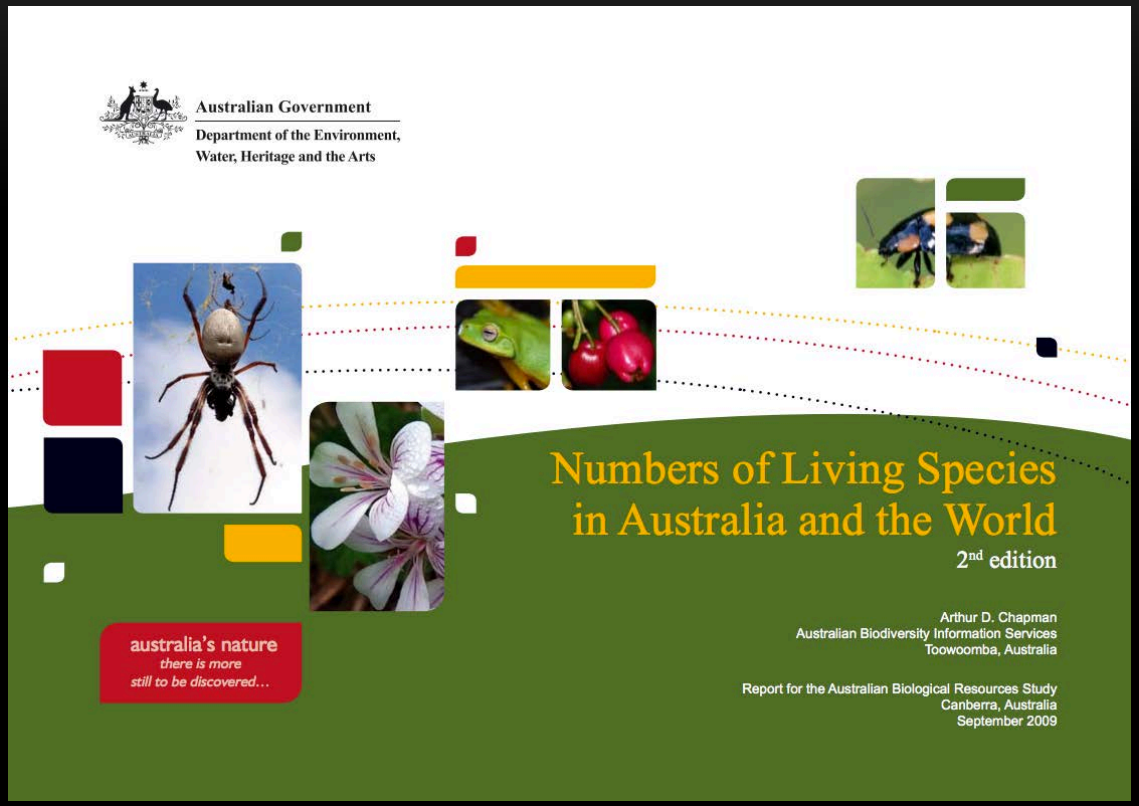
MAKING GOOD TIME:

