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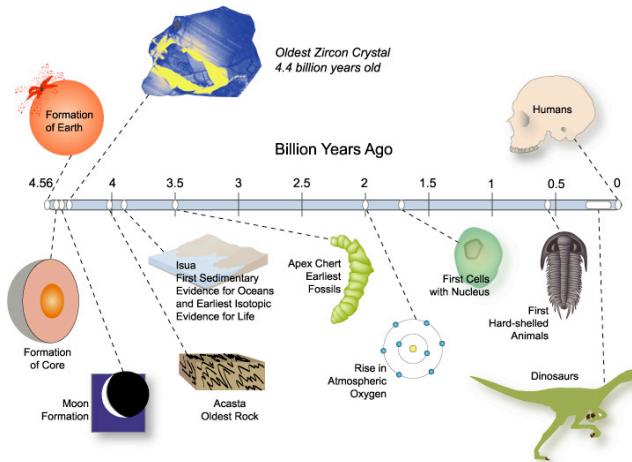
EVOLUTION & ADAPTATION (EEB214S) 2012

Lecture 3: Evidence for Evolution

In the rocks

- | | | |
|--|----|---|
| Jan. | 10 | Why is evolution under debate? |
| | 12 | Darwin's Ideas
<i>Video: Darwin's Dangerous Idea (Part 3) 60 min</i> |
| | 17 | Evidence for evolution: Written in the rocks |
| | 19 | Evidence for evolution: Vestigial traits, atavisms and bad designs
<i>Video: Planet dinosaur (Part 2) 60 min</i> |
| | 24 | Evidence for evolution: Biogeography |
| | 26 | Evidence for evolution: Artificial and Natural selection
<i>Video: Galápagos (Part 2) 50 min</i> |
| | 31 | What Darwin missed: The unit of heritability part 1 |
| BLACKBOARD FORUM DISCUSSIONS Opened (20%) | | |
| Feb. | 2 | What Darwin missed: The unit of heritability part 2
<i>Video: TBD 60 min</i> |
| | 7 | What Darwin missed: Speciation |
| | 9 | MIDTERM (20%)
Exam Centre on McCaul St. 2 hours |

