 'The Wolf and the Kids'. To shed more light on these relationships, data on 58 folktales were analysed using cladistic, Bayesian and phylogenetic network-based methods. The results demonstrate that, contrary to the claims made by critics of the historic-geographic approach, it is possible to identify ATU 333 and ATU 123 as distinct international types. They further suggest that most of the African tales can be classified as variants of ATU 123, while the East Asian tales probably evolved by blending together elements of both ATU 333 and ATU 123. These findings demonstrate that phylogenetic methods provide a powerful set of tools for testing hypotheses about cross-cultural relationships among folktales, and point towards exciting new directions for research into the transmission and evolution of oral narratives.

In the Beginning...

Even in science, where we are devoted to developing well-tested, natural explanations of phenomena, it is worthwhile to delve deep into the historical origins of our fields, because

1. We can learn why certain major questions are framed the way they are
2. Terminology sometimes makes more sense when we understand its origins
3. Sometimes we discover that common assumptions in the field are unjustified / are disguising cultural/historical biases
4. Most important: “history is a different place...we don’t live there” – it is one way to see different ways of thinking, and of checking if our current scientific view is actually well-justified.

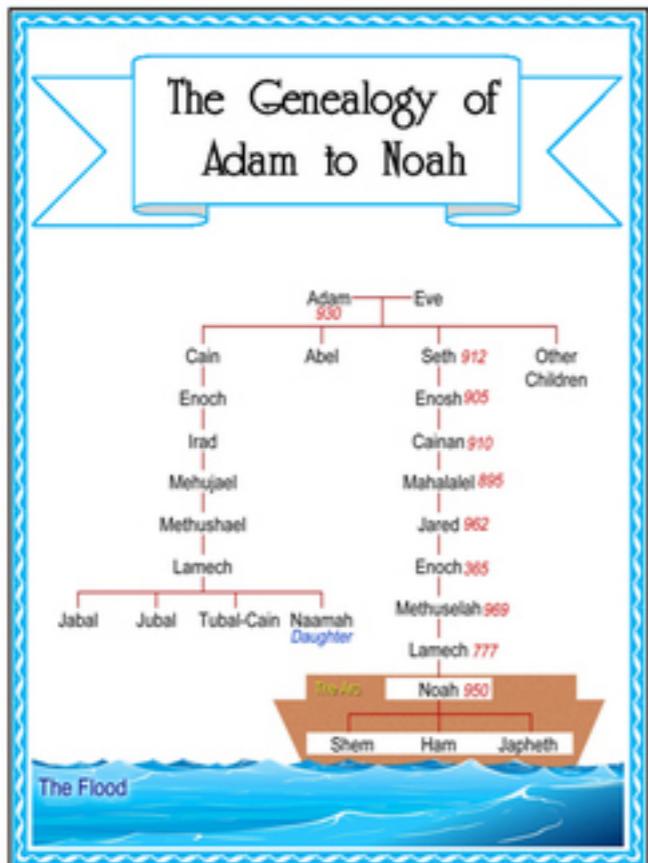
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Noah's Flood story...

Part of a longer set of accounts similar between the book of Genesis and other ancient middle-eastern stories:



<https://www.teacherspayteachers.com/Product/Notebooking-Genesis-4-5-Genealogy-of-Adam-to-Noah-2636741>

Atrahasis	Genesis 2–8
Agriculture by irrigation	Eden watered by irrigation
Igigi gods are original laborers	Yahweh is original laborer (plants garden)
Annunaki gods enjoy privileges of divine rank	Yahweh has a private garden with magic trees of life and wisdom
Primeval humans (<i>Lullû</i>) created as laborers for gods <ul style="list-style-type: none">modeled from clay + rebel god's bloodimplicitly immortal (no natural death)	Primeval human (<i>ha-'ādām</i>) created to care for Yahweh's garden <ul style="list-style-type: none">modeled from clay + divine breathpotentially immortal (tree of life)
Institution of marriage	Institution of marriage
<i>Lullû</i> (proto-humans) rebel against the divine sovereign	<i>Ha-'ādām</i> rebels against Yahweh
<i>Lullû</i> punished: life diminished by plague, drought, and famine	<i>Ha-'ādām</i> punished: life diminished by exile from garden, denial of access to tree of life, and hard labor
The god Enlil sends a flood to drown out humanity's noise and control over-population	Yahweh sends a flood to punish humanity's wickedness and cleanse the creation
The god Enki tells Atrahasis to build an ark and so escape the flood	Yahweh tells Noah to build an ark and so escape the flood
Atrahasis survives the flood and offers a sacrifice	Noah survives the flood and offers a sacrifice
The gods smell the sacrifice and bless the survivors	Yahweh smells the sacrifice and blesses creation
Enlil is reconciled to noisome humanity	Yahweh is reconciled to sinful humanity
Limitations imposed on humans: <i>Lullû</i> become normal humans	Limitation of 120-year lifespan imposed on humans: <i>ha-'ādām</i> become normal humans
Sign of divine goodwill: Nintu's fly necklace	Sign of divine goodwill: duration of seasons (and Yahweh's bow [9:12–17])

The “Generations of Adam” (from Adam to Noah)

Sethite line	Cainite line	North Arabian (Chayne) ^[3]	Sumerian kings ^[5]
1. Adam	1. Adam	1. Jerahmeel	1. Alulim of Eridu
2. Seth	8. [Seth]	2. Eshtaol	2. Alalgar of Eridu
3. Enosh	9. [Enoch]	3. Ishmael	3. Enmenluanna of Bad-tibira
4. Kenan	2. Cain	4. Kain	4. Enmengalanna of Bad-tibira
5. Mahalalel	5. Mehujael	5. Hanoch	5. Dumuzid the Shepherd of Bad-tibira
6. Jared	4. Irad	6. Arvad	6. Ensipazianna of Larak
7. Enoch	3. Enoch	7. Jerahmeel	7. Enmeduranna of Sippar
8. Methuselah	6. Methusael	8. Ishmael	8. Urbatu of Shuruppak
9. Lamech	7. Lamech	9. Jerahmeel	9. [Illegible]
10. Noah	10. Naamah	10. Nahman	10. Ziusudra

https://en.wikipedia.org/wiki/Generations_of_Adam

Daniel C. Harlow (2010). After Adam: reading Genesis in an age of evolutionary science. *Perspectives on Science and Christian Faith*, 62(3). <https://link.gale.com/apps/doc/A234714307/AONE?u=learn&sid=AONE&xid=ac0fc0fb>

Noah's Flood story...

One version of the story: God tells Noah to build the boat, as he is going to destroy the world because of man's wickedness

COMPARISON OF GENESIS AND GILGAMESH		
	GENESIS	GILGAMESH
Extent of flood	Global	Global
Cause	Man's wickedness	Man's sins
Intended for whom?	All mankind	One city & all mankind
Sender	Yahweh	Assembly of "gods"
Name of hero	Noah	Utnapishtim
Hero's character	Righteous	Righteous
Means of announcement	Direct from God	In a dream
Ordered to build boat?	Yes	Yes
Did hero complain?	Yes	Yes
Size of boat	3 stories, 120 cubits long	6 stories, 120 cubits long
Compartments inside?	Many	Many
Doors	One	One
Windows	At least one	At least one
Outside coating	Pitch	Pitch
Shape of boat	Rectangular	Square
Various waiting periods	7 days, 40 days, 150 days	7 days
Human passengers	Family members only	Family & few others
Other passengers	All species of animals, 2 or 7	All species of animals, 7
Means of flood	Ground water & heavy rain	Heavy rain
Duration of flood	Long (40 days & nights plus)	Short (6 days & nights)
Test to find land	Release of birds	Release of birds
Types of birds	Raven & three doves	Dove, swallow, raven
Ark landing spot	Mountain -- Mt. Ararat	Mountain -- Mt. Nisir (300 miles from Mt Ararat)
Sacrificed after flood?	Yes, by Noah	Yes, by Utnapishtim
Blessed after flood?	Yes (new start)	Yes (immortality)



'Noah's Ark', Edward Hicks, 1846

Noah's Flood story...

Then Russell Crowe-Noah and his rock-monster friends fight all the bad guys to keep them off the Ark



<https://time.com/42274/ken-ham-the-unbiblical-noah-is-a-fable-of-a-film/>

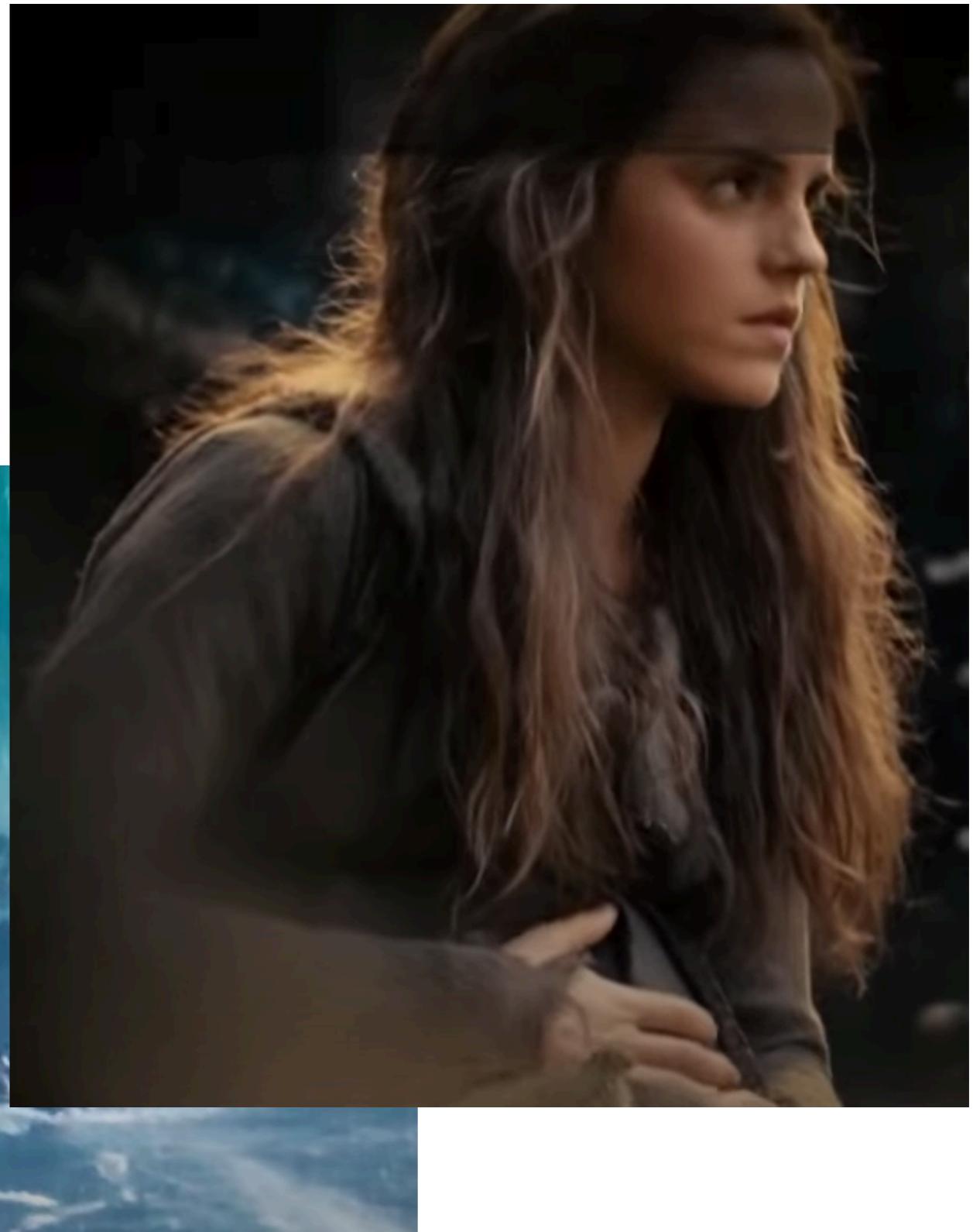
Noah (2014), starring Russell Crowe



Noah (2014) fight scene: <https://www.youtube.com/watch?v=3IMBlyztU2Q>

Noah's Flood story...

Then everyone else drowned, and Emma Watson got pregnant on the Ark...



Noah's Flood story...

After 40 days and 40 nights, the Ark came to rest on Mt. Ararat

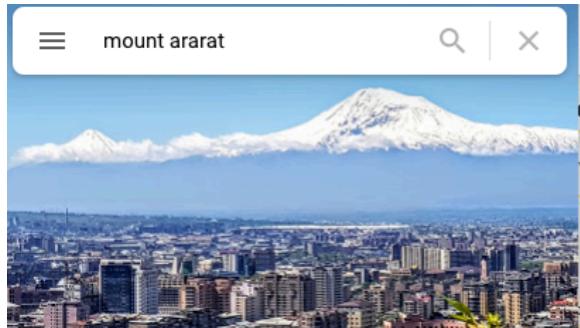


The Animals Leaving the Ark, Mount Ararat, by Filippo Palizzi (1818–1899) <https://artuk.org/discover/artworks/the-animals-leaving-the-ark-mount-ararat-14683>

Noah's Flood story...

After 40 days and 40 nights, the Ark came to rest on Mt. Ararat

mount ararat



Mount Ararat

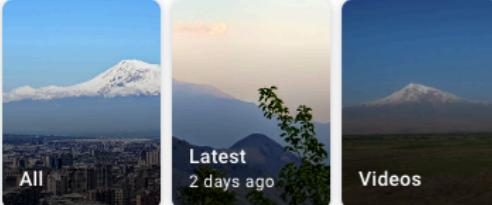
4.5 ★★★★☆ (1,862)
Mountain peak

Directions Save Nearby Send to your phone Share

Boasting 2 volcanic peaks, this snow-capped mountain is the country's largest & considered sacred.

P72X+XJ Karagüney, İğdır Merkez/İğdır, Turkey
Add a label

Photos

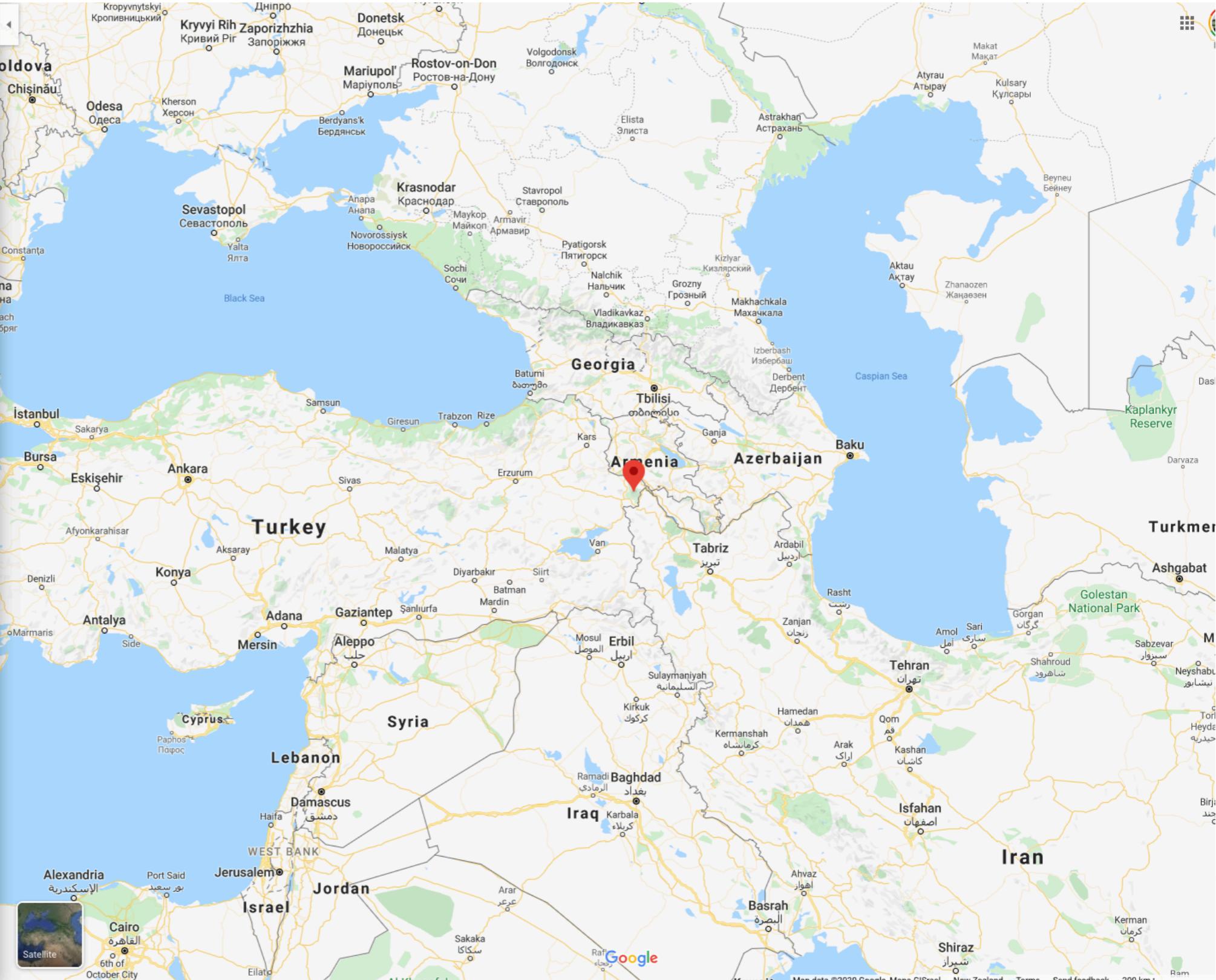


Add a photo

Review summary

5 ★★★★★ 4.5 ★★★★☆
1,862 reviews

Satellite Write a review



The map displays the Caucasus region and parts of the Middle East. Mount Ararat is marked with a red pin in Armenia. Major cities shown include Istanbul, Ankara, Baku, Tbilisi, and Tehran. The Black Sea and Caspian Sea are to the north and east respectively. The map also shows the borders of Armenia, Azerbaijan, Georgia, Turkey, Syria, Iraq, Lebanon, Jordan, Israel, and the West Bank.