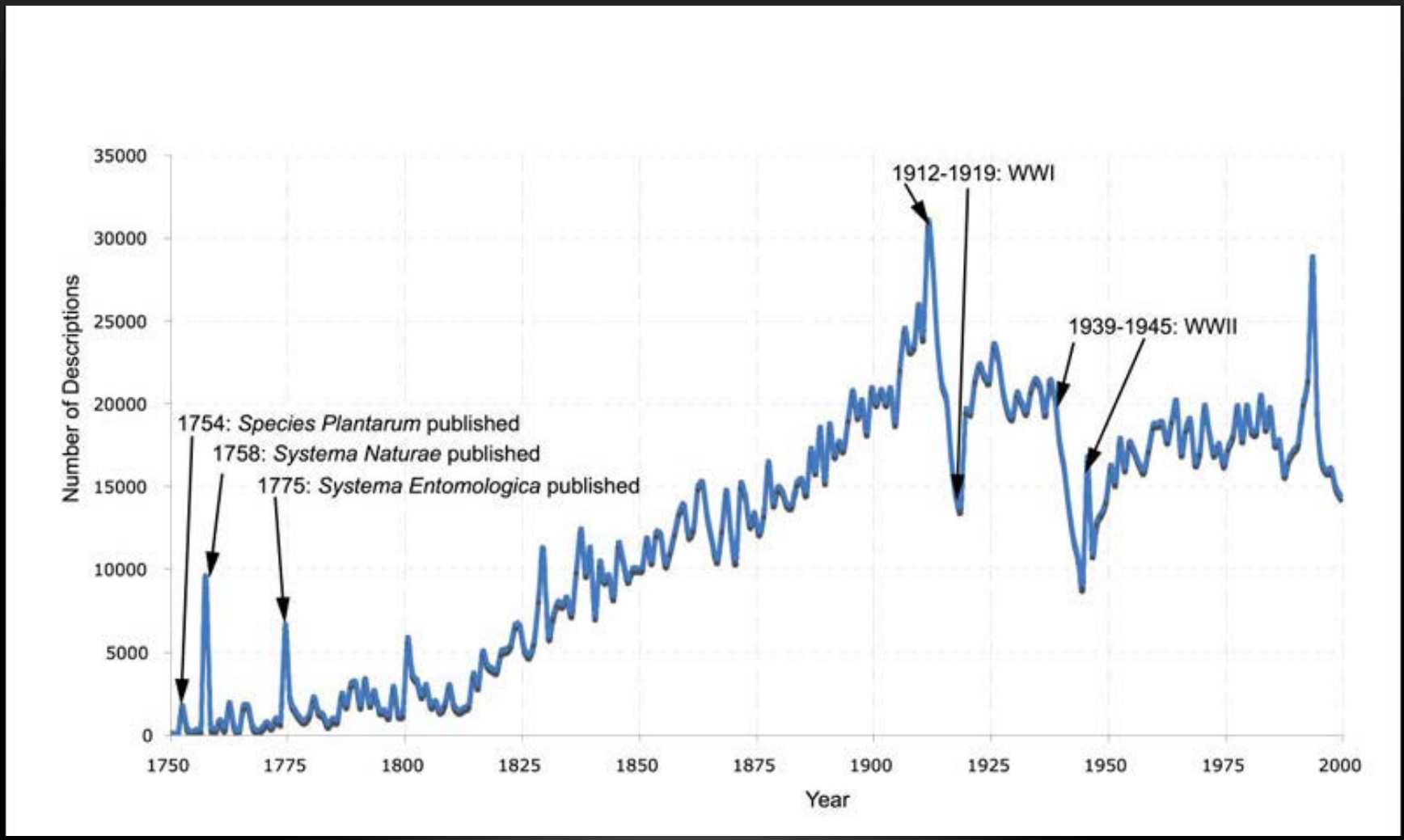
EXPLORING EARTH'S SPECIES

Quentin Wheeler

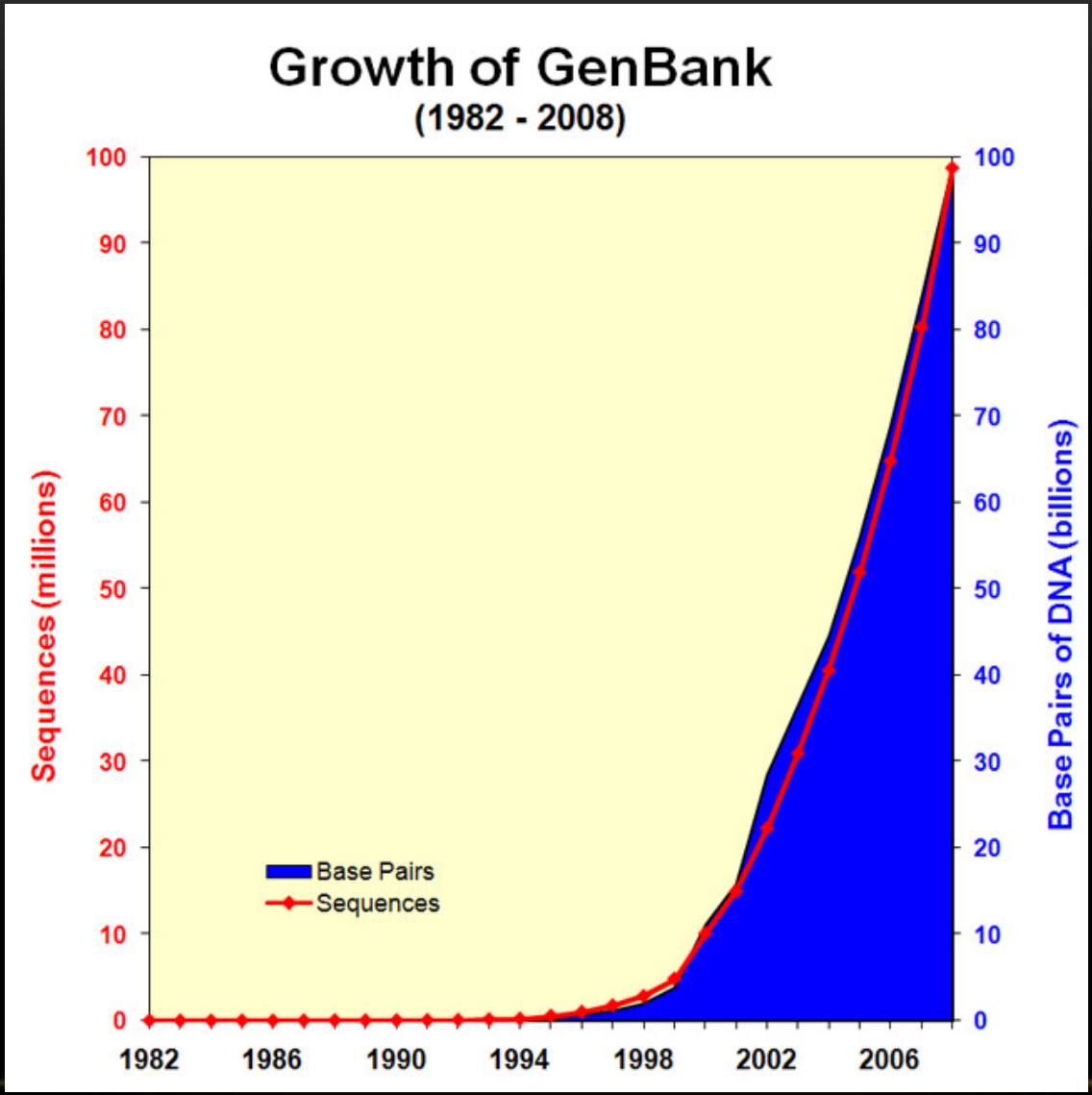
ORIGINS: THE EVOLUTIONARY CONTINUUM

“How many species of organisms are there on Earth? We do not know, not even to the nearest order of magnitude.” — E. O. Wilson, 1985


Australian Government
Department of the Environment,
Water, Heritage and the Arts
Numbers of Living Species
in Australia and the World
2nd edition
australia's nature
there is more
still to be discovered...
Arthur D. Chapman
Australian Biodiversity Information Services
Toowoomba, Australia
Report for the Australian Biological Resources Study
Canberra, Australia
September 2009



SOURCE: I.N. SARKAR, R. SCHENK & C. NORTON (2008)



SOURCE: NCBI GENBANK STATISTICS (1982-2008)

DOUBLING TIME

- Sum Human Knowledge 2 years
- GenBank 1.5 years
- Species 114 years

By the Select Committee appointed to consider Science and Technology.

ORDERED TO REPORT

WHAT ON EARTH?

The Threat to the Science underpinning conservation

Summary

In 1992 the United Kingdom signed the Convention on Biological Diversity (CBD), ratifying it two years later. Later this year the Prime Minister will follow up this commitment by leading the UK delegation to the World Summit on Sustainable Development in Johannesburg. Discussions at this summit will include how to tackle poverty and enable economic development alongside conserving the world's rich variety of living things and using it in a sustainable manner.

In order to know which parts of the world have a high level of diversity of living things we need experts to identify such areas. In order to know which species to protect from becoming extinct, we need experts to identify those species. In order to know which species could be of great value or of great harm to humans, we need experts to identify those species. In order to save ecosystems, we need experts to improve understandi