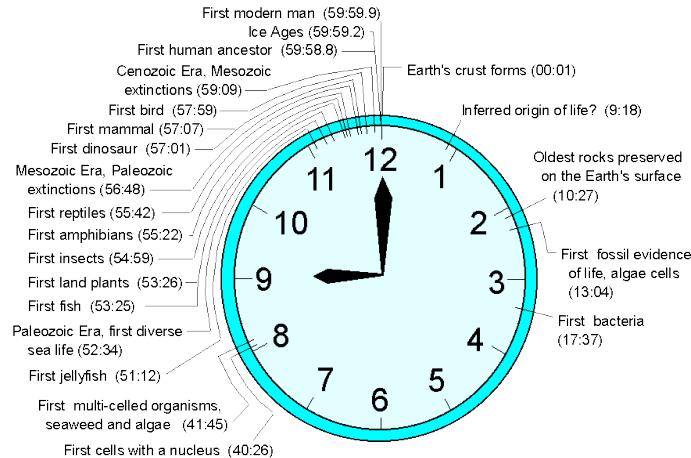
Brief (really brief) history of time



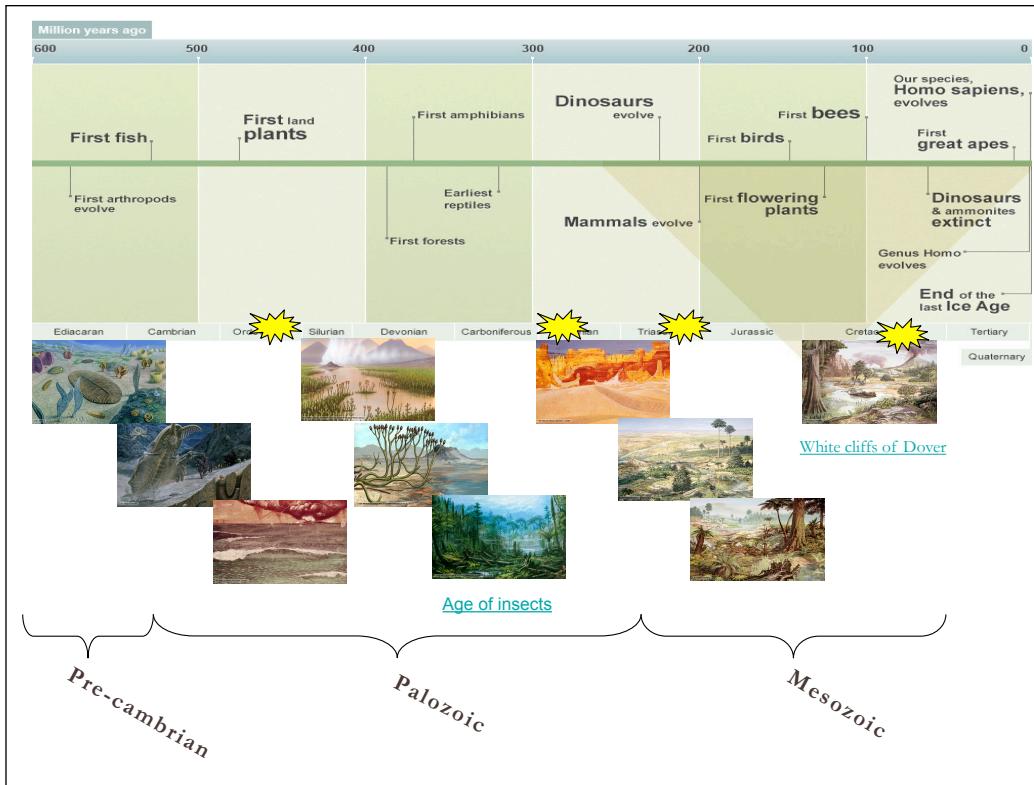
<http://www.bbc.co.uk/news/10577055>

Brief (really brief) history of time

We humans don't rock up until a couple of minutes before midnight

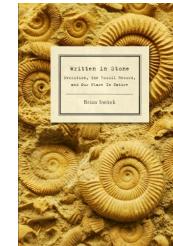


4.6 billion years in one hour

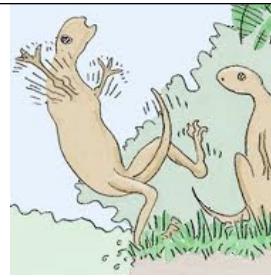


The fossil record

"The fossil record does not contain a complete roll of every living thing that ever lived. It is rare that a living thing dies in circumstances amenable to fossilisation, and even among this fossil pool the remains of many organisms are destroyed by geological processes. Of this fraction of a fraction only a very few specimens exist in rocks accessible to scientists, and of that tiny slice fewer still are collected and studied. The discovery of any fossil with transitional features that helps us understand the transformation of one form into another is cause for celebration, and most celebrated of all are those that connect familiar animals to their extinct forerunners"



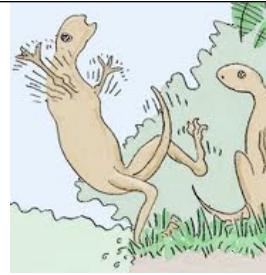
Fossilisation



- Fossilisation requires that animals and plants must die, preferably somewhere near water, sink to the bottom, and get quickly covered in sediments.

Why?

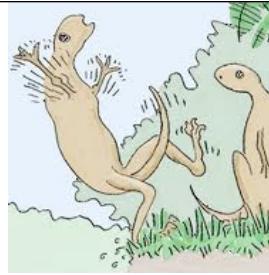
Fossilisation



- Fossilisation requires that animals and plants must die, preferably somewhere near water, sink to the bottom, and get quickly covered in sediments.
- Once buried, soft tissues (usually) decays, and the hard parts are filled in with sediments that crystallise - soft bodied animals...