Noah's Flood story...

Leading to hundreds of attempts by modern fundamentalists to imagine they've rediscovered the Ark in Eastern Turkey:

Google search results for "discovery of noah's ark".

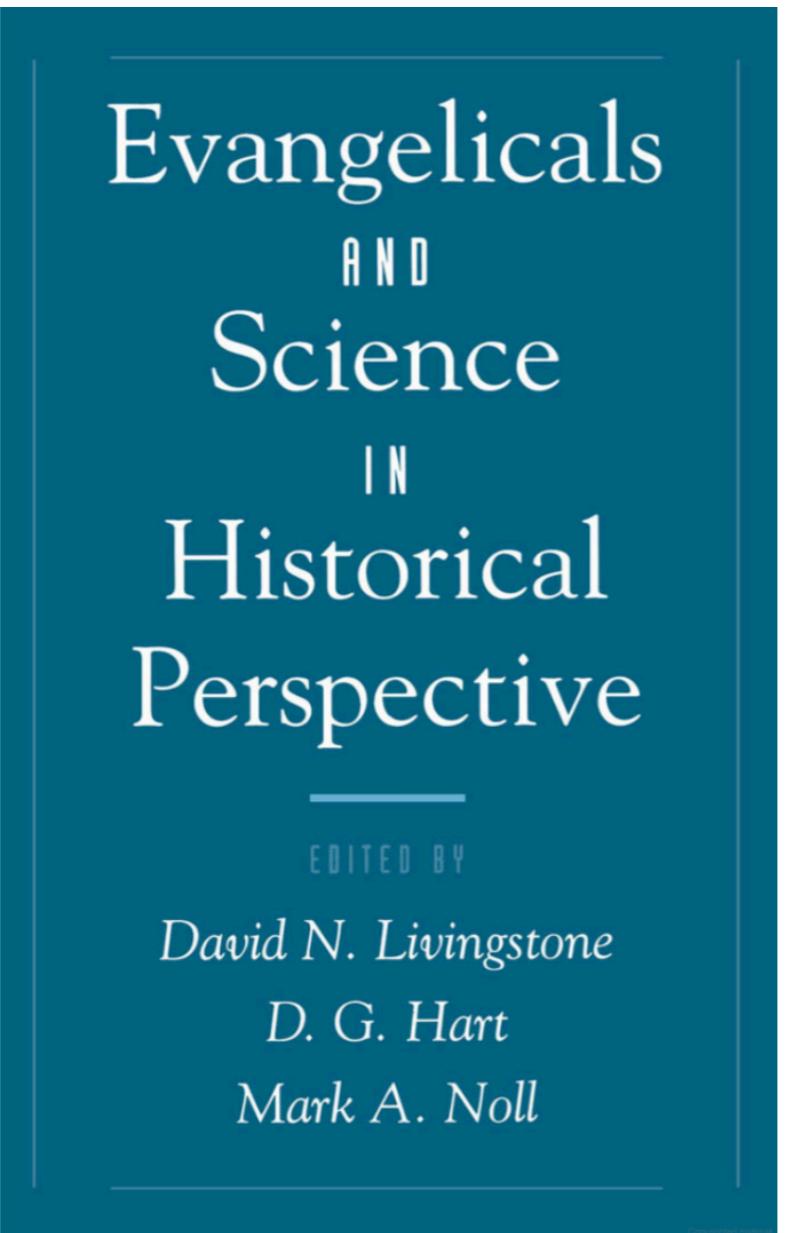
Search filters: All, Images (selected), Videos, News, Shopping, More, Settings, Tools.

Related searches: Collections, SafeSearch.

Image grid:

- Row 1: Noah's Ark Overview (arkdiscovery.com), Shocking Discovery: Noah's Ark Found ... (pinterest.com), Ark discovery ... (fox17.com), NOAH'S ARK HAS BEEN DISCOVERED! (viewzone.com), Noah's Ark Discovery (noahsarkdiscovery.com), Real Noah's Ark 'buried in Turkish ... (thesun.com)
- Row 2: Ark discovery ... (fox17.com), Durupinar site - Wikipedia (en.wikipedia.org), Noah's Ark Has Been Fou... (pinterest.com), ve found Noah's Ark ... (thesun.co.uk), Noah's Ark 'buried in Turkish mountains ... (foxnews.com), Ark Landed on a Mountain 17 Miles South ... (ancient-origins.net), Wyatt Archaeological Research (wyattmuseum.com)
- Row 3: Noah's Ark has been found ... (facebook.com), Real Noah's Ark 'buried in Turkish ... (thesun.com), NOAH'S ARK- The Early Years | Wyatt ... (wyattmuseum.com), Scientists Discover Noah's Ark Remains ... (youtube.com), Researchers believe Mount Ararat... (express.co.uk), Noah's Ark discovered on Mt. Arrarat i... (pinterest.com), Existence Of Noah's Ark Found ... (disclose.tv)
- Row 4: NOAH'S ARK (NOAH'S ARK), Noah's Ark Discovery of the Century (Cem Sertesen:Erkan ...), Ark Have Just Been Discovered ... (Who discovered noah's ark? Ron Wyatt or ...), Related searches (noah's ark found google earth, noah's ark found in ice, real noah ark found turkey), How many people were on Earth at the ...

(More on what motivates the modern fundamentalists' search for Noah's Ark)



Eskridge, Larry (1999). "A Sign for an Unbelieving Age: Evangelicals and the Search for Noah's Ark". In David N. Livingstone (ed.). *Evangelicals and Science in Historical Perspective*. D. G. Hart, Mark A. Noll. Oxford UP.
https://www.google.co.nz/books/edition/Evangelicals_and_Science_in_Historical_P/4K720YRj88C?hl=en&gbpv=0

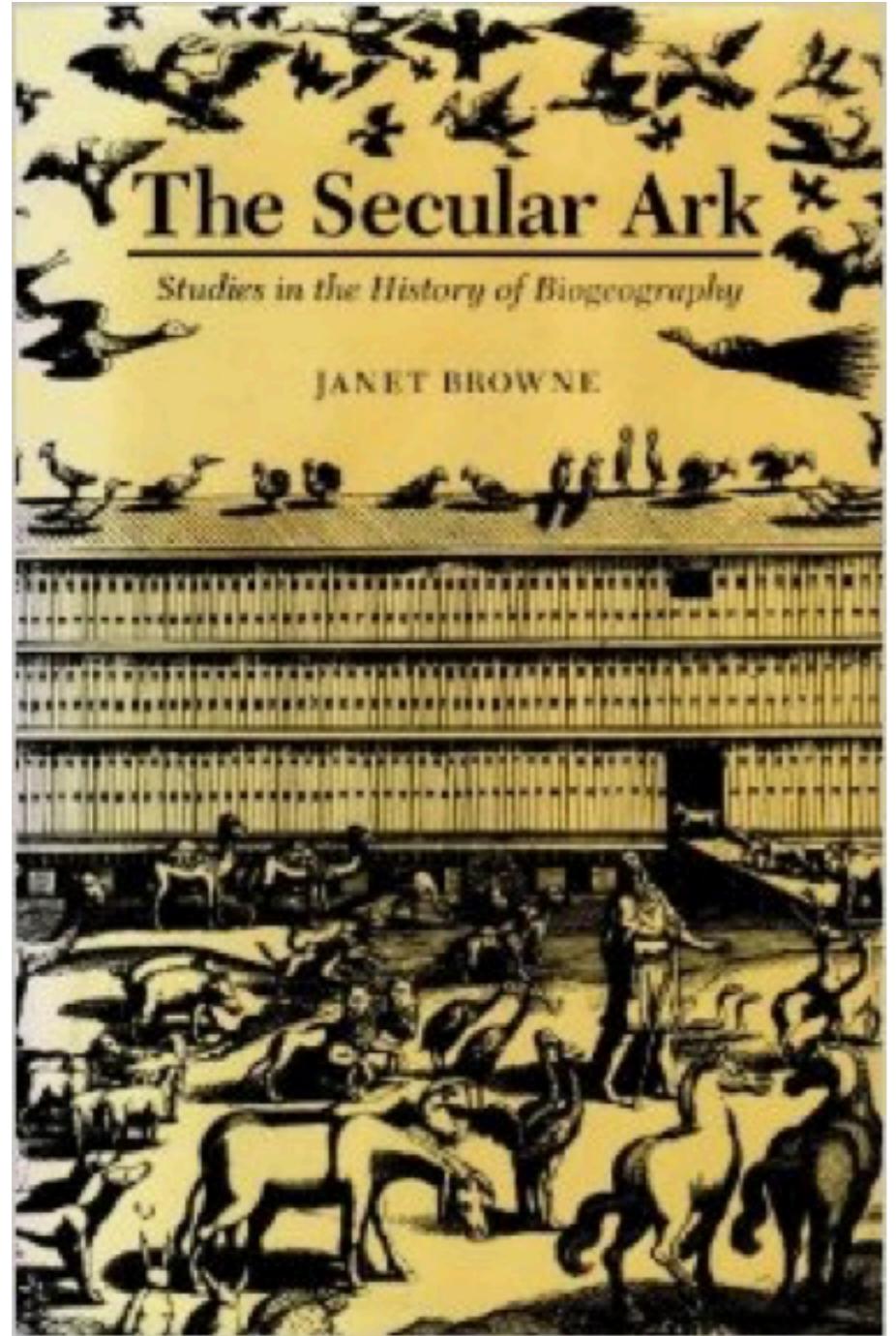
... I'm sure that no one else [on Ararat] has had such a wonderful time of prayer and singing as we did that evening."²

In many ways, John Morris's harrowing adventure speaks volumes about an interesting phenomenon that has arisen within twentieth-century conservative American evangelicalism—the widespread conviction that the ancient Ark of **Noah** is embedded in ice high atop Mount Ararat, waiting to be found. It is a story that has combined earnest faith with the lure of adventure, questionable evidence with startling claims. The hunt for the ark, like evangelicalism itself, is a complex blend of the rational and the supernatural, the modern and the premodern. While it acknowledges a debt to pure faith in a literal reading of the Scriptures and centuries of legend, the conviction that the ark literally lies on Ararat is a recent one, backed by a largely twentieth-century canon of evidence that includes stories of shadowy eyewitnesses, tales of mysterious missing photographs, rumors of atheistic conspiracy, and pieces of questionable "ark wood" from the mountain. Fortified by grassroots creationist networks and the publicity of a string of articles, books, movies, and television specials, the quest for the ark has spawned a network of committed "ärkeologists," thousands of dedicated supporters, and legions of the just plain convinced.

Charting the history and development of American evangelicals' hunt for the ark is in and of itself an interesting exercise. In many ways, it demonstrates the highly rationalist nature of the fundamentalist/evangelical worldview and its inherent tendency to "nail down" the theological and the supernatural in the here and now. It also parallels the story that Ronald Numbers tells so convincingly in his book *The Creationists*, of the spread of flood geology and creationism from Adventist circles to the larger realms of evangelicalism.³ Moreover, it skirts the domain of pop pseudoscience and the paranormal, making the attempt to find the ark the evangelical equivalent of the search for Bigfoot and the Loch Ness Monster. In all these ways, it reveals much about evangelicals' distrust of mainstream science and the motivations and modus operandi of the scientific elite.

Beyond this, however, the attempt to find the ark peculiarly sheds light upon evangelicals' perception of their society and the times in which they live. For the search for the ark is, in a number of ways, as much an exercise in millennialism as in creation science, especially suited to the cosmic drama prevalent in the dispensationalism that pervades many sectors of evangelicalism.⁴ The ark's enthusiastic hunters have continually seen in their quest the possibility of an end-times sign for all humanity. Hearkening back to Christ's Olivet Discourse in Matthew 24: 37–39—"As the days of **Noah** were, so also shall the coming of the Son of Man be"—the ark hunters have envisioned their search as potentially playing a key role in God's prophetic timetable. In their view, the uncovering of Noah's Ark would provide one last chance for the world to reject the presumptions of the modernist antichrist and his scientific prophets and embrace the truth of Christ and the Bible before God unleashes his final judgment upon mankind. The search for Noah's Ark then is part apologetics, part mystery, and part adventure with a purpose—all of which promise the ultimate end run around Darwinism and the structures of modern unbelief.

Back to biogeography



Janet Browne (1983).
The Secular Ark: Studies in the History of Biogeography

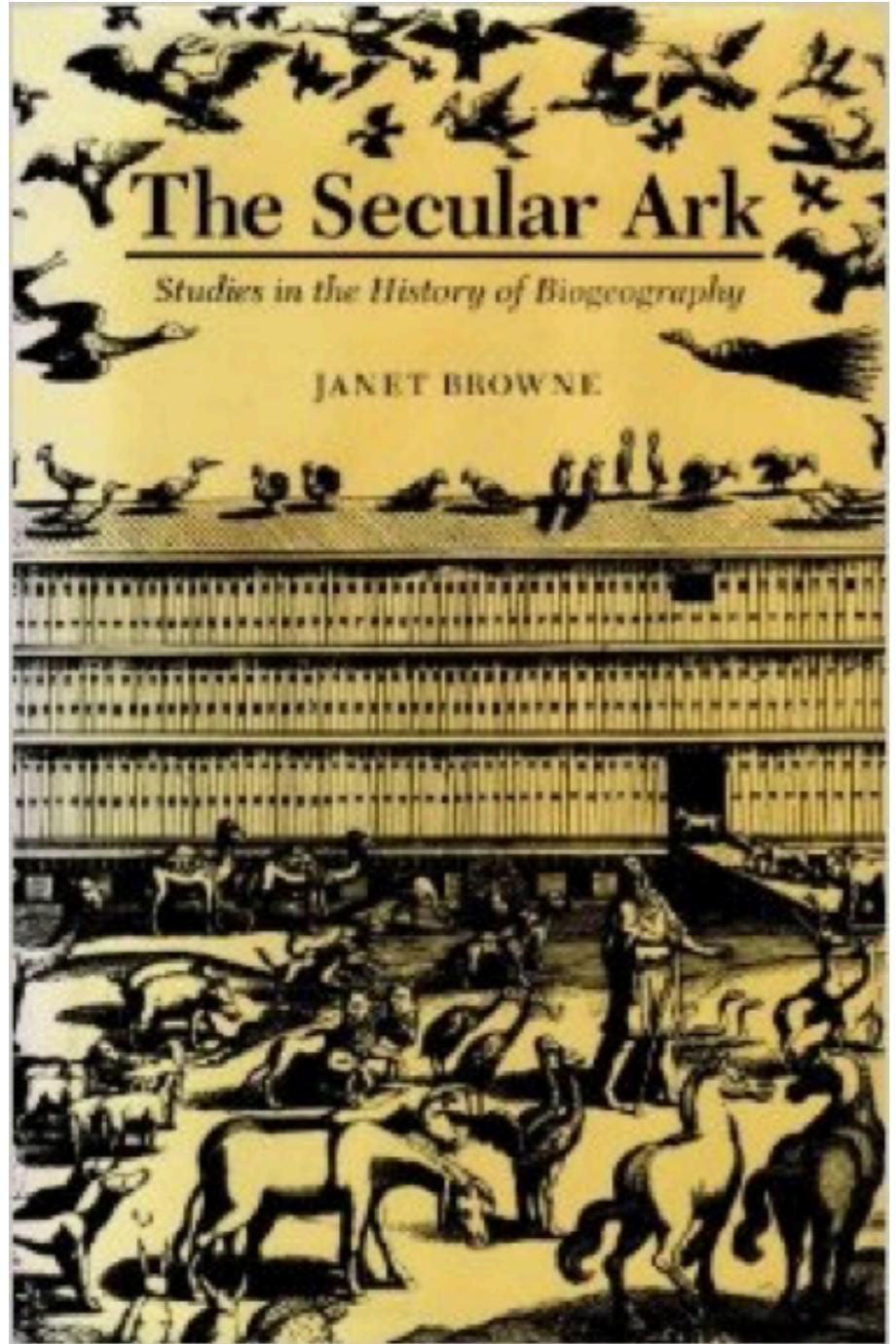
For most scientists of the 1880s there was no question of a literal interpretation of the Noachian Deluge. Charles Darwin, for one, had treated the idea of an Ark with derision, telling his friend the geologist, Charles Lyell, that the giant mastodon must have perished in the waters because it could not squeeze through the door. Alfred Russel Wallace, Joseph Hooker, Louis Agassiz, and Edward Forbes had all agreed on the implausibility of Genesis as a true account of the world's early history. Indeed, they assumed that the legend of Noah and his Ark had materially impeded the development of more acceptable ideas about the animal kingdom and believed that it was not until the discrediting of the Ark toward the middle of the eighteenth century that modern zoology began to flourish.

1

2 DESCENT FROM ARARAT

But these self-consciously "modern" naturalists were forgetting—or, more likely, were completely unacquainted with—the critical role played by Noah's Ark in the development of ideas about the geographical distribution of animals and plants. The idea of an Ark in which pairs of animals were preserved during the Deluge had been a concept of far-reaching significance, as had the disembarkation on Mount Ararat and the subsequent dispersal of animals over the unoccupied globe. The biblical story, in fact, had done a great deal to stimulate investigations into the natural world and, among other things, provided the first systematic explanation for the phenomena of biogeography. Far from being the intellectual impediment ridiculed by Darwin and his circle, the theological certainty that Gordon anxiously searched for, the idea of an Ark focussed scholarly attention on the topographic arrangements of species, as well as encouraging naturalists to build up a repertoire of theoretical commitments and practical expertise in the analysis of organic distribution. The Ark actually promoted, rather than hindered, the growth of this particular branch of the natural historical sciences.