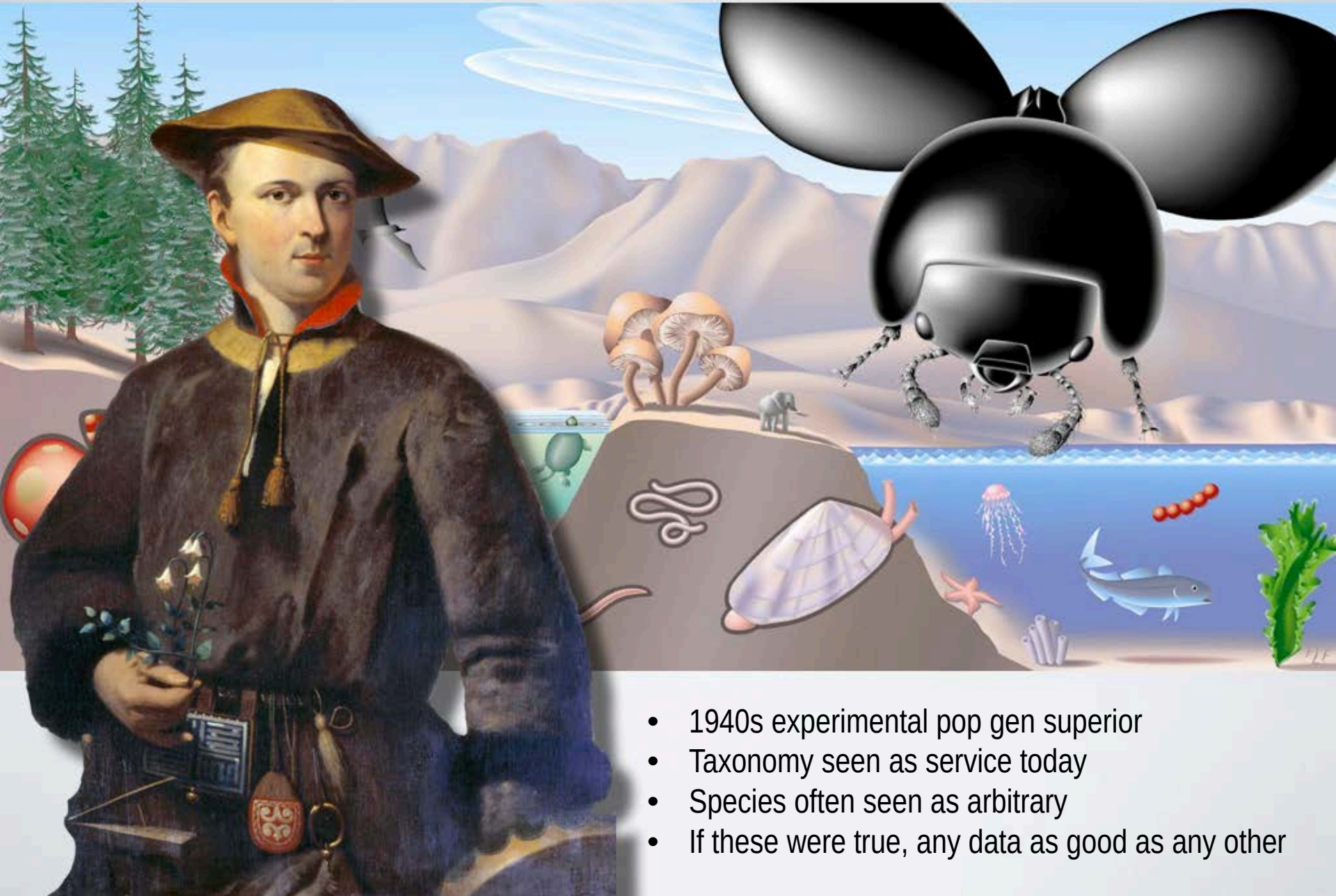
"(taxonomy) is a subject in crisis."

The economic impac gy has a vital role to play in agriculture a[illegible] ology research in the United Kingdom. Last year we heard that this decline continues. This inquiry found compelling evidence that the level of systematic biology expertise in the United Kingdom has, despite some areas of increased activity, continued to fall overall.

Despite signing the CBD, grant-in-aid from successive UK governments to the major systematic biology institutions has declined in real terms. This has led to a decrease in research that supports biodiversity conservation. It has also placed the reference collections of specimens comprising a wide range of biodiversity, which are housed at these institutions, at considerable risk.