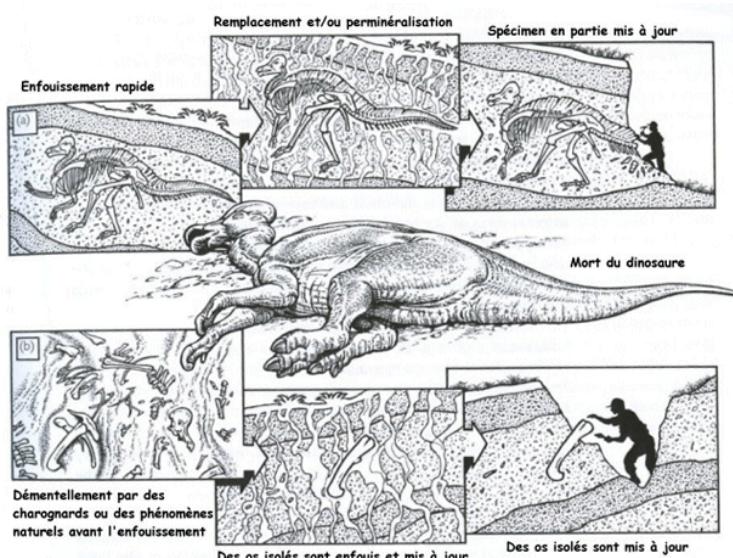


Fossilisation



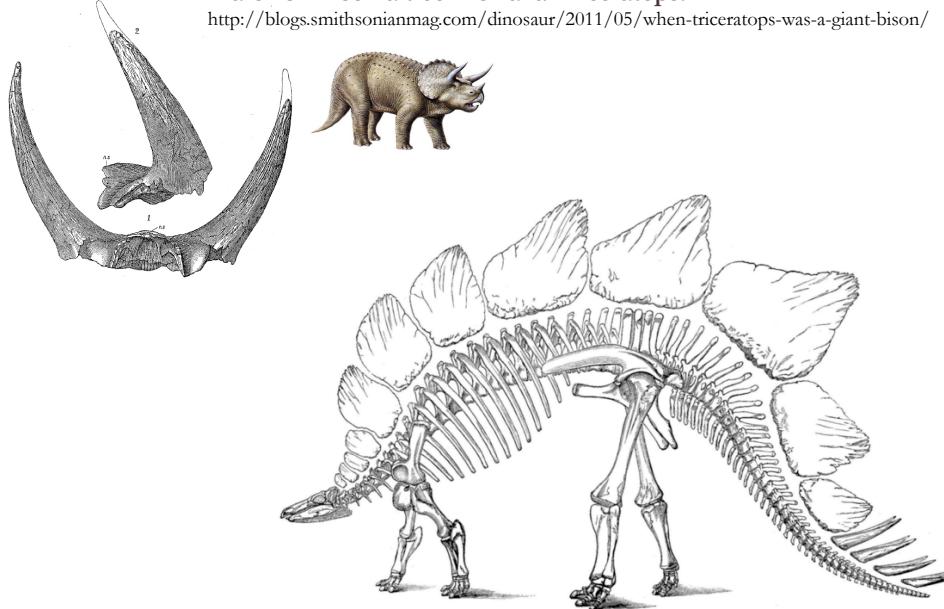
- Fossilisation requires that animals and plants must die, preferably somewhere near water, sink to the bottom, and get quickly covered in sediments.
- Once buried, soft tissues (usually) decays, and the hard parts are filled in with sediments that crystallise - soft bodied animals don't fossilise well, therefore early life forms are little understood, bones and teeth are abundant, as are shells and insects.
- Fossils have to survive folding, heating and crushing forces.
- Exposure to the elements, and if they/we are lucky, very lucky, someone stumbles over them.

Fossilisation



Marsh's "Bison alticornis" aka Triceratops:

<http://blogs.smithsonianmag.com/dinosaur/2011/05/when-triceratops-was-a-giant-bison/>



Marsh's eight-spiked Stegosaurus (roof-lizard):

<http://blogs.smithsonianmag.com/dinosaur/2011/05/the-myth-of-the-eight-spiked-stegosaurus/>

What would evidence for evolution in the fossil record look like?