Back to biogeography



Janet Browne (1983).
The Secular Ark: Studies in the History of Biogeography

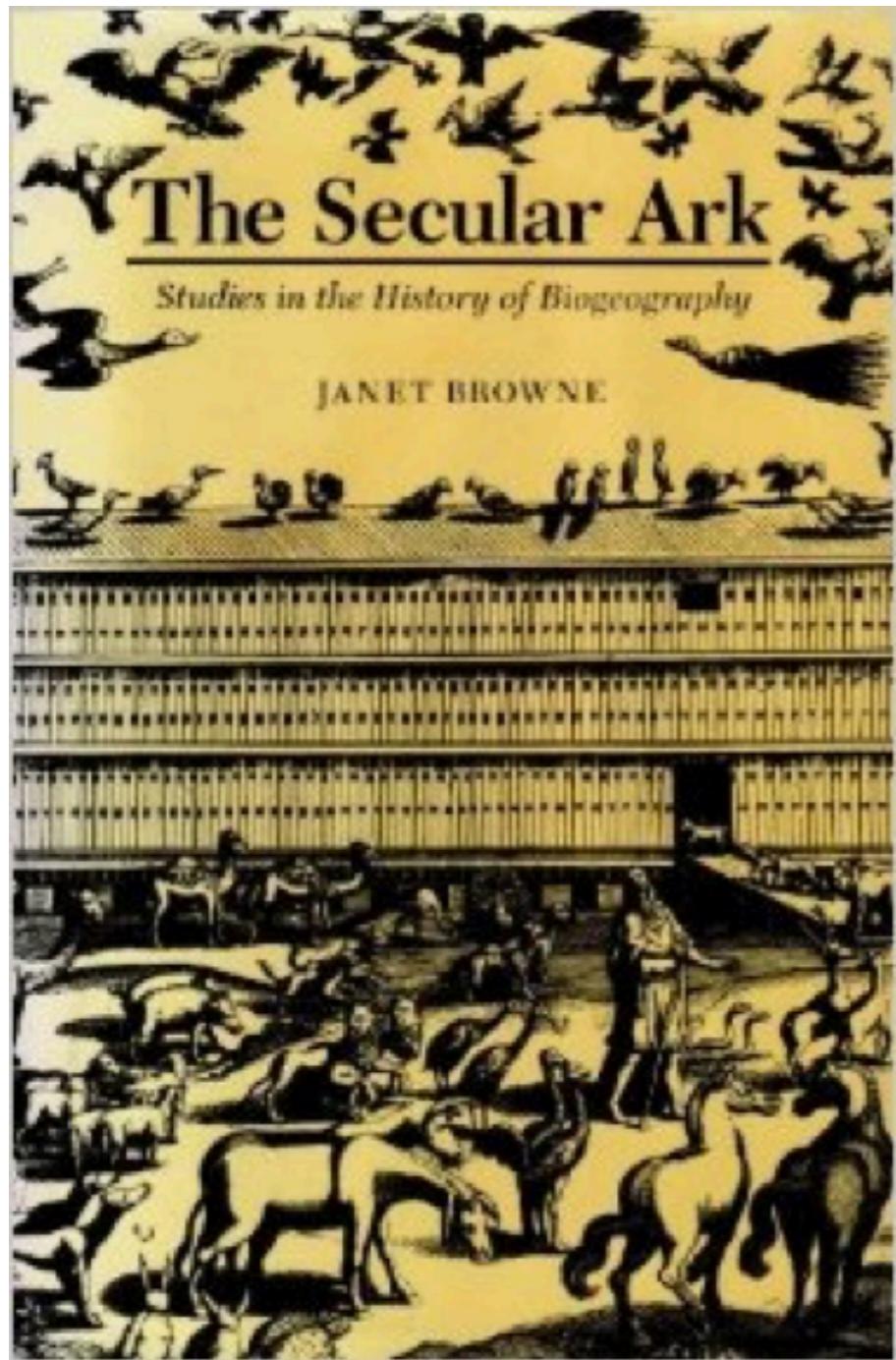
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Early modern science + Bible = literalism



Janet Browne (1983).

The Secular Ark: Studies in the History of Biogeography

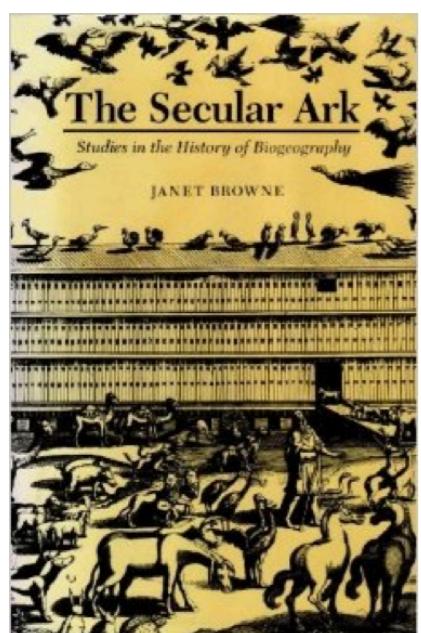
Indeed, it was only with the Renaissance and the subsequent change in attitudes toward Genesis that Noah's Ark took on an influential new role in European philosophy. Gradually, over the sixteenth century, the Scriptures lost much of their metaphorical and allegorical meaning and came to be understood by many as a literal tract, a real account of the origins of the natural world. The Bible, it was argued, was grounded in fact rather than imagery. With such an emphasis on literalism, the story of Noah—indeed all the patristic writings—acquired a new importance; and to explain and justify the Mosaic account of creation and the Deluge became an act of the highest theological significance. In one sense, a literal interpretation of the Bible would help theologians reaffirm the power and glory of God; in another sense, a successful account would dramatically confirm the Christian church's authoritative position in contemporary society. Late-sixteenth-century churchmen (who were not unaware of these possibilities, of course) therefore encouraged one another to take up the new hermeneutics—to consider biblical texts as if they described real events.

But once you start to take things literally, questions arise...

How to fit everything on the ark?

Like other Scriptural scholars, Kircher first sought to answer the old question about the size and shape of the Ark. Was it big enough to accommodate all the animals? Kircher minutely scrutinised the dimensions given in Genesis. Unlike other biblical commentators, he concluded that Noah must have used the common cubit (one and one-half feet) for his calculations, not the larger geometrical unit. If Noah allowed for adequate aisles and passageways, using the common cubit, then three hundred animal stalls could be built on the lower deck, each big enough to house an elephant. The second floor provided a great storage hold, containing food enough for a vast city, and the top deck, according to Kircher, must have held at least two hundred bird cages and the accommodation for the human passengers (illustration 1).

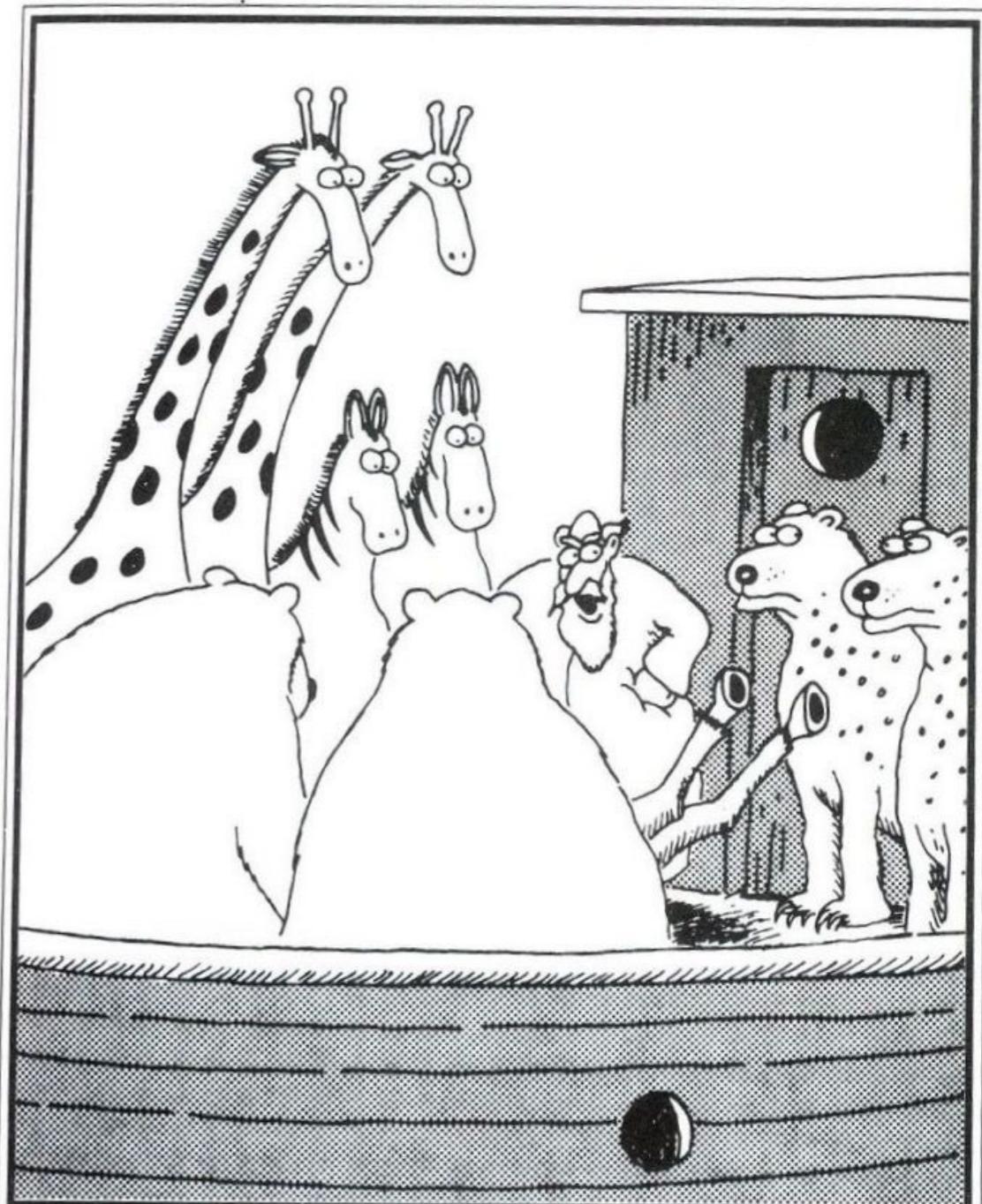
Since Kircher listed no more than 130 species of animals, 30 pairs of snakes, and 150 different kinds of birds, there was obviously no overcrowding. Nor did Noah need to take fish on the Ark, or those reptiles and insects that spawned from putrefaction. Indeed it was not even necessary to take hybrid animals, in Kircher's view, or other species that had been subsequently altered by climate or had degenerated from their original created state. With all these exclusions the number of species was small enough for a moderate-sized Ark.³



Janet Browne (1983).

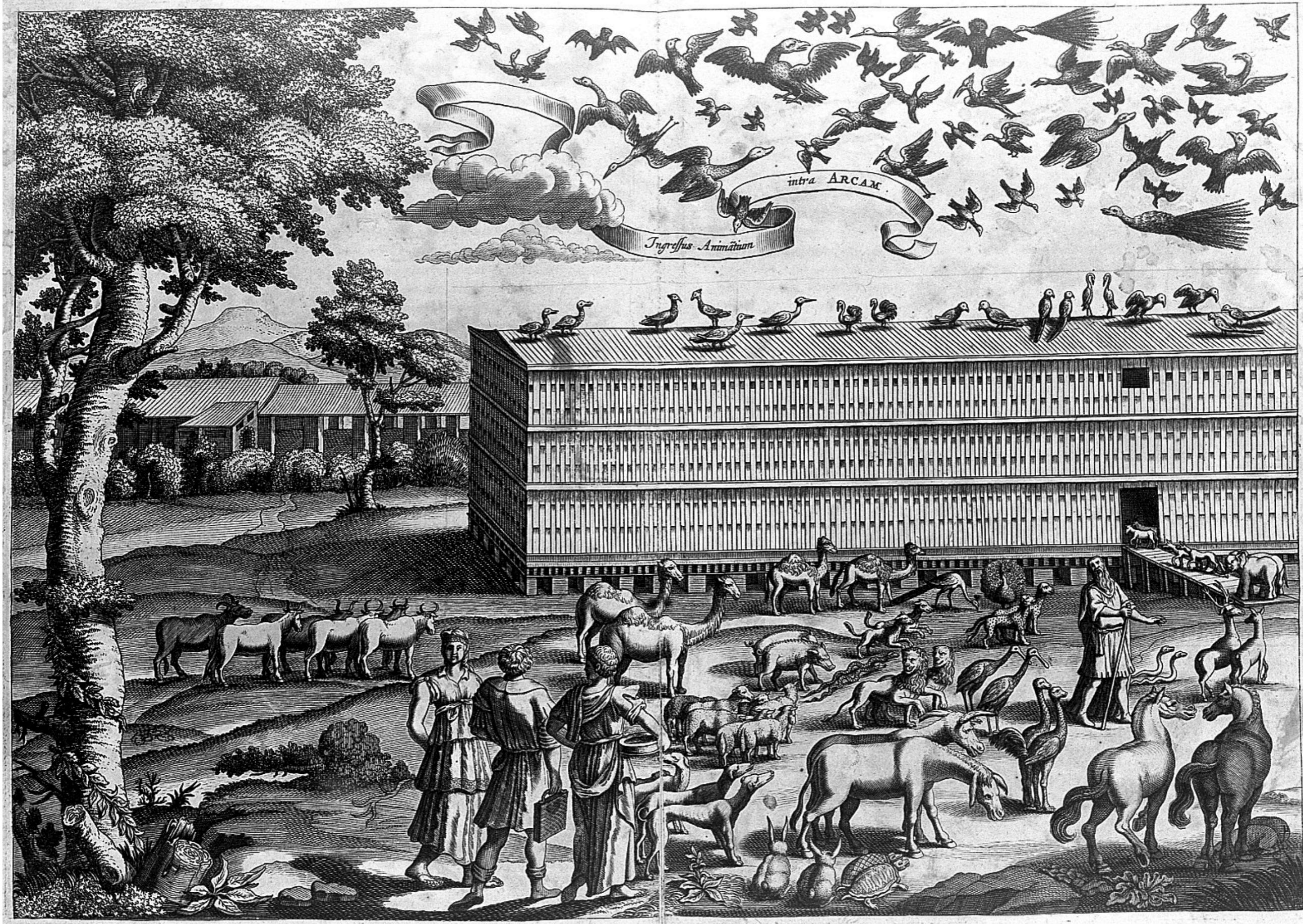
*The Secular Ark: Studies in the History
of Biogeography*

mon cubits one-sixth their size. And since these measurements may have referred to only one deck out of three, they ought to be tripled for the final dimensions of the vessel. Noah's daily life was endlessly examined and the logistics of stabling, feeding, and cleaning the animals were worked out in exhaustive detail. Other questions of a literal nature arose over provisions for the livestock. What did they eat and where was the fodder stored; did Noah bring extra sheep and goats for the carnivores; what of the disposal of dung? Two extra decks were added to the three described in the Bible to accommodate additional food supplies, to make room for gangways and workrooms, and to house all the domesticated beasts not mentioned by Moses. Additional partitions and stables were introduced to keep unclean animals away from the rest and to provide ventilated living quarters for Noah and his family.⁴ Not surprisingly, the proliferation of such ad hoc alterations ultimately transformed the traditional silhouette of the Ark. Where earlier writers had thought of it as pyramidal in shape, Kircher and others believed it to be more like a rectangular house perched on an invisible keel: Kircher's *Arca Noë* of 1675, for example, has something of the appearance of a shoebox or modern hotel. The iconography of this transformation is striking and appears to bear no relation to improvements in contemporary ship design⁵ (illustration 2).



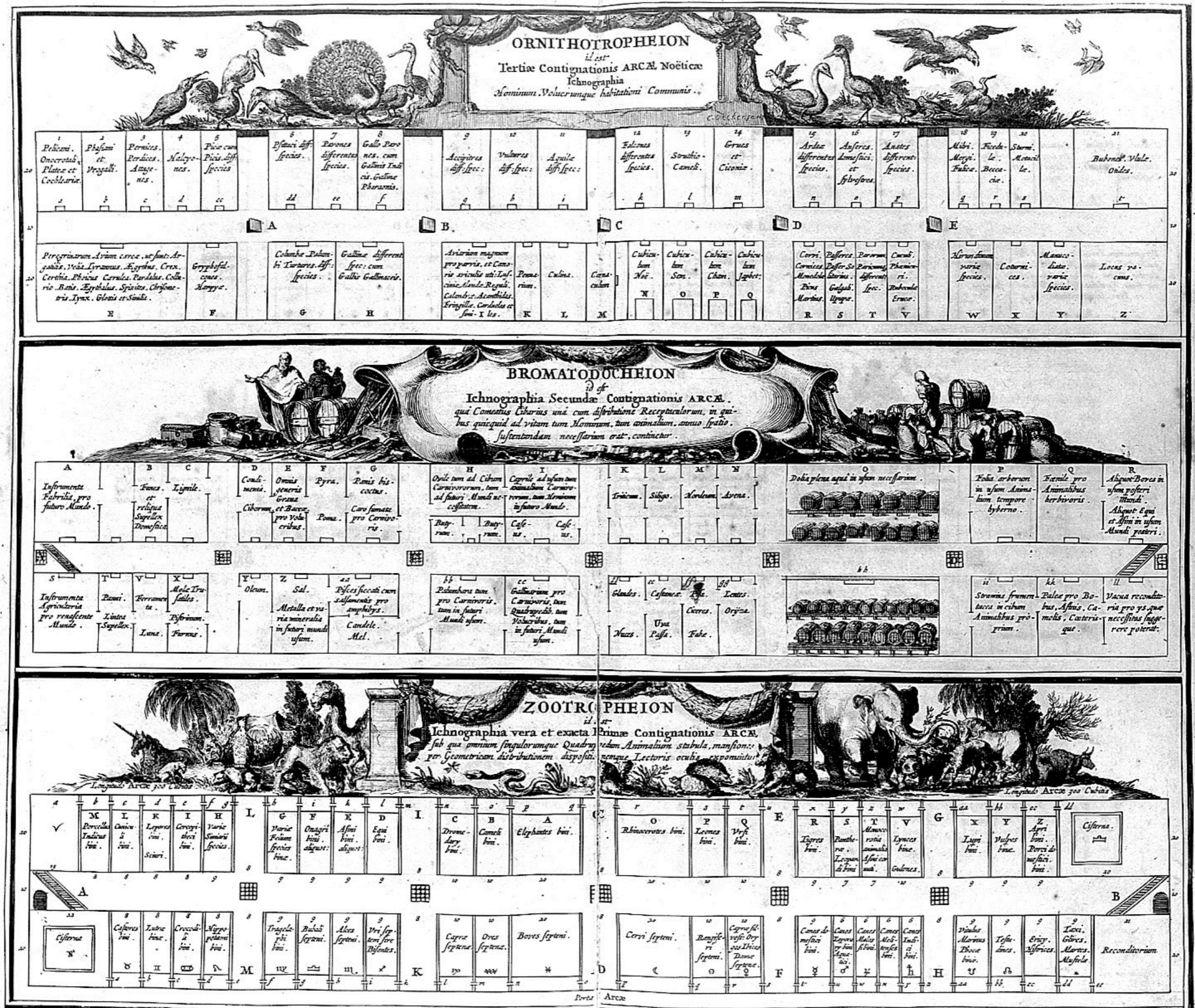
"Well, so much for the unicorns . . . But from now on,
all carnivores will be confined to 'C' deck."