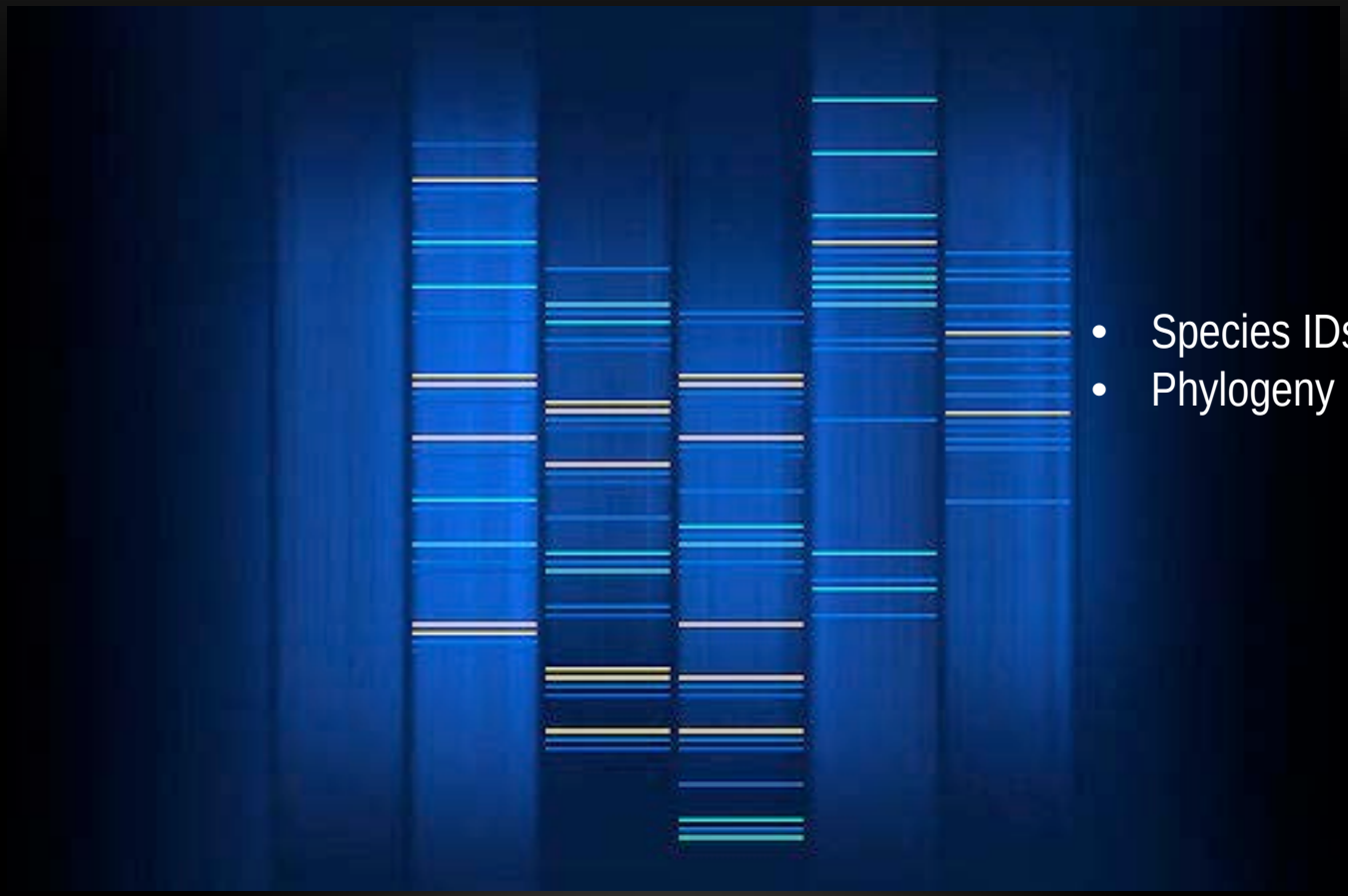
Our recommendations are two-fold in nature. Some relate to increasing financial support. We recommend an increase in Government grant-in-aid to the major systematics institutions in order to protect the collections of biodiversity housed there and to recognise the increase in work-load which has resulted from the UK's obligations under international treaties. We also recommend an increase in Darwin Initiative funding, which uses UK expertise to develop scientific understanding in developing countries. We suggest that the Darwin Initiative should fund more projects to digitise UK collections in order to make more data available on the world-wide web and thus accessible to a larger number and variety of people.


Argument



- 1940s experimental pop gen superior
- Taxonomy seen as service today
- Species often seen as arbitrary
- If these were true, any data as good as any other

DNA-BASED TAXONOMY: SERVICES