If we assume that rocks are laid down on top of each other so that oldest are the deepest - Principle of Superposition, **what would we expect to see in terms of life in the deepest layers? As you move up? In the shallowest layers?**

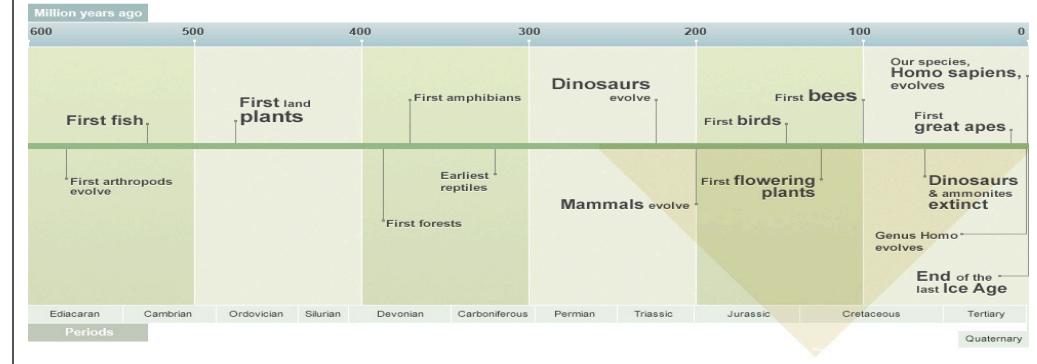
[THINK: Common ancestry, Gradualism, Evolution]

If life gets more complex through evolutionary time, the simplest should be at the bottom. **TRUE**

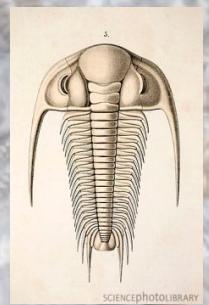
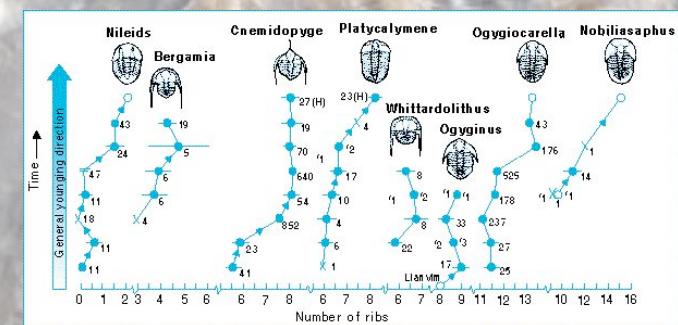
Animals in adjacent layers are more similar to each other than animals further apart, and you should see gradual change as you move up. **TRUE**

If species are related to one another then you would expect to see evidence of their ancestors in the rocks. **YEP.**

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Transitional forms/Missing links

TUESDAY, APRIL 15, 2009 | MAIL ONLINE | YOUR PAPERS | FEEDBACK | MY STORES

Mail Online

Tuesday, April 15, 2009

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Smile from 2m years ago: Revealed, the face of the 'missing link' between ape and man

Paleo-artist bases painting on the well-preserved skeleton of a boy

'Missing link' fungi fo

By Pallab Ghosh
Science correspondent, BBC News

Scientists have identified what may be the "missing link" connecting fungi to plants, animals and bacteria.

The beautifully preserved remains of a 47-million-year-old, lemur-like creature have been unveiled in the US.

The preservation is so good, it is possible to see the outline of its fur and even traces of its last meal.

The fossil, nicknamed Ida, is claimed to be a "missing link" between today's higher primates - monkeys, apes and humans - and more distant relatives.