Packing the animals on the ark:



Arca Noe, entry of animals, by A. Kircher (1675). <http://catalogue.wellcomelibrary.org/record=b1310145>

Packing the animals on the ark:

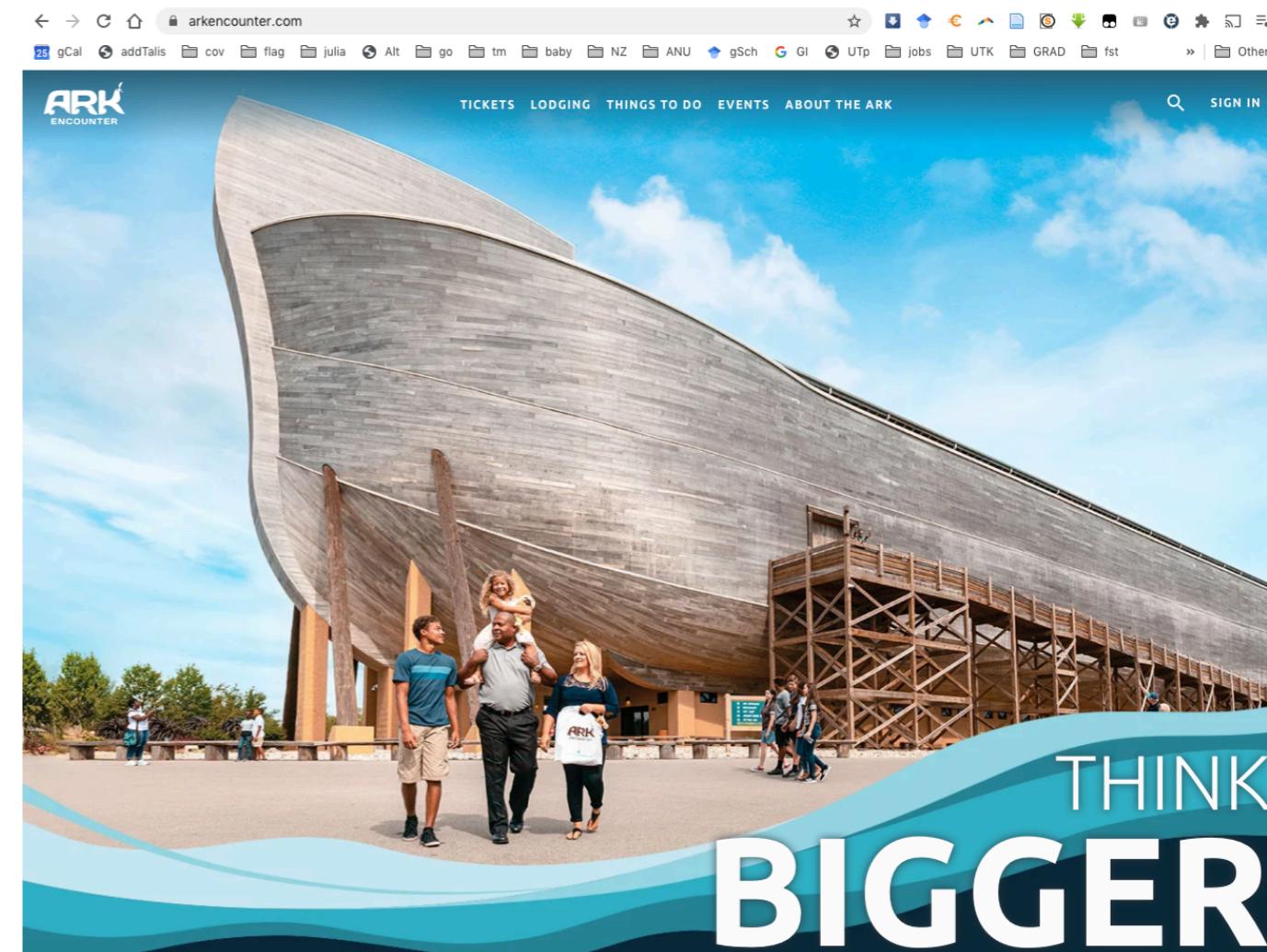


OK fine. But what if you discover more animals?

Browne 1983:

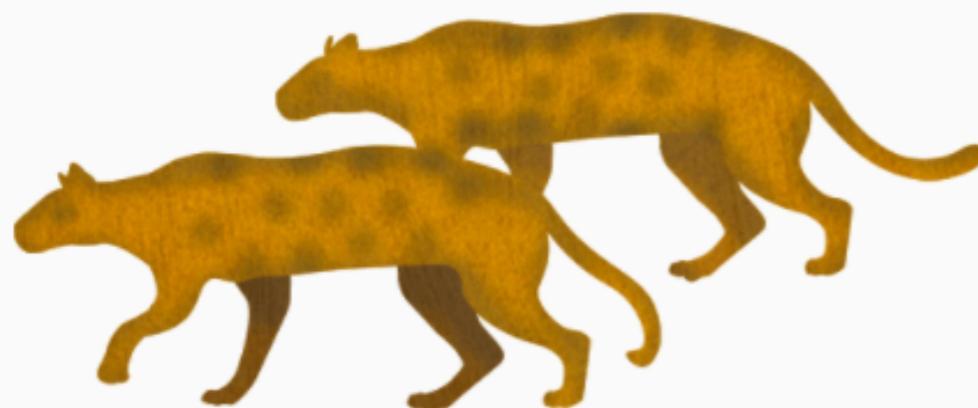
Kircher and his generation seemingly had good reason to worry about the actual size of the Ark. For just at this point—just when belief in the literal truth of the Bible was at its highest—foreign travellers began to bring back to Europe an unprecedented wealth of unusual creatures from other parts of the world. To the enormous mid-century catalogues of Ulysses Aldrovandus, Johannes Jonston, and Edward Topsell were added many, more comprehensive lists of regional faunas. Strange species like the kangaroo, anteater, sloth, and dodo were sighted in distant countries and reported to European naturalists.⁶ Indeed, by the end of the seventeenth century Britain's premier systematist and natural philosopher, John Ray, knew of over 500 species of birds, 150 quadrupeds, and approximately 10,000 invertebrates of one kind or another. Plainly, there was an abundance of previously unknown forms of life and, unless alternative suggestions could be made, all these had to be enrolled on the Ark's list of passengers. Equally plainly, the Ark was not infinite in size. Literal interpretations of the Bible therefore introduced a dilemma of a magnitude unheard of in previous centuries: all animals had to get into the Ark, yet there were far too many species for this to be remotely possible.

Let's look at a 2020 estimate from Answers in Genesis:

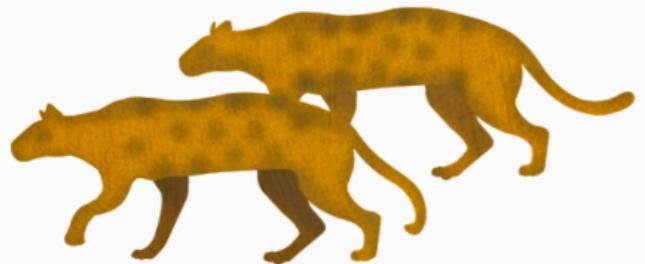


Two of Every Species?

Was every species on the Ark? No. Species is a term used in the modern classification system. The Bible uses the term "kind." The created kind was a much broader category than the modern term of classification, species.



Modern creationists: “kinds” instead of species



Two of Every Species?

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WAS EVERY KIND OF ANIMAL ON THE ARK?

The Bible states that Noah’s cargo was limited to land-dwelling animals in which was the breath of life (**Genesis 7:15**). This clearly excludes fish and other sea creatures, and it probably excludes the insects and other invertebrates.

Variety Within Kinds

There can be a tremendous amount of variation within a created kind. For example, various types of dogs, such as wolves, dingoes, coyotes, jackals, and domestic dogs, can often breed with one another. When dogs breed together, you get dogs; so there is a dog kind.



How Many Kinds of Animals?

Recent studies estimate the total number of living and extinct kinds of land animals and flying creatures to be about 1,500. With our “worst-case” scenario approach to calculating the number of animals on the Ark, this would mean that Noah cared for approximately 7,000 animals.



Modern creationists: “kinds” instead of species



WHAT IS A “KIND”?

The biblical concept of created “kind” probably most closely corresponds to the family level in current taxonomy. A good rule of thumb is that if two things can breed together, then they are of the same created kind. It is a bit more complicated, but this is a good quick measure of a “kind.”

<https://arkencounter.com/animals/how-many/>

Numbers, Ronald L. (2004). How Young-Earth Creationists Came to Embrace Rapid Microevolution by Means of Natural Selection. *Darwinian Heresies*. Cambridge University Press, 84-100. <http://site.ebrary.com/id/10131737?ppg=94>

CHAPTER FIVE

Ironic Heresy

How Young-Earth Creationists Came to Embrace Rapid Microevolution by Means of Natural Selection

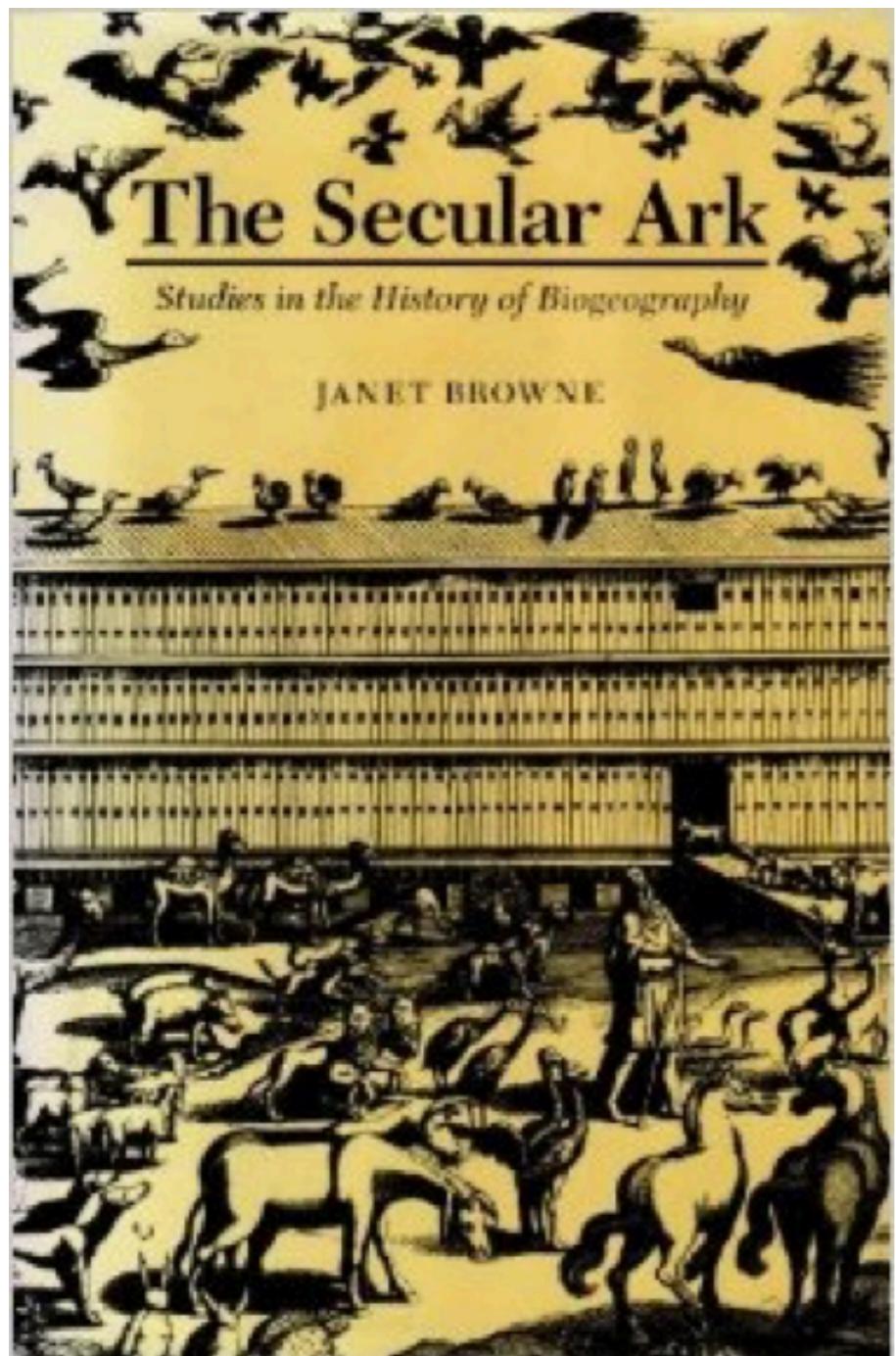
Ronald L. Numbers

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ebrary

Some years after writing his famous essay *On the Origin of Species* (1859), Charles Darwin noted that his primary goals had been to overthrow “the dogma of separate creations” and to establish natural selection as the primary, though far from exclusive, mechanism of change. Regarding the relative importance of these twin goals, he left no doubt. “Personally, of course, I care much about Natural Selection,” he confided to an American correspondent; “but that seems to me utterly unimportant, compared to the question of Creation or Modification.” Well into the twentieth century naturalists continued to debate the merits of natural selection, but since the early 1870s they have been describing the theory of common descent as an “ascertained fact.” The ultimate Darwinian heresy was thus the denial of common descent.¹

Even Lammert’s considerable influence could not stop the majority of creationist writers from joining Marsh and Morris in calling for extensive postdiluvian evolution. By the late 1950s, such Young-Earth creationists were beginning openly to accept *microevolution* (evolution within kinds) as opposed to *macroevolution* (evolution above the level of kinds), terms coined by the Russian geneticist Iurii Filipchenko (1882–1930) in 1927 and introduced to the English-speaking world by his most famous student, Dobzhansky. As one Young Earther proclaimed in 1959, “the creationist can find room for microevolution or variation, but refuses to accept macroevolution, on the grounds that it is unscriptural as well as unproved in any form.” By the 1990s, microevolution and natural selection had become standard features of Young-Earth creationism. When the Alabama State Board of Education in 1995 required that state-approved biology textbooks carry a pasted-in “message” warning of the controversial nature of evolution, it carefully distinguished between microevolution, “which can be observed and described as fact,” and macroevolution, such as the development of birds from reptiles, which “has never been observed and should be considered a theory.” Despite the popular image of creationists being wedded to the fixity of species, no one argued for more rapid speciation by means of natural selection than those notorious Darwinian heretics, the creationists.³⁶

OK, even if you can fit everything on the Ark... how did they get from Ararat to around the world?



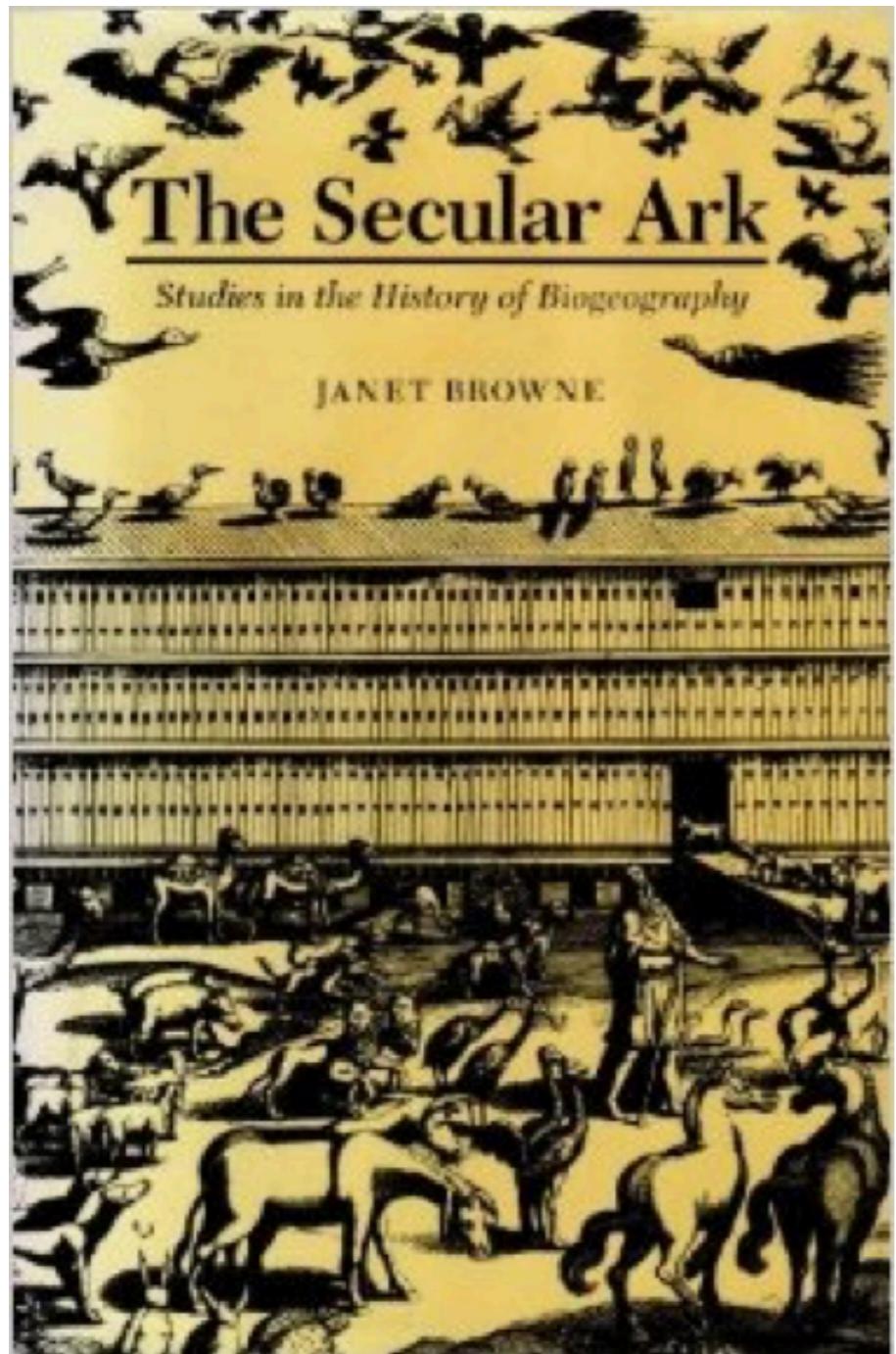
Janet Browne (1983).
The Secular Ark: Studies in the History of Biogeography

However, this emphasis on the universality of the Flood forced scholars to consider another aspect of the Noachian story that had previously been ignored—namely, the way the earth was restocked with animals and plants. If the Deluge was to be taken literally, all species had originally disembarked from the Ark on Mount Ararat and had dispersed from there across the deserted globe. Literal-minded natural philosophers were therefore obliged to explain how animals had arrived at their final destination. And this, in a sense, marks the first beginnings of the study of geographic dispersal.

DISPERSAL FROM A SINGLE CENTRE

Taking their cue from what was already known about species introduced to Europe, most seventeenth-century commentators supposed that plants and animals had a marked capacity for migration; that they could establish themselves successfully in a new country and, in the case of some particularly exotic species, could even hybridise or degenerate into related forms. Plain observation told men like James

The first dispersalists!



Janet Browne (1983).
The Secular Ark: Studies in the History of Biogeography

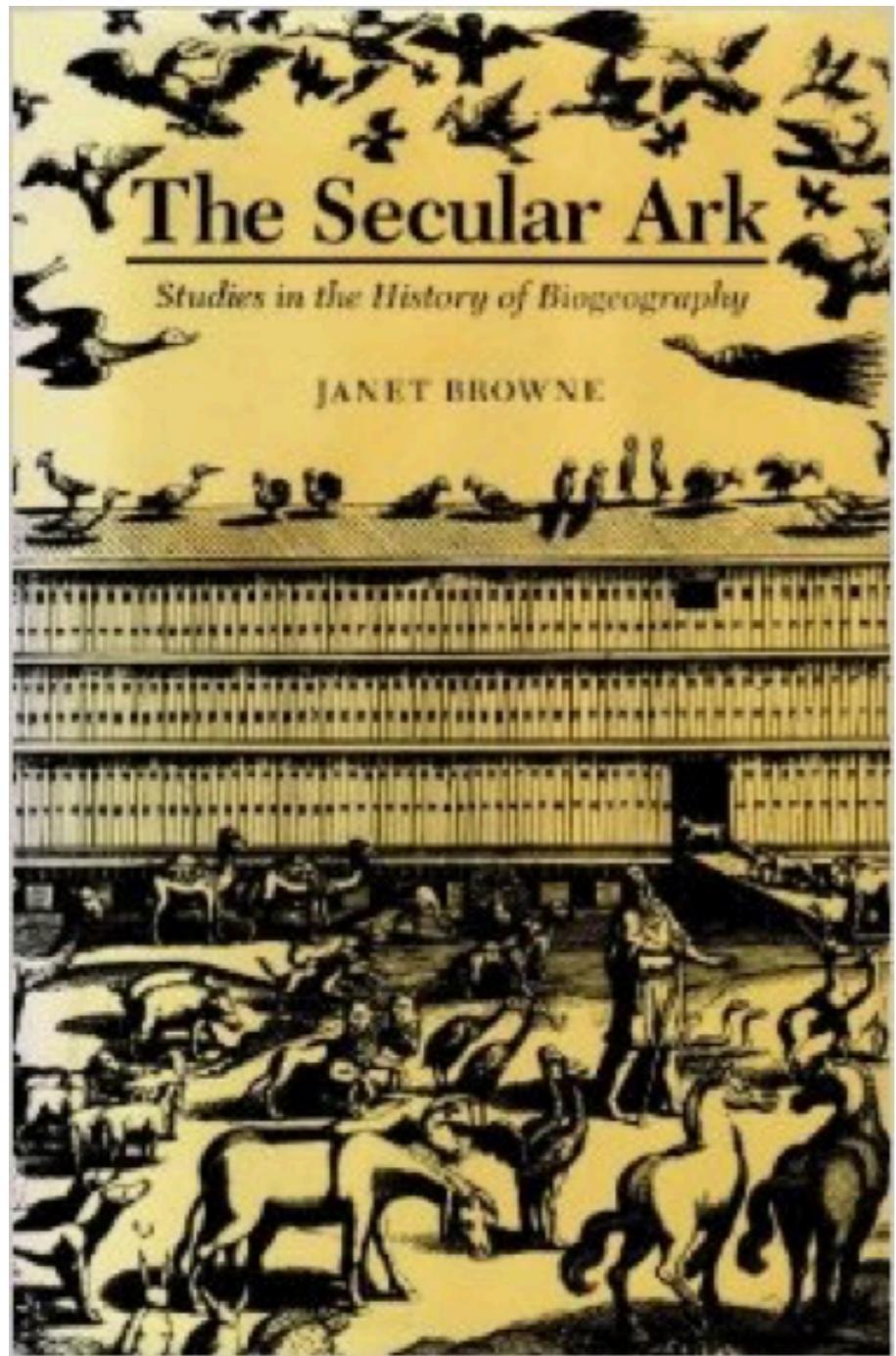
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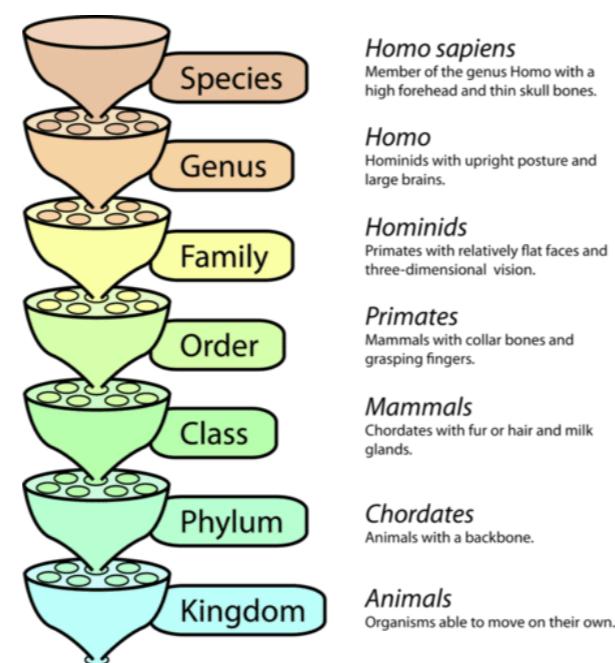
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Linnaeus' Paradisical Mountain Hypothesis

Mid-1700s:
Linnaeus dispensed with the Ark (too many species!), but substituted a tropical island, that became a mountain as the waters receded (e.g. Ararat) with all the species from tropical lowlands to alpine



Mount Ararat, Turkey

If organisms are designed for their environments, how could they disperse??

E.g. how do you get
reindeer from the
mountaintop to the Arctic?



<https://www.youtube.com/watch?v=ZM7zi4jQgAU>

THE ABANDONED ARK

Since species had been created, according to Linnaeus, in the shape they now possessed, and this shape was the most appropriate one for the conditions they lived in, then it must follow that species had also been created in the station they now occupied. "Form," "suitability," and "place" were now an indissoluble threesome. With Linnaeus's work there came together the notion of different types of animals and plants and the notion of the different places or spaces occupied by them. In other words, since species were real entities connected by descent to a distant ancestral pair, they must have been created *like* today's forms and under conditions identical to those *where* they are now. Linnaeus himself went to some trouble to ensure that this duality was not contravened in his account of the creation process.

Unfortunately for his argument, however, Linnaeus's thinking opened the door for more secular accounts of geographical distribution. By arguing so effectively for a close link between the structure of an animal and its physical surroundings, he unwittingly endorsed a rival theory of distribution first proposed by Buffon and taken up by Johann Reinhold Forster, Eberhardt Zimmermann, and Karl Willdenow, among others. Each Linnean species was so well suited to its native habitat that scholars could not imagine it travelling across half the world from Syria. The reindeer, it was argued, would have to pass over some of the most difficult and inhospitable lands in the world to get from Ararat to Lapland. If it was designed for the cold, how had it survived in the deserts en route? Perfect adaptation of organisms to their place in nature, as dictated by Linnaeus, simply was not compatible with migration from a single source. It was more feasible to inject new life into the old theory of La Peyrière and to assert that species had been created in many different places, each animal in the country where it was destined to live.

The Comte de Buffon (1707–1788) was, perhaps, the most famous exponent of this revitalised hypothesis. His philosophy was remark-

If organisms are designed for their environments,
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E.g. how do you get
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<https://www.youtube.com/watch?v=ZM7zi4jQgAU>

Buffon: Northern centre of origin, followed by degeneration

matic hypothesis. Buffon seems to have believed that all organic life originated near the north pole in some warmer period and had moved south over the globe as the earth progressively cooled. Because the three major landmasses of the world were juxtaposed at their northern extremities and separated by vast oceans in their southerly parts, this flow of organisms from the north to the south meant that the original population was rendered disjunct. Once the northern areas of the landmasses cooled down, they effectively isolated each set of species in a topographical and climatic cul-de-sac.

In the New World this was followed, Buffon thought, by some kind of structural degeneration from the primary type caused by the debilitating environment. "All animated nature is comparatively diminutive in the new continent," he stated; "Something in the combination of the elements and other physical causes opposes the aggrandisement of animated nature."³⁸ But he was hard pressed to identify the causes of this diminution. He attempted to link what he imagined was the small stature and reduced vigour of American species with a corresponding decline in the manners and social structure of the country's human inhabitants. Native Americans, he reasoned, had little cultural cohesion and no interest in taming or domesticating nature, a quality which should have led inevitably to a "strengthening" of the region's plants and animals and to a greater overall diversity. But how-

Views from:

Georges-Louis Leclerc, Comte de Buffon (and colleagues)
Histoire naturelle, générale et particulière, written in 44 quarto volumes between 1749 and 1809

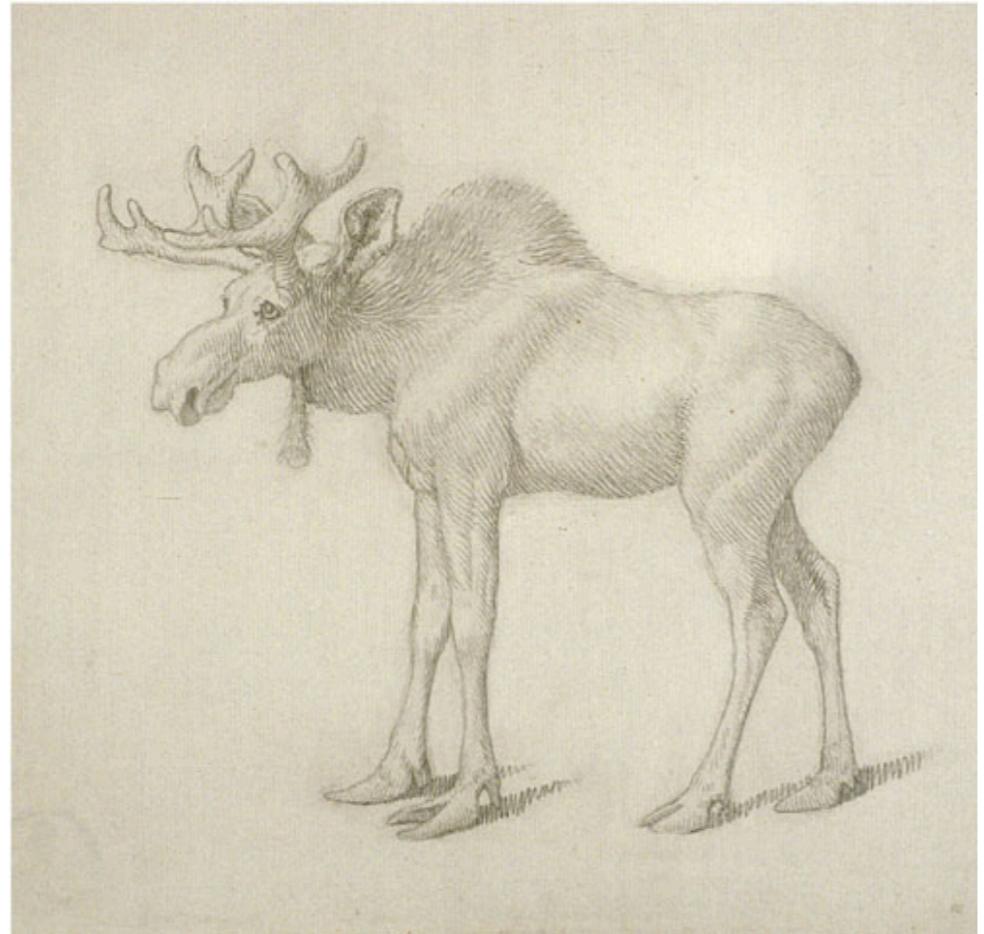
Buffon's Law: environmentally similar regions that are geographically isolated have distinct assemblages of mammals and birds

Northern origins:



(Hello, colonialist attitudes!)

(An aside: Thomas Jefferson rebuttal: hey Buffon, look at this moose!)



A moose. Which is big.

Given these contrary reports, why was the leading natural scientist of Europe so zealous in arguing for American degeneracy? One answer was that Buffon believed the anecdotal evidence more than the written records. He was also blinkered by preconceived notions, thinking that America was cold because of winds blowing off the Atlantic Ocean. Other possible explanations of the cold and damp were that the biblical Great Flood had retreated later from the New World than the Old, or that the New World had more recently emerged from the ocean. Buffon also developed the more sophisticated idea that the low population density of humans in the Americas meant that they had had less opportunity to improve the ecology and thereby ameliorate the climate.

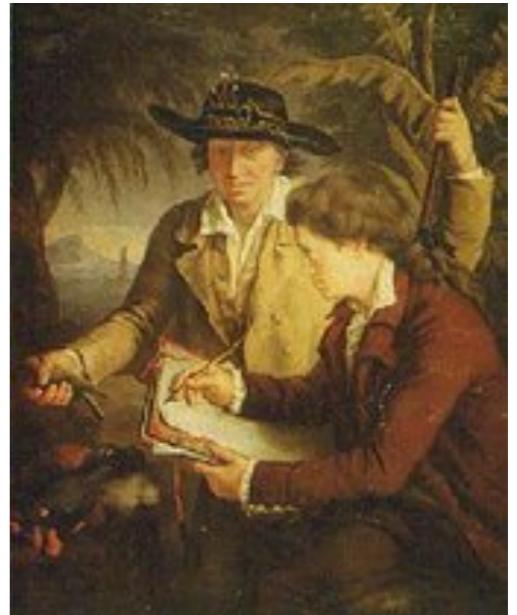
Yet another answer was philosophical. Buffon opposed Jean-Jacques Rousseau's notion of the "noble savage" and argued that the indigenous American people did not represent humans in a state of primeval grace. Instead, like the animals and plants, they had migrated from the Old World and deteriorated.