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The New York Times

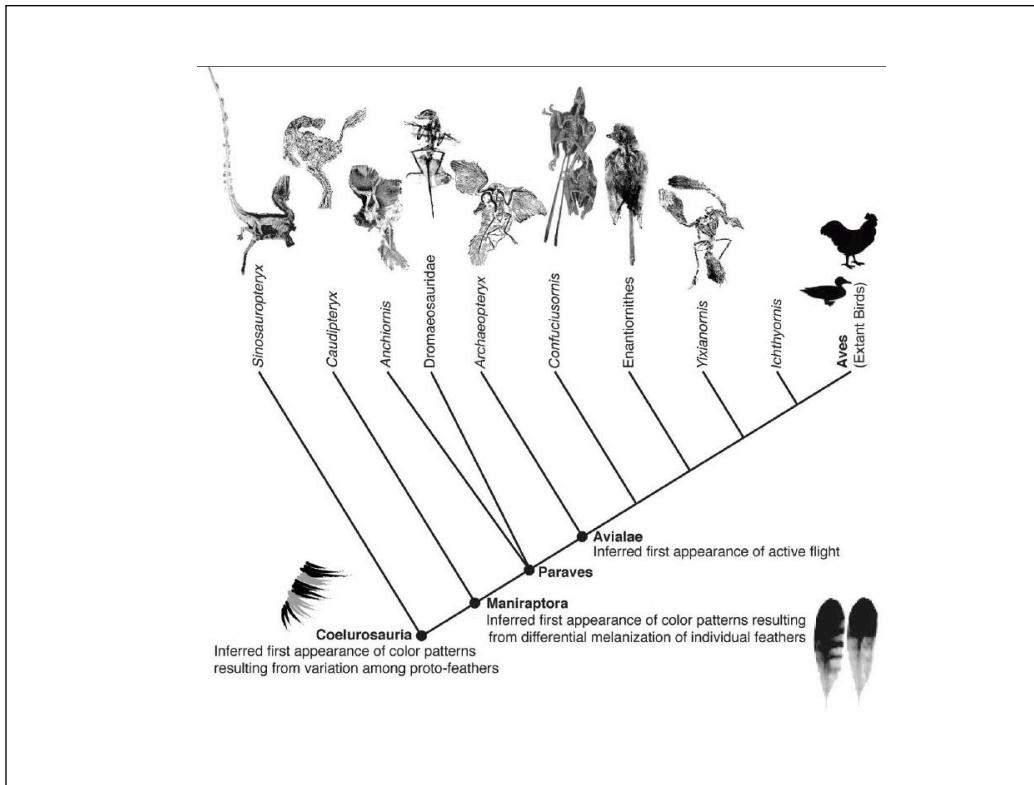
WORLD U.S. N.Y./REGION BUSINESS TECHNOLOGY SCIENCE HEALTH ENVIRONMENT



Scientists Call Fish Fossil the 'Missing Link'