There was also a political reason to denigrate the Americas. Although much of the New World had been founded on colonialism and slavery, North America threatened to throw off these fetters. With huge natural resources, strong population growth and increasing affluence, the former colonies were rapidly evolving to become a beacon of new democracy. This egalitarianism was anathema to European aristocrats—a group that included most natural scientists of the time. The new United States was a populist place that neither needed nor tolerated aristocracy. The zeal with which Buffon's opinions were repeated may be a sign of how serious a threat the European oligarchy perceived the Americans to be. Among the authors who spread Buffon's tripe

Banks and Foster (on Cook's voyages)

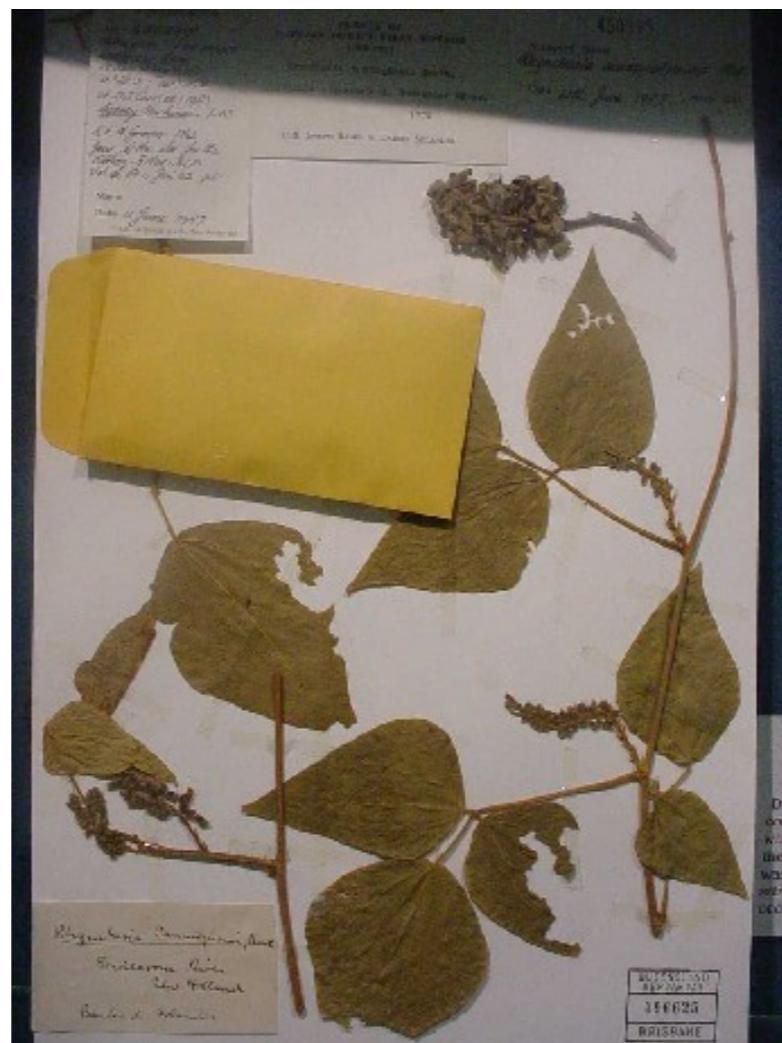
Johann Reinhold Forster (1729-1798)

Sir Joseph Banks (1743-1820)



Forster

They extend Buffon's Law to plants: different regions have different plants, even if they are environmentally similar



Also: the tropical diversity gradient

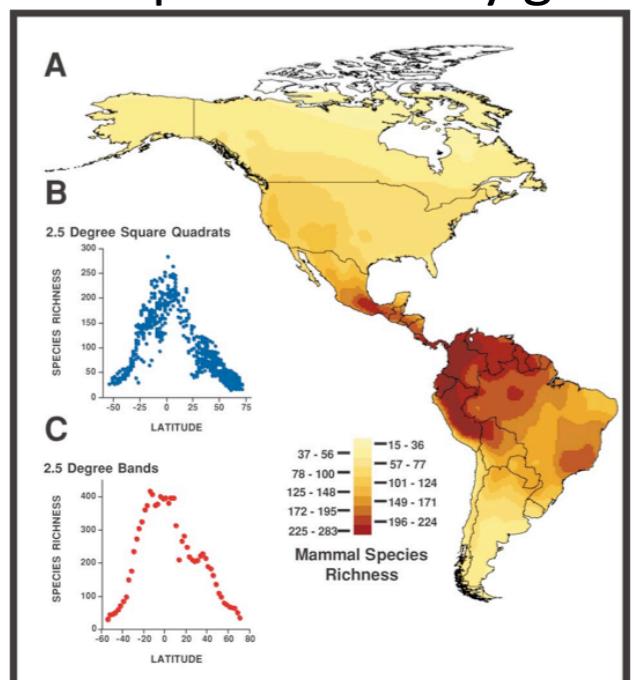


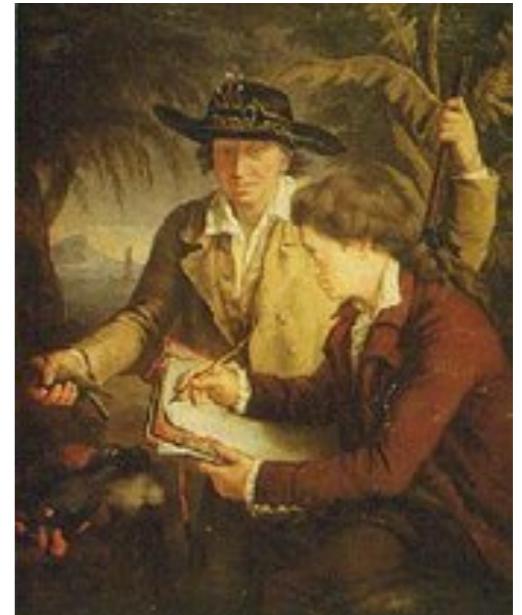
Figure 4 Spatial gradient of mammalian species richness in the continental New World for cells defined by 2.5° parallels and meridians. (A). Interpolated richness values in the map were created using the tension spline function in the Spatial Analyst extension to ArcGIS 8.2. Graphic representation of the latitudinal gradient in species richness for those same data (negative values for latitude indicate southern parallels), based on 2.5° cells (B) and 2.5° latitudinal bands (C). Data from Kaufman & Willig (1998).

Banks and Foster (on Cook's voyages)

Forster: kind of the opposite of Buffon:

This emphasis on heat as the ultimate reason for the appearance of nature was significant in several ways. It meant that diverse facts of distribution and seemingly disparate floras and faunas could be interpreted as the various manifestations of a single causal factor. For Forster, the organic world could be arranged in two huge spectra originating at the equator and finishing at the poles, mimicking the temperature belts of the earth. These two "living" hemispheres more or less reflected each other in the diminution of the "strength" and variety of natural resources as distance from the equator increased. Forster's belief in such a spectrum unified and gave validity to his distribution studies and encouraged him to think of the subject as a global affair dependent on one basic explanation: heat.

Moreover, Forster's preoccupation with heat led him to the proposal that the tropics were the source of life—or if not the source, the area in which nature reached its highest and most diversified expression. This theory stood not only for plants and animals, but for human beings as well. Because they lived in the heart of the tropics, where food was plentiful and manners were simple, he thought the Tahitians had the highest form of civilisation. In contrast, the inhabitants of Tierra del Fuego were as savage as their environment was miserable. Forster's book was a paean to the Enlightenment vision of nature more usually associated with Rousseau; he glorified the natural behaviour,



Forster

Tropical diversity gradient

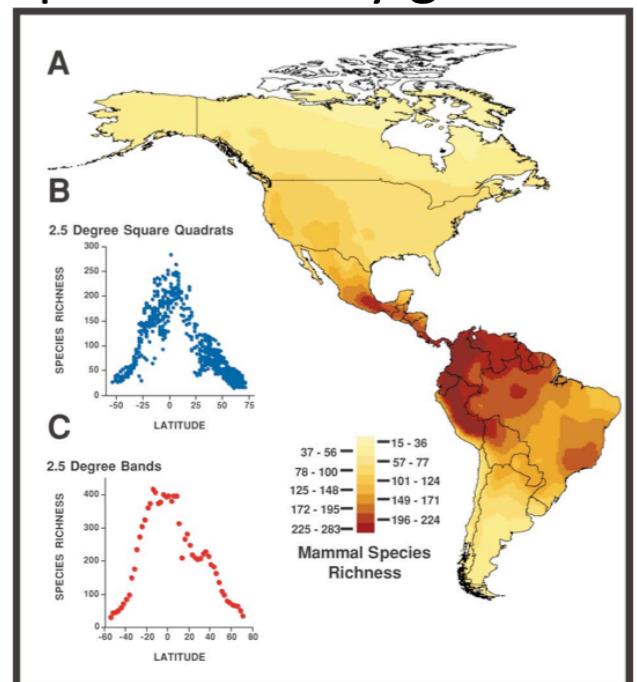


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(early version of the temperature hypothesis)

Multiple mountains, one for each botanical province



Karl Willdenow (1765-1812)

40 THE NATIONS OF PLANTS

an ingenious scheme for the origin of the plant kingdom that also explained its present topographical arrangement. At an early stage in the earth's formation, he suggested, it consisted of many mountains surrounded by a shallow but global sea. Plants were created on the peaks and gradually spread from these foci as the seas subsided. Each botanical province of the present day was the result of dissemination from a single mountain or mountain range—a suggestion that neatly explained the self-contained identity of such populations. To account for some of the oddities of distribution, such as the occurrence of *Ericaceae* in northern Europe and the southern tip of Africa and nowhere in between, he postulated a subsequent era of gales, volcanoes, and dramatic fracturing of continents, which carried some species way beyond their natural limits to the “furthest corners of the globe.” This period of intense activity also served to explain the existence of fossilised plants, particularly “exotic productions,” by which he meant tree ferns and the like, in the geological formations of Europe.

Willdenow's hypothesis therefore incorporated features of the universal flood and an epoch of chaos, which were evidently still essential to a Protestant interpretation of the past. His ideas are notable for their synthesis of elements drawn from the recent and not so recent history of botanical investigation. To him, botanical geography held the key to the creation and subsequent development of the plant kingdom. Yet he framed his explanation in conventional terms of a flood, isolated foci of species, and their eventual migration over the face of the earth. The only difference between his views and those of Linnaeus—important though it is—is that Willdenow had consciously dropped the Garden of Eden and was thinking not of one point of origin for all living beings, but of many. His scheme contained as many aboriginal mountains as there were modern botanical provinces. Should a new province become known to science, all that had to be done was to postulate another peak: like many cosmogonists, Willdenow felt no need to specify real locations. He could add or subtract a mountain as and when the occasion demanded. Ad hoc as it may seem, the theory was nonetheless a genuine attempt to relate his new field of the “history of plants” to deeper, more philosophically relevant questions about the origins of the natural world.

Multiple mountains, one for each botanical province

402 PRINCIPLES OF BOTANY, ETC.

themselves to change of climate, that they have followed man into almost every zone.

§ 365.

From what has been said it follows, that after such various and manifold changes, it would be very difficult to fix accurately the point from whence each plant originally came. We shall, however, endeavour to make some general remarks with regard to the plants of our part of the globe, and their most probable dissemination, as we are better acquainted with this part, especially the northern countries, than with others. Greece only we must exclude at present, as we know nothing at all of its botany. Its flora, however, seems to come from the mountains of Sardinia, from the coasts of Asia and Africa, and from the islands in the Archipelago.

We suppose, then, that plants are disseminated from the highest mountains towards the flat countries; and, according to this supposition, establish five principal floras in Europe, to wit, the Northern Flora, the Helvetic, the Austrian, the Pyrenean, and the Apenninian Floras.

The Northern Flora, originates in the mountains of Norway, Sweden, and Lapland. All these nourish the same plants, which grow in the highest North. Scotland with its mountains appears to have cohered once with those of Norway, as both have nearly the same plants.

The Helvetic Flora, originates in the mountains of Switzerland, Bavaria, and Tyrol. The moun-

HISTORY OF PLANTS.

403

tains of Dauphiny, as well as those in Bohemia and Siberia, are only lateral branches of the same chain. All have a great number of plants in common.

The Austrian Flora, originates in the Alps of Austria, Krain, Karinthia, and Steyenmark. The Karparthians are a side branch of those.

The Pyrenean Flora, originates in the Pyrenees. The mountains of Catalonia, Castilia and Valentia, are its branches.

The Appenninian Flora, originates in the Appenines, which send out many side branches.

The Helvetic Flora is dispersed farthest of all. All Germany, except Austria and Moravia; all Prussia, Poland, France, the southern parts excepted, the Netherlands and Holland, have this Flora.

The Northern Flora comprehends Denmark, Sweden and Russia, as well as a part of Great Britain.

The Austrian Flora extends from Austria through Moravia, the southern parts of Poland, Hungary, Moldavia, Wallachia, Bulgaria, Servia, Bosnia, Croatia, Sclavonia, Istria and Dalmatia.

The Pyrenean Flora goes through all Spain, the island of Majorca and Minorca, perhaps through Portugal, but this last remains still to be determined.

The Apenninian Flora extends all over Italy, Sardinia, Corsica, and part of Sicily.

If we take the lists of the plants of these five different Floras, we will find the most marked difference in them.

C c 2

§ 366:

Willdenow (1805)



A modern classification

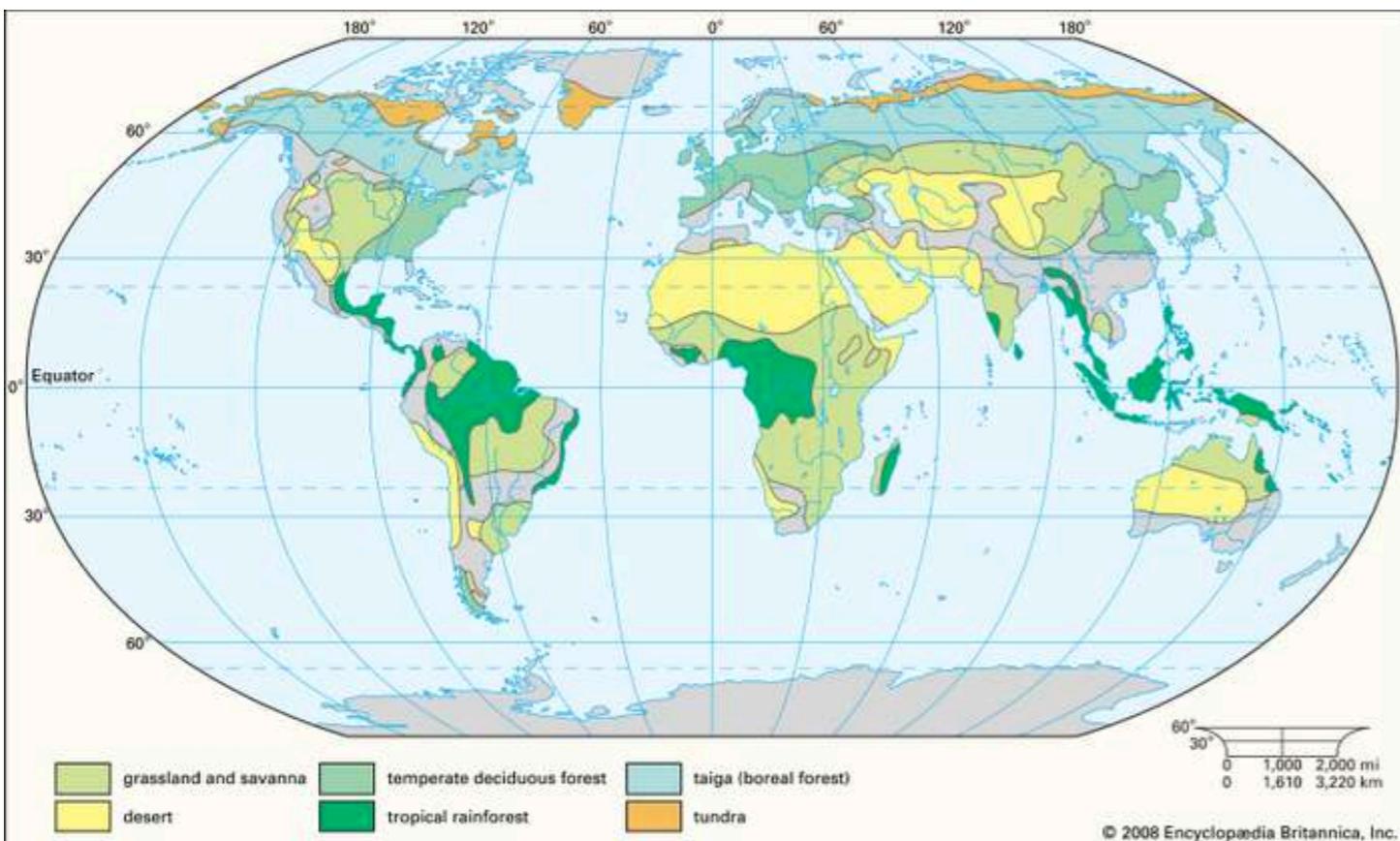
(<https://www.britannica.com/place/Europe/Plant-life>)

Alexander von Humboldt: Geographical and Latitudinal Zones

We might call this kind of biogeography “environmentalist”, or “ecological”.

Little concern about origins.

(It's still the kind of biogeography you can find in Geography Departments!)



For all his innovation, though, Candolle was not prepared to elaborate on the investigation of habitations or “des régions botaniques” as he subsequently defined them. He had already noted in the *Essai* that this field depended on a knowledge of the origin of species and their subsequent history. In later passages he commented on the thesis presented by Willdenow (of which he disapproved) and on the scanty information being derived from palaeobotany by Sternberg and Alexandre Brongniart in Paris. The idea of a historical biogeography that reached back beyond the period of man’s existence was

difficult for him to visualise, and practically impossible to document with so few fossil materials on which to base acceptable hypotheses. In this way Candolle was very like his friend Humboldt. Humboldt, for instance, was fascinated by the relationship between human history and the dissemination of useful plants such as Indian corn or other cereals. When he cast his mind further into the past, however, he fell back on other people’s explanations, believing with Cuvier that there had been successive epochs in the formation of the earth, each stocked with animals and plants appropriate for the different conditions. Many of the plants, Humboldt supposed, had survived the most recent catastrophe—the deluge—and recolonised the earth from refugia, which explained why there were species now living in the tropics that also occurred in fossilised form in European strata.²⁵

Candolle’s views on the past life of plants were much the same as Humboldt’s. But he found the whole field so novel and unexplored that he preferred to assess only the methods by which present-day provinces could be itemised and described. To understand these phenomena thoroughly was the first requirement in a more generalised endeavour to discover the origins of species: the present, he felt, should be examined before theorists attacked the past.

In this respect, Candolle’s ideas were broadly the same as those expressed by Humboldt and Johann Forster. Their interests lay not in how things came into being but rather in the relationships of organisms existing today. They wished to compare and contrast, to see how phenomena were mutually consistent, and to disclose patterns more fundamental than those on the surface. In essence, they took a geographer’s view of nature, searching out the major topographical divisions of the globe, listing the physical conditions of each region, and linking to these the plant life supported there. Vegetation was be-

Alexander von Humboldt: Botanical arithmetic

Although origins questions were left aside temporarily, methods and “science of pattern” were developed.

E.g. counting genera, families, ratios:

each other and to the whole itself, this technique was ideal for constructing generalised statements about complex patterns. The entire study of phytogeography, he claimed, would be the better for using botanical arithmetic:

Terrestrial physics have their numerical elements, as has the system of the Universe, or celestial physics, and by the united labours of botanical travellers we may expect to arrive gradually at a true knowledge of the laws which determine the geographical and climatic distribution of vegetable forms. . . . The numerical laws of the families of plants, the often striking agreement of the numbers expressing their ratios, where yet the species of which the families consist are for the most part different, conduct us into the mysterious obscurity which envelopes all that is connected with the fixing of organic types in the species of plants and animals, or with their original formation or creation.⁶

(presaging phylodiversity studies!)