By JOHN NOBLE WILFORD
Published: April 6, 2008

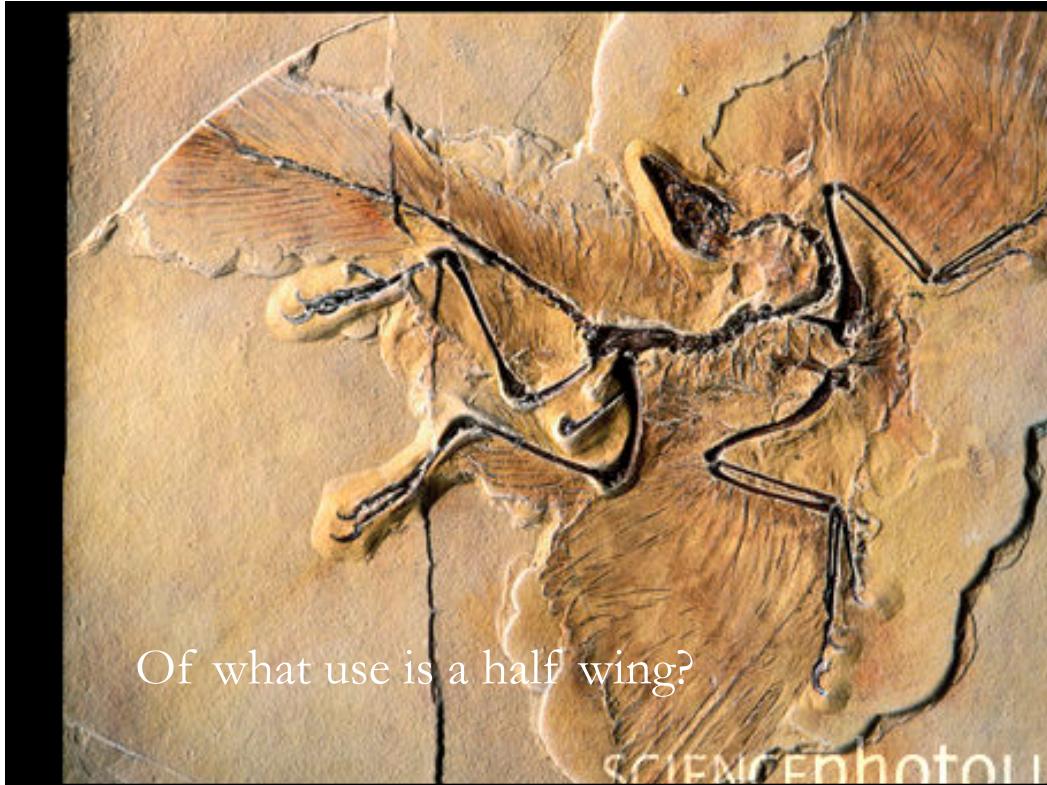
Scientists have discovered fossils of a 375 million-year-old fish, a large scaly creature not seen before, that they say is a long-sought "missing link" in the evolution of some fishes from water to a life walking on four limbs on land.



“I have found it difficult, when looking at any two species, to avoid picturing to myself, forms directly intermediate between them. But this is a wholly false view; we should always look for forms intermediate between each species and a common but unknown progenitor; and the progenitor will generally have differed in some respects from all its modified descendants.”

--Darwin, The Origin





Of what use is a half wing?

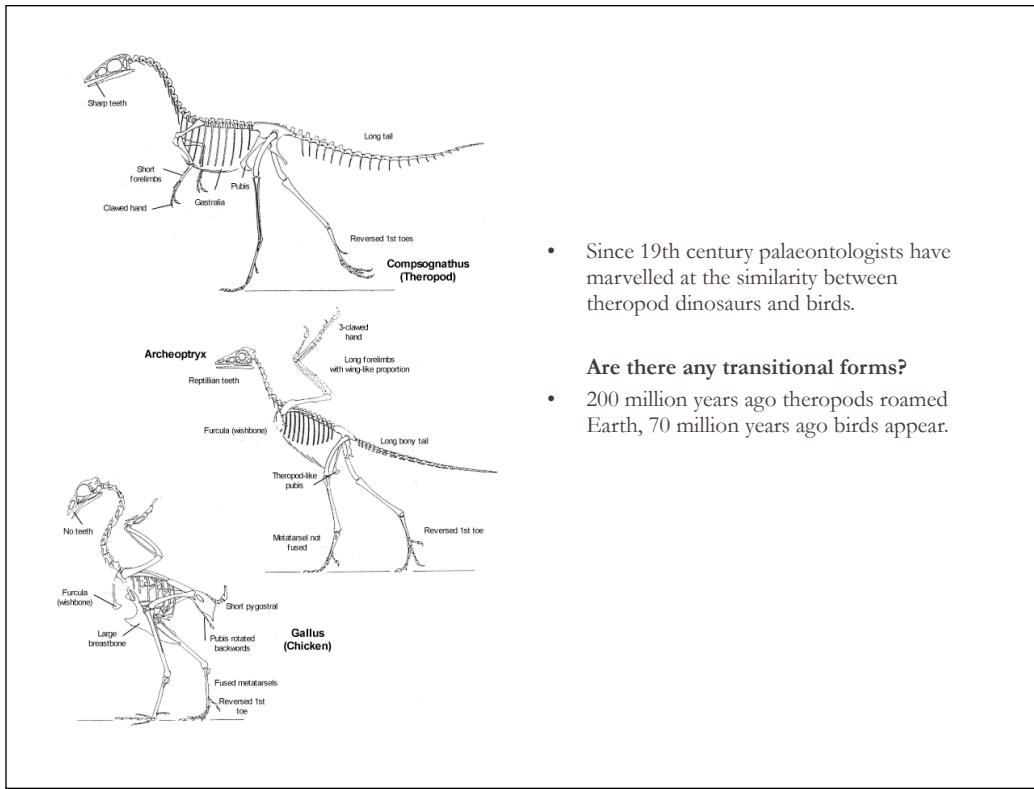
SCIENCEphotou

But can you think of any intermediate forms, where a small wing might have been better than none?