A SCIENCE OF PATTERNS 61

CLASSES ET ORDINES NATURALES.	RATIO CUJUSCUNQUE CLASSIS VEL ORDINIS ad totam copiam Phanerogamarum locis planis provenientium:			AD NOTATIONES.
	In Zona æquinoxiali (Cal. med. 27°.)	In Zona temperata (Cal. 10°—14°.)	In Zona glaciali (Cal. 0°—10°.)	
Agamæ cellulosæ	1 : 5	1 : 2	1 : 1	
Filices		1 : 60	1 : 25	Germ. $\frac{1}{2}$ Gallia $\frac{1}{7}$
Monocotyledones	1 : 6	1 : 4	1 : 3	
Cyperoideæ	1 : 60	1 : 30	1 : 9	
Gramineæ	1 : 15	1 : 12	1 : 10	
Juncæ	1 : 400	1 : 90	1 : 25	Amer. bor. $\frac{1}{15}$ Gallia $\frac{1}{11}$
Glumaceæ vel tres ord. præced.	1 : 11	1 : 8	1 : 4	
Labiatae	1 : 40	1 : 25	1 : 70	Amer. bor. $\frac{1}{10}$ Gallia $\frac{1}{7}$
Ericinæ et Rhododendra . . .	1 : 130	1 : 100	1 : 25	Amer. bor. $\frac{1}{10}$ Gallia $\frac{1}{11}$
Compositæ	1 : 6	1 : 8	1 : 13	
Rubiaceæ	1 : 20	1 : 60	1 : 80	Gallia $\frac{1}{3}$ Germ. $\frac{1}{6}$
Umbelliferæ	1 : 3000	1 : 30	1 : 60	Amer. bor. $\frac{1}{15}$ Gallia $\frac{1}{11}$
Cruciferæ	1 : 3000	1 : 18	1 : 24	Amer. bor. $\frac{1}{12}$ Gallia $\frac{1}{11}$
Malvaceæ	1 : 50	1 : 200	0	Amer. bor. $\frac{1}{15}$ Gallia $\frac{1}{11}$ Germ. $\frac{1}{11}$
Leguminosæ	1 : 12	1 : 18	1 : 35	
Euphorbiaceæ	1 : 35	1 : 80	1 : 500	
Amentaceæ exclusis Casuarinæ .		1 : 45	1 : 20	

Adjecimus differentias notabiliores quas offerunt Zonæ temperatæ boreales utriusque Continentis. In universum minus fides habenda numeris absolutis quam rationi qua crescunt vel decrescent numeri a polo versus æquatoriem aut ab æquatore versus polum.

Figure 1 Ratio of botanical classes and orders in the northern hemisphere. From A. von Humboldt, *Prolegomena, Nova Genera et Species Plantarum* (Paris: Lutetiae, 1815), p. xviii.

Robert Brown (1773-1858)

- Botanist, taxonomist, microscopist
- Naturalist for Flinders in Australia
- Collected 3000+ plants
- Discovered “Brownian motion” (which later led to Einstein’s (1905) proof of the existence of atoms)
- Botanical arithmetic applied to origins:
 - Early example of diversity = centre of origin hypothesis:

yet to be discovered. In another context, Brown also calculated the number of genera in certain families at various locations on the Australian continent. The region with the most genera was, in his opinion, the native home or country of that family. This was a particularly valuable device for working out the diverse relationships between the floras of Australasia, South Africa, and South America, and, on a more restricted scale, for suggesting the geographical source, or centre, for groups such as the *Proteaceae*.⁸



Return to origins

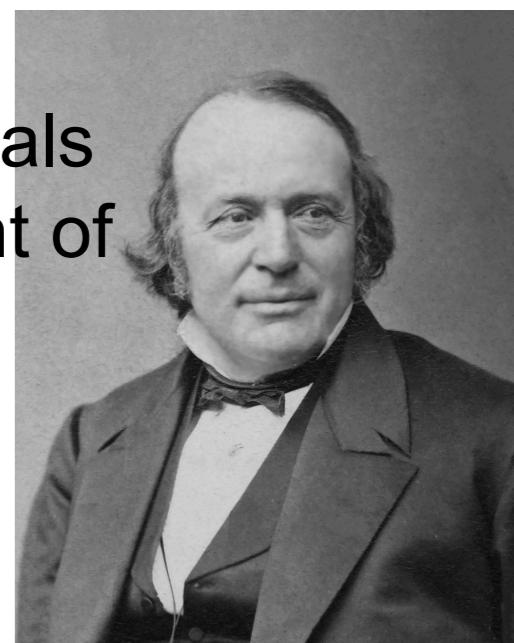
Louis Agassiz (1850). "Geographical Distribution of Animals."
Christian Examiner and Religious Miscellany, 48: 181-204.

"There is a prevailing opinion, which ascribes to all living beings upon earth one common centre of origin"

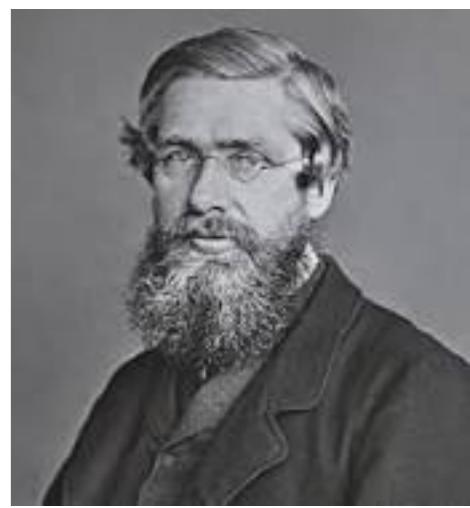
"There is another view, to which, more recently, naturalists have seemed to incline; namely, the assuming several centres of origin, from which organized beings were afterwards diffused over wider areas, in the same manner as according to the first theory, the difference being only in the assumption of several centres of dispersion instead of a single one."

"[W]e have been gradually led to the conclusion, that most animals and plants must have originated primitively over the whole extent of their natural distribution"

Agassiz (1807-1873); Swiss; founded Museum of Comparative Zoology at Harvard, founder of American zoology; invented "Ice Age"(s); polygenist (ie separate creation of animals/plants and human populations! Not surprisingly, he was pretty racist, although not pro-slavery). https://commons.wikimedia.org/wiki/File:Louis_Agassiz_H6.jpg



Return to origins



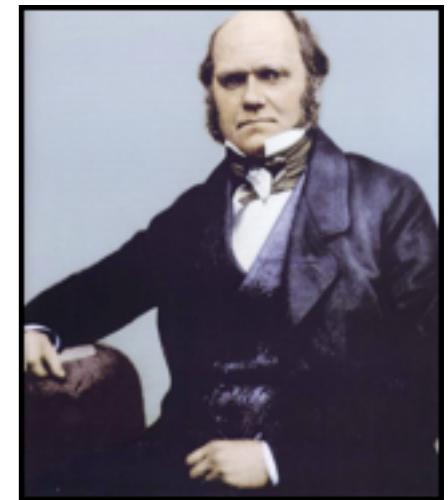
Alfred Russel Wallace (1855). “On the law which has regulated the introduction of new species.” *Annals and Magazine of Natural History* 16 (2nd ser.): 184-196.

“Why are the genera of Palms and of Orchids in almost every case confined to one hemisphere? Why are the closely allied species of brown-backed Trogons all found in the East, and the green-backed in the West? Why are the Macaws and the Cockatoos similarly restricted? Insects furnish a countless number of analogous examples;—the Goliathi of Africa, the Ornithopteræ of the Indian islands, the Heliconidæ of South America, the Danaidæ of the East, and in all, the most closely allied species found in geographical proximity. The question forces itself upon every thinking mind,—why are these things so? They could not be as they are, had no law regulated their creation and dispersion.”

Darwin in 1835 (returning home)

December 30th, 1835: Darwin leaves Bay of Islands, New Zealand

January 18th, 1836, *Journal of Researches ("Voyage of the Beagle")*, in Australia:



I had been [...] reflecting on the strange character of the animals of this country as compared with the rest of the world. An unbeliever in every thing beyond his own reason might exclaim, 'Two distinct Creators must have been at work; their object, however, has been the same, and certainly the end in each case is complete.' While thus thinking, I observed the hollow conical pitfall of the lion-ant: first a fly fell down the treacherous slope and immediately disappeared; then came a large but unwary ant; it struggles to escape being very violent, those curious little jets of sand [...] were promptly directed against the expected victim. But the ant enjoyed a better fate than the fly, and escaped the fatal jaws which lay concealed at the base of the conical hollow. There can be no doubt but that this predacious larva belongs to the same genus with the European kind, though to a different species. Now what would the sceptic say to this? Would any two workmen ever have hit upon so beautiful, so simple, and yet so artificial a contrivance? It cannot be thought so: one Hand has surely worked throughout the universe (Darwin 1989 [1839], 325).

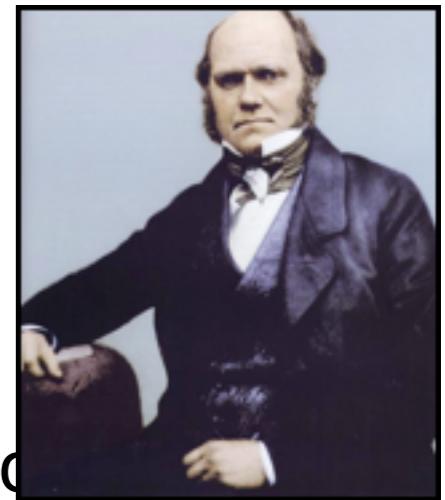
“Two distinct Creators must have been at work...”

Special creation eventually leads to the idea that you have different creators in different regions...heresy!



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1859: Darwin

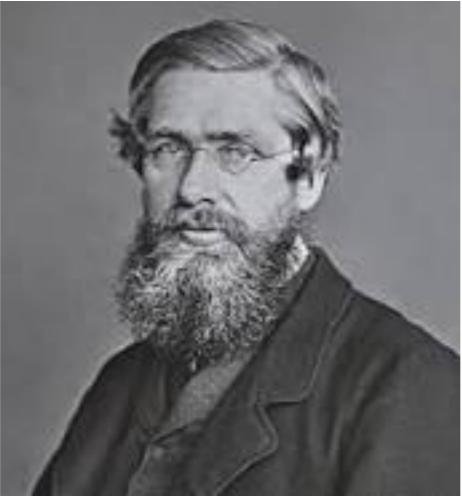


“When on board H.M.S. Beagle as naturalist, I was much struck with certain facts in the distribution of the organic beings inhabiting South America...” (Introduction to *On the Origin of Species*).

E.g.:

- ant lions in Australia vs. Eurasia
- fossil & living armadillos
- rheas in South America
- similarity of Galapagos flora & fauna to South America (but with differentiation)
- (years later) Galapagos finches

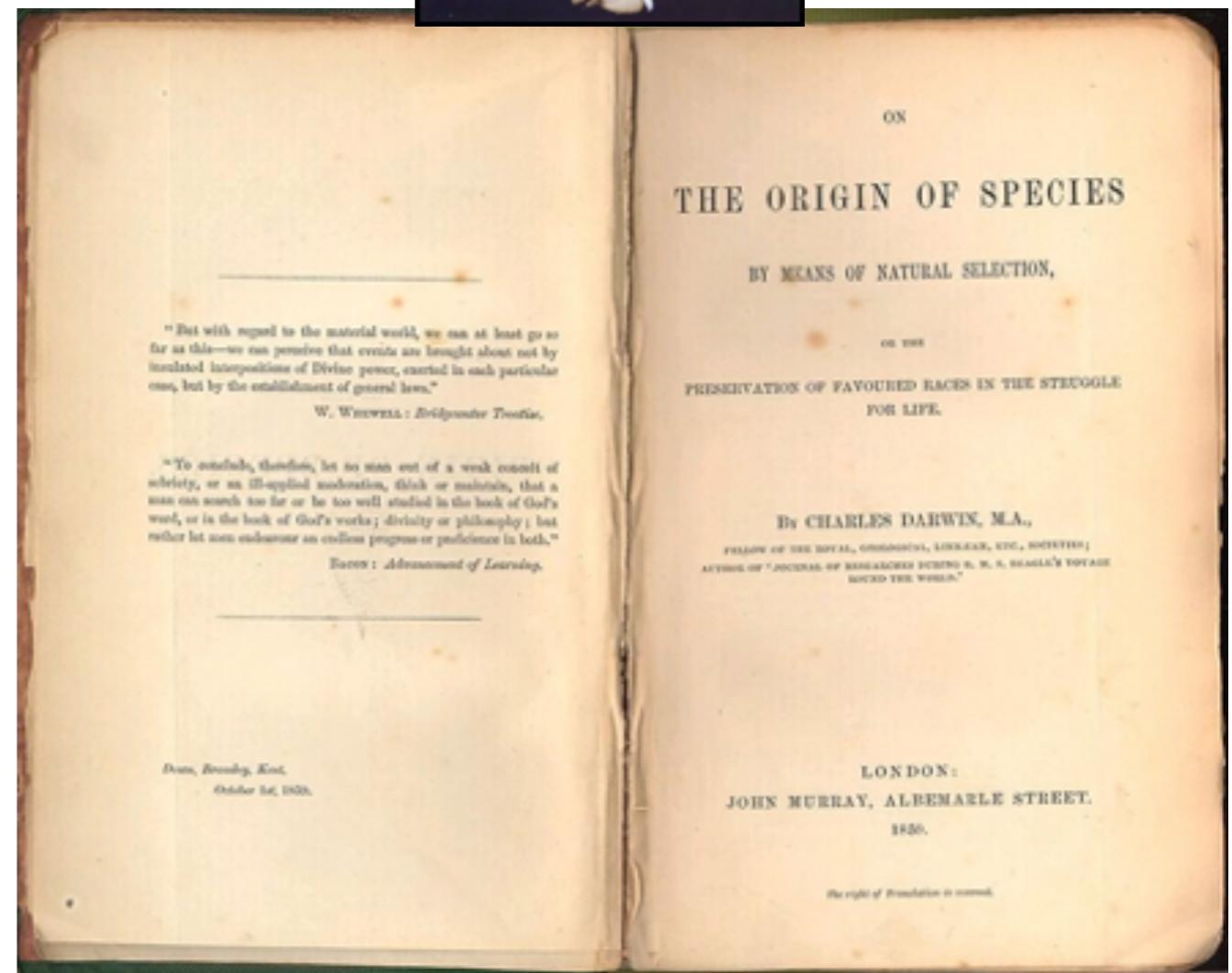
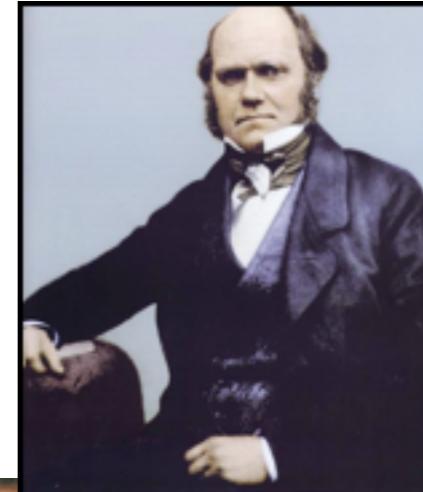
Common ancestry solved problems



XVIII.—*On the Law which has regulated the Introduction of New Species.* By ALFRED R. WALLACE, F.R.G.S.

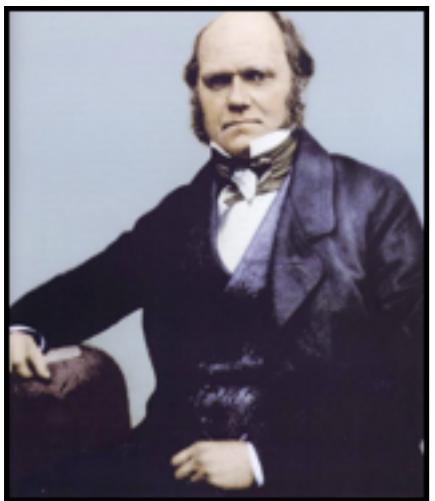
EVERY naturalist who has directed his attention to the subject of the geographical distribution of animals and plants, must have been interested in the singular facts which it presents. Many of these facts are quite different from what would have been anticipated, and have hitherto been considered as highly curious, but quite inexplicable. None of the explanations attempted from the time of Linnæus are now considered at all satisfactory; none of them have given a cause sufficient to account for the facts known at the time, or comprehensive enough to include all the new facts which have since been, and are daily being added. Of late years, however, a great light has been thrown upon the subject by geological investigations, which have shown that the present state of the earth, and the organisms now inhabiting it, are but the last stage of a long and uninterrupted series of changes which it has undergone, and consequently, that to endeavour to explain and account for its present condition without any reference to those changes (as has frequently been done) must lead to very imperfect and erroneous conclusions.

Wallace (1855): “Every species has come into existence coincident both in space and time with a pre-existing closely allied species.”



Darwin (1859): “the more nearly any two forms are related in blood, the nearer they will generally stand to each other in time and space”.

Common ancestry solved problems



Darwin (1859): “the more nearly any two forms are related in blood, the nearer they will generally stand to each other in time and space”.

A statement of pattern. In modern (statistical!) terms:

Spatial autocorrelation (similarity increases over shorter distances)

Cross-correlation: physical similarity correlates with geographic similarity

- within species
- across similar species
- across floras/faunas

A statement of process: these patterns are explained by common ancestry

i.e., similar species descend from common ancestral species

Therefore they had to physically move (or be moved) to get to their present distributions, even if currently separated by barriers

Common ancestry created *new* problems

- next time

What have we learned?

Humans *love* to tell origins stories

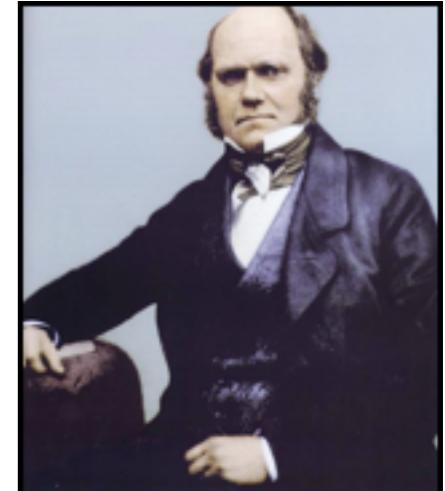
People can hardly avoid doing it, even when evidence is thin

Within science, and biogeography, there have been some attempts to avoid origins (process) and focus on pattern. These never last long, though. In the end, science is about *process*, i.e. *explaining* patterns.

The key role of background assumptions, culture, politics, religion in inventing origins stories, and in their deployment (typically to justify the author's point of view, or that of their benefactors!)

HOWEVER – KEY POINT – data and testing (the scientific process) can eventually overwhelm even very strong pre-existing biases. This is why science is special (but also why we should always keep an eye on data versus assumptions).

All these issues are actually STILL ALIVE TODAY in biogeography and elsewhere. As we will see with 20th century biogeography, and even 21st-century, model-based, computational biogeography!



**Bonus slides – background on US
creationism debate, if needed/desired**

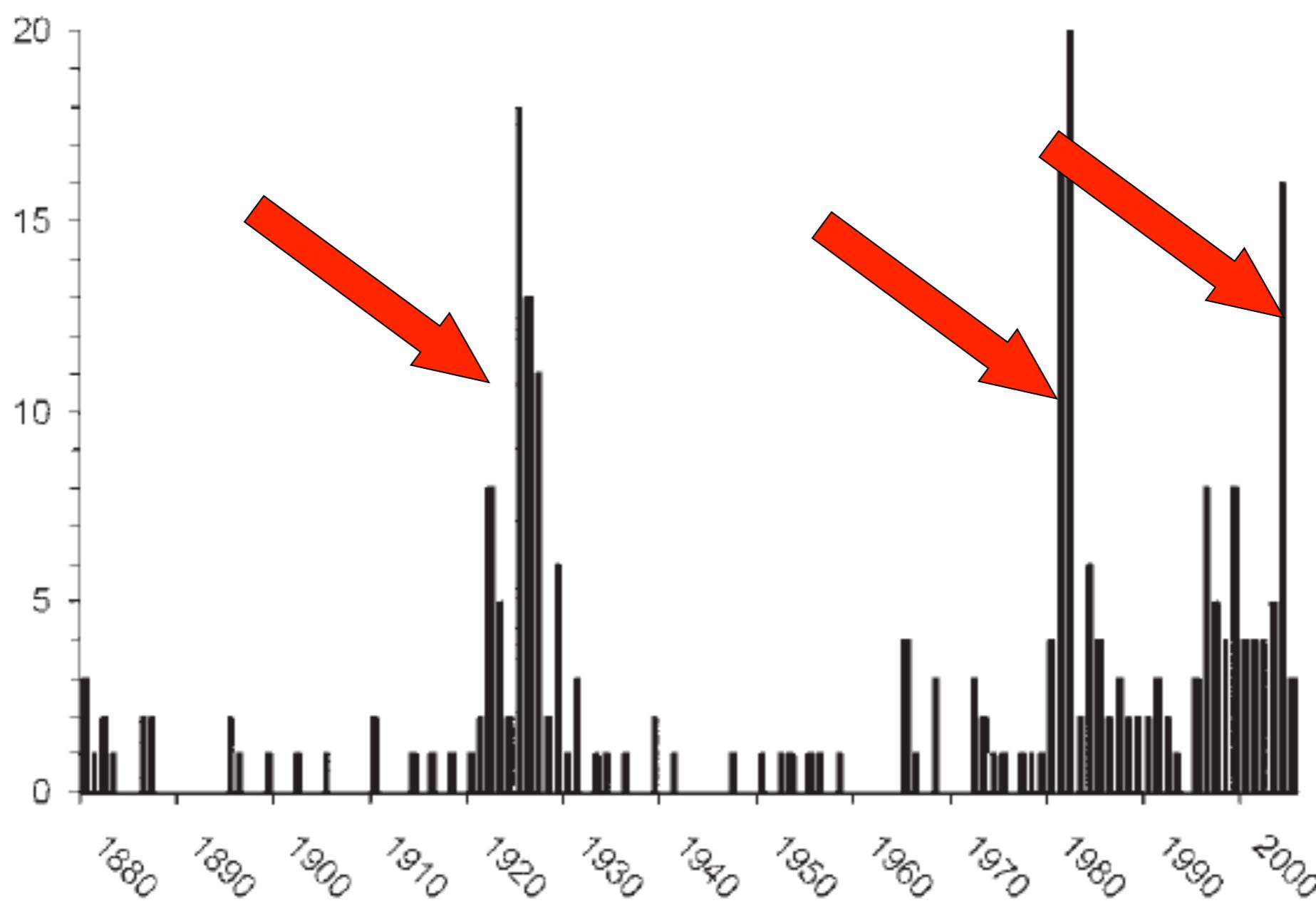


Figure 1. Numbers of references in Science and The Scientific Monthly to the creationist–evolutionist controversy, shown by year. Peaks in 1925 and 1981 through 1987 reflect the Scopes trial and trials in California, Arkansas, and Louisiana. Since 1996, the intelligent design movement has attracted attention.

Time magazine (summer 2005)



COAST-TO-COAST CHALLENGES

Across the U.S., states and localities have considered changing the way biological evolution is taught. Some call for critical analysis of the theory; others seek equal time for intelligent design and creationism

Antievolution proposals considered since 2001 by:

- State board of education
- State legislature
- Both
- Local schools or panels [2005 only]

Ohio • State has changed science standards to include critical analysis of evolution

Kansas • Nonbinding state resolution requests that students be taught the range of views on evolution

Alaska • Recently strengthened science standards for teaching evolution

Dover, PA

A TALE OF TWO TEXTBOOKS: Excerpts from a leading traditional volume, left, and from a book by advocates of intelligent design

Biology
By Kenneth Miller and Joseph Levine
Prentice Hall
1,146 pages
More than 2 million copies sold

“Darwin made bold assumptions about heritable variation, the age of Earth and relationships among organisms. New data from genetics, physics and biochemistry could have proved him wrong on many counts. They didn’t. Scientific evidence supports the theory that living species descended with modification from common ancestors that lived in the ancient past.” (p. 410)

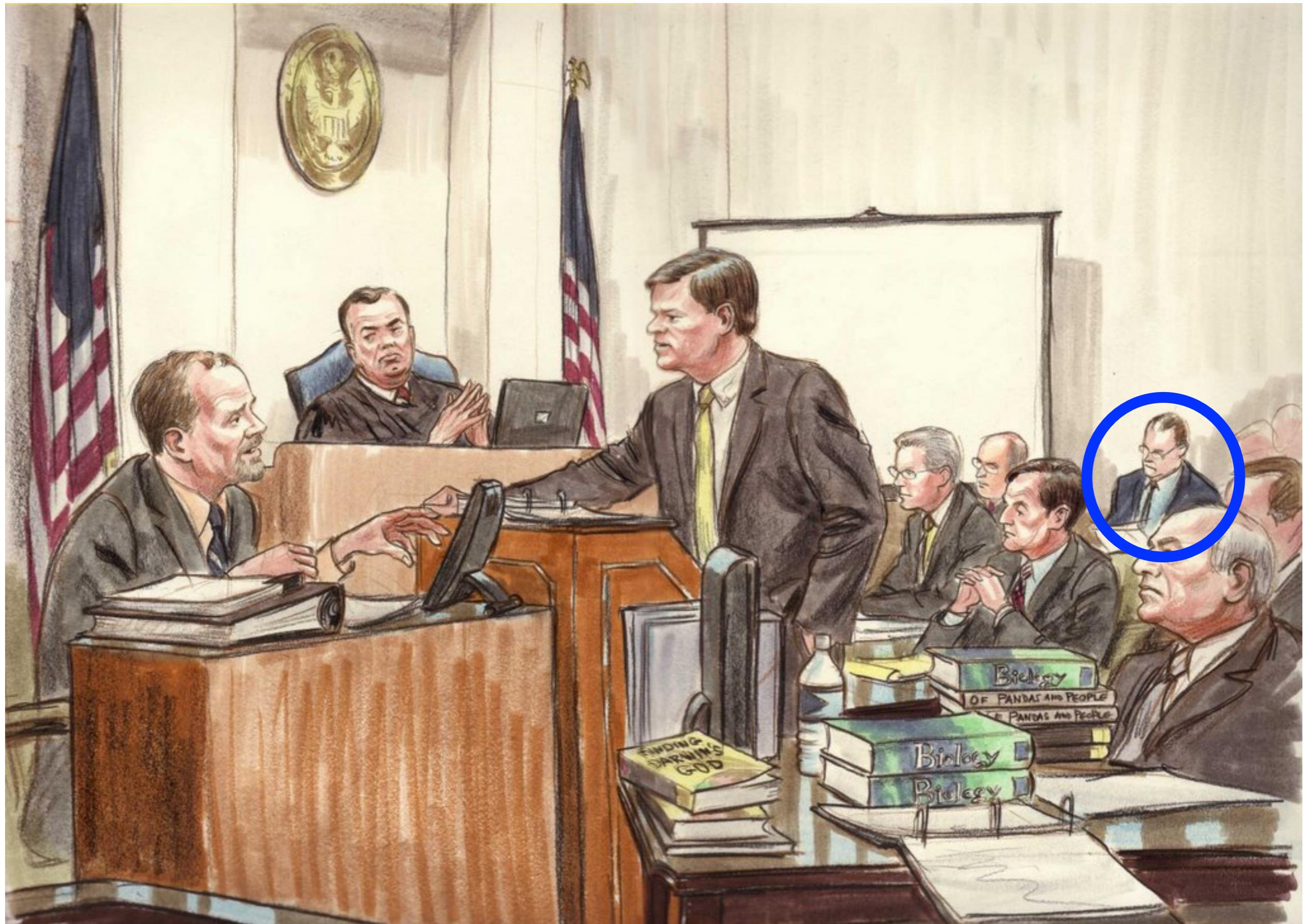
Of Pandas and People
By Percival Davis and Dean Kenyon
Haughton Publishing
170 pages
More than 20,000 copies sold

“Intelligent design means that various forms of life began abruptly through an intelligent agency, with their distinctive features already intact—fish with fins and scales, birds with feathers, beaks and wings, etc. Some scientists have arrived at this view since fossil forms first appear in the rock record with their distinctive features intact, rather than gradually developing.” (p. 99-100)

Nick Matzke,

[Return to Cover Story >>](#)

Kitzmiller v. Dover



PARTLY CLOUDY
32°
19°
BACK PAGE

PENNSYLVANIA NEWSPAPER OF THE YEAR

The Patriot-News

VALUATION
WEDNESDAY
December 21, 2005

50 cents

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HARRISBURG, PA. PENNLIVE.COM FINAL EDITION

JUDGE JONES ON THE DOVER SCHOOL BOARD: "The students, parents, and teachers of the Dover Area School District deserved better than to be dragged into this legal maelstrom, with its resulting utter waste of monetary and personal resources."

THE DECISION: U.S. District Judge John E. Jones III, right, struck down Dover's intelligent design policy, saying the school board's real purpose was to promote religion.



JUDGE JONES ON INTELLIGENT DESIGN: "We have addressed the seminal question of whether ID is science. We have concluded that it is not, and moreover that ID cannot uncouple itself from its creationist, and thus religious, antecedents."

JUDGE RULES INTELLIGENT DESIGN IS 'NOT SCIENCE'

Area schools walk a fine line over religion

BY DIANA FISHLOCK
OF The Patriot-News

Religion still has a place in public schools, a fact in evidence during the holidays, but districts face a delicate balance in studying faith without promoting it or alienating students.

This time of year, midstate schools take different approaches. While some of the more religiously diverse communities revel in Christmas, Hanukkah and Kwanzaa, others avoid religious holidays altogether.

Religion can't be avoided when studying American history and culture, some area school officials say.

Derry Twp. teachers talk about traditions, including Christmas, Hanukkah and Kwanzaa, said Troy Portser, a school district spokesman.

FROM THE RULING:

"The citizens of the Dover area were poorly served by the members of the Board who voted for the [intelligent design] Policy. It is ironic that several of these individuals, who so staunchly and proudly touted their religious convictions in public, would time and again lie to cover their tracks and disguise the real purpose behind the ID Policy."



Historic ruling orders Dover to rescind policy

BY BILL SULON
OF The Patriot-News

In a sweeping and potentially landmark ruling, a federal judge yesterday said that the Dover Area School District's policy on intelligent design is unconstitutional and that the concept of intelligent design is unscientific and religious.

And in an unusually scathing rebuke, he called several former school board members who supported the policy liars.

U.S. Middle District Judge John E. Jones III, who presided over a six-week trial in Harrisburg, ruled that the intelligent design policy promotes religion and violates the U.S. and Pennsylvania constitutions. The First Amendment's Establishment Clause bars government from

“Intelligent Design” = creationism relabeled

2-10

life started in the first place. Creation means that the various forms of life began abruptly through the agency of an intelligent creator with their distinctive features already intact--fish with fins and scales, birds with feathers, beaks, and wings, etc.

Biology and Creation 1986

Biology and Origins 1987

Of Pandas and People 1987, version 1

Of Pandas and People 1987, version 2

2-13

Creation means that various forms of life began abruptly through the agency of an intelligent Creator with their distinctive features already intact--fish with fins and scales, birds with feathers, beaks, and wings, etc.

2-14

Creation means that various forms of life began abruptly through the agency of an intelligent

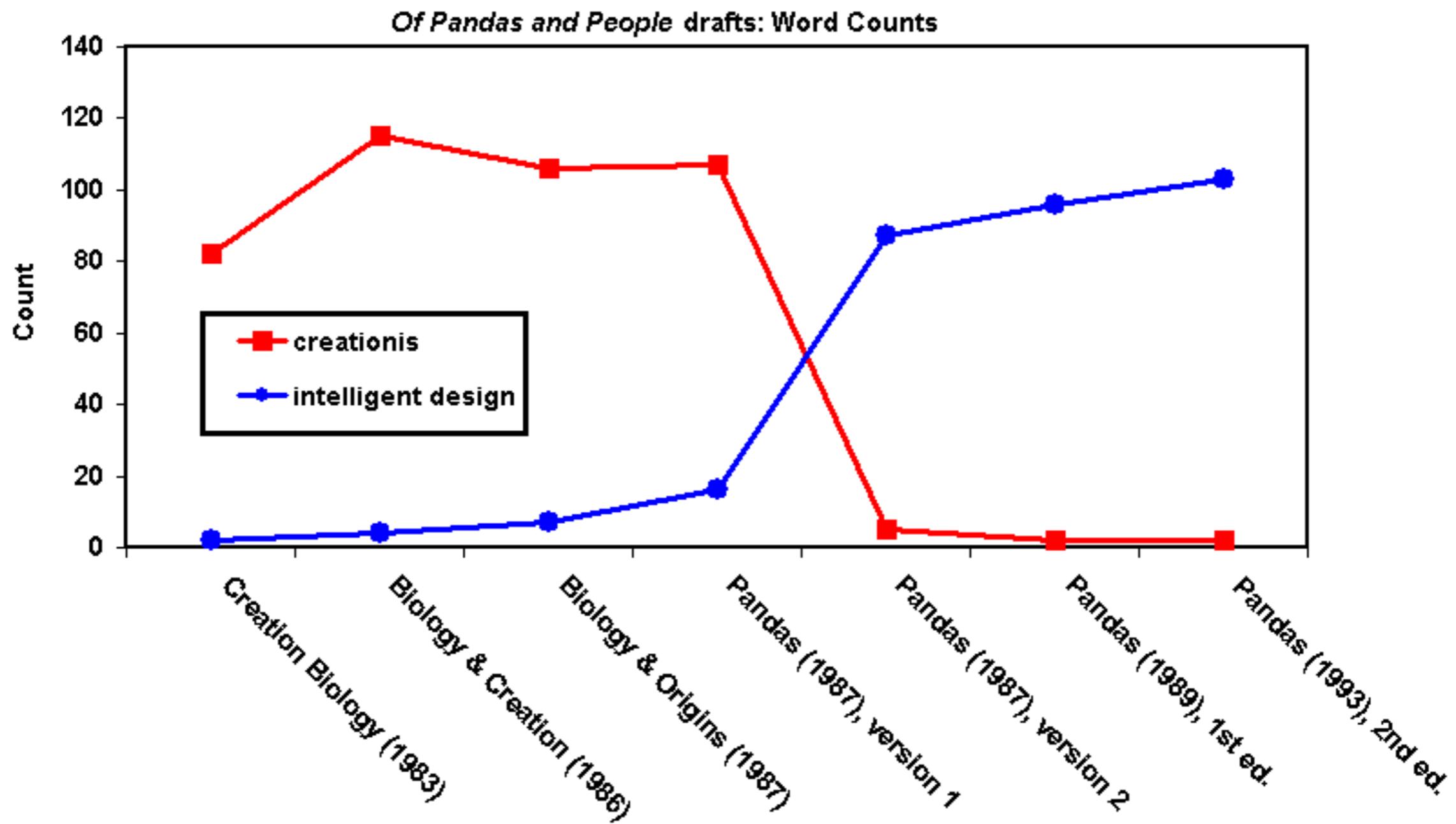
2-15

Creator with their distinctive features already intact--fish with fins and scales, birds with feathers, beaks, and wings, etc.

2-15

Intelligent design means that various forms of life began abruptly through an intelligent agency with their distinctive features already intact--fish with fins and scales, birds with feathers, beaks, and wings, etc.

Intelligent Design = Creation science



The evolution of *Pandas*

creationists

cdesign proponentsists

The missing link!