Gliding has evolved independently in marsupials, mammals and lizards





- Since 19th century palaeontologists have marvelled at the similarity between theropod dinosaurs and birds.

Are there any transitional forms?

- 200 million years ago theropods roamed Earth, 70 million years ago birds appear.



Limestone quarry
in Germany 1860

SCIENCEPHOTO

Archaeopteryx “ancient wing”

- **Reptilian-like features:** jaw with teeth, long bony tail, claws, neck attached from behind
- **Bird-like features:** feathers and opposable toes





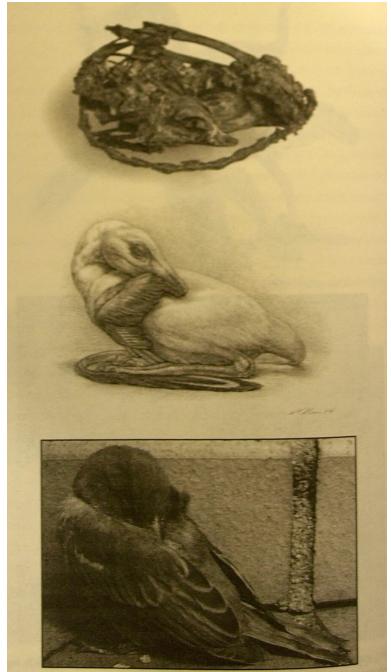
Sinornithosaurus millenii -
whose body was covered in tiny
feathers, so small they couldn't
have helped it fly.



Microraptor gui - who had feathers extending from its wings and legs, and probably used them to glide.



SCIENCEPHOTOLIBRARY



Theropod dinosaurs also behaved like birds,
sleeping and brooding their eggs.

Mei long - “soundly sleep
dinosaur” is a theropod
dinosaur fossilised when it
was sleeping



So far...

- Non-flying feathered dinosaurs date to 135-110 million years ago, while Archaeopteryx is from 145 million years ago.
- Therefore these animals were not Archaeopteryx's direct descendants, but they could be cousins.
- This generates a testable prediction that we will find older specimens.



WIRED SCIENCE

NEWS FOR YOUR NEURONS



Four-Winged Fossil Bridges Bird-Dinosaur Gap

By Sid Perkins, Science News | September 25, 2009 | 3:10 pm | Categories: Earth Science



BRISTOL, England — A newly described, profusely feathered

understanding of bird and flight evolution, researchers report.

Birdlike Dinosaur Fossil May Shake Up the Avian Family Tree



Xing Xu/Nature, via Agence France-Presse — Getty Images

FEATHERED A chicken-size 155-million-year-old dinosaur found in China.
By JOHN NOBLE WILFORD
Published: August 1, 2011

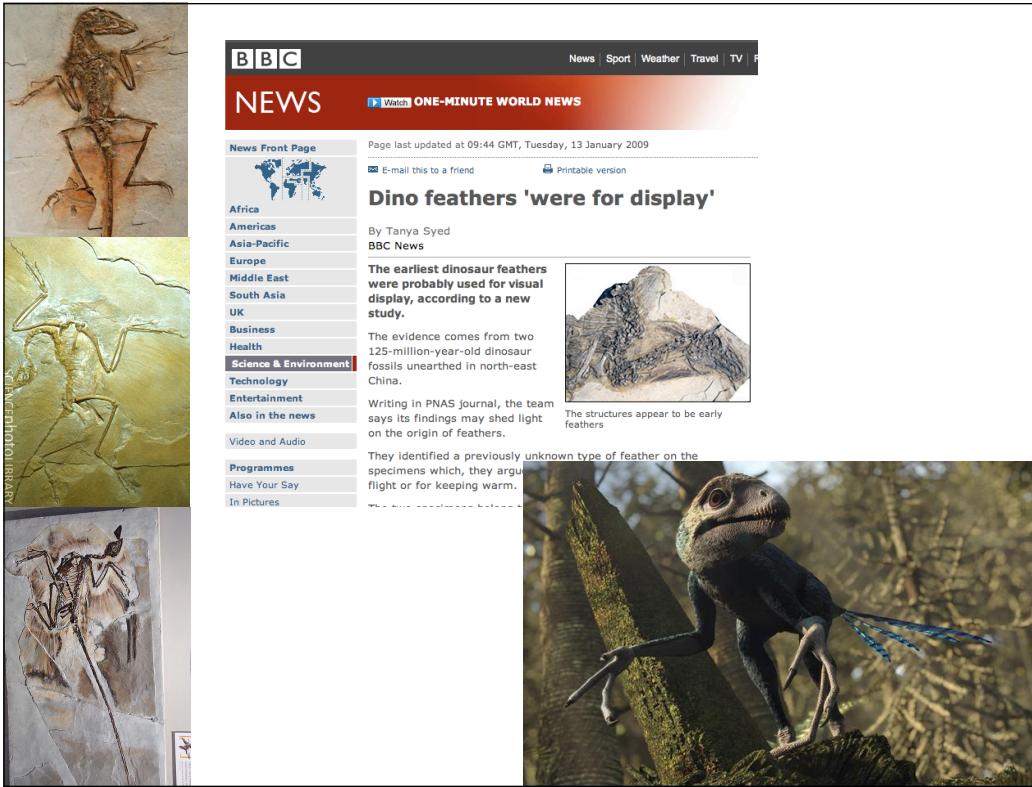
In the 150 years since its discovery in Germany, *Archaeopteryx* has perched high on the avian family tree as the earliest and most primitive bird, somewhere near the evolutionary moment when some dinosaurs gave rise to birds. But recent fossil finds cast doubt on this interpretation: *Archaeopteryx* may be only a birdlike dinosaur rather than a dinosaurlike true bird.

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- **Feathers evolved before flight, so what were they used for?**
- **How did flight evolve in theropods?**



The image shows three fossilized dinosaur skeletons displayed on a BBC News website page. The top image is a detailed brown fossil of a small theropod. The middle image is a yellowish-green fossil of a similar small theropod. The bottom image is a white fossil of a larger theropod, possibly a Deinonychus. The BBC News header is visible at the top, along with a navigation bar and a sidebar with links to various news categories.

Dino feathers 'were for display'

By Tanya Syed
BBC News

The earliest dinosaur feathers were probably used for visual display, according to a new study.

The evidence comes from two 125-million-year-old dinosaur fossils unearthed in north-east China.

Writing in PNAS journal, the team says its findings may shed light on the origin of feathers.

They identified a previously unknown type of feather on the specimens which, they argue, flight or for keeping warm.

The structures appear to be early feathers



“ground-up” OR “tree-down”?

- Evidence exists that therapods lived partly in trees, feathery forearms would help these animals cushion a fall or glide to evade predators.
- Evidence from today's birds that dinosaurs could have used rudimentary wings to help them run uphill to evade predators.
(Chukar birds can run up vertical walls propelled by their wings)



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- We see progression from tiny theropods with light covering of feathers to dinosaurs that glided (the deepest/oldest are least birdlike)
- We see refashioning of old features (hands and fingers and skin) into new ones (fingerless wings and feathers)

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Feathers in amber (2011)



How did fish evolve to survive on land?





Ancient Tracks Question Ideas About Tetrapod Origins

[http://scienceblogs.com/laelaps/2010/01/
an_early_tetrapod_that_made_it.php](http://scienceblogs.com/laelaps/2010/01/an_early_tetrapod_that_made_it.php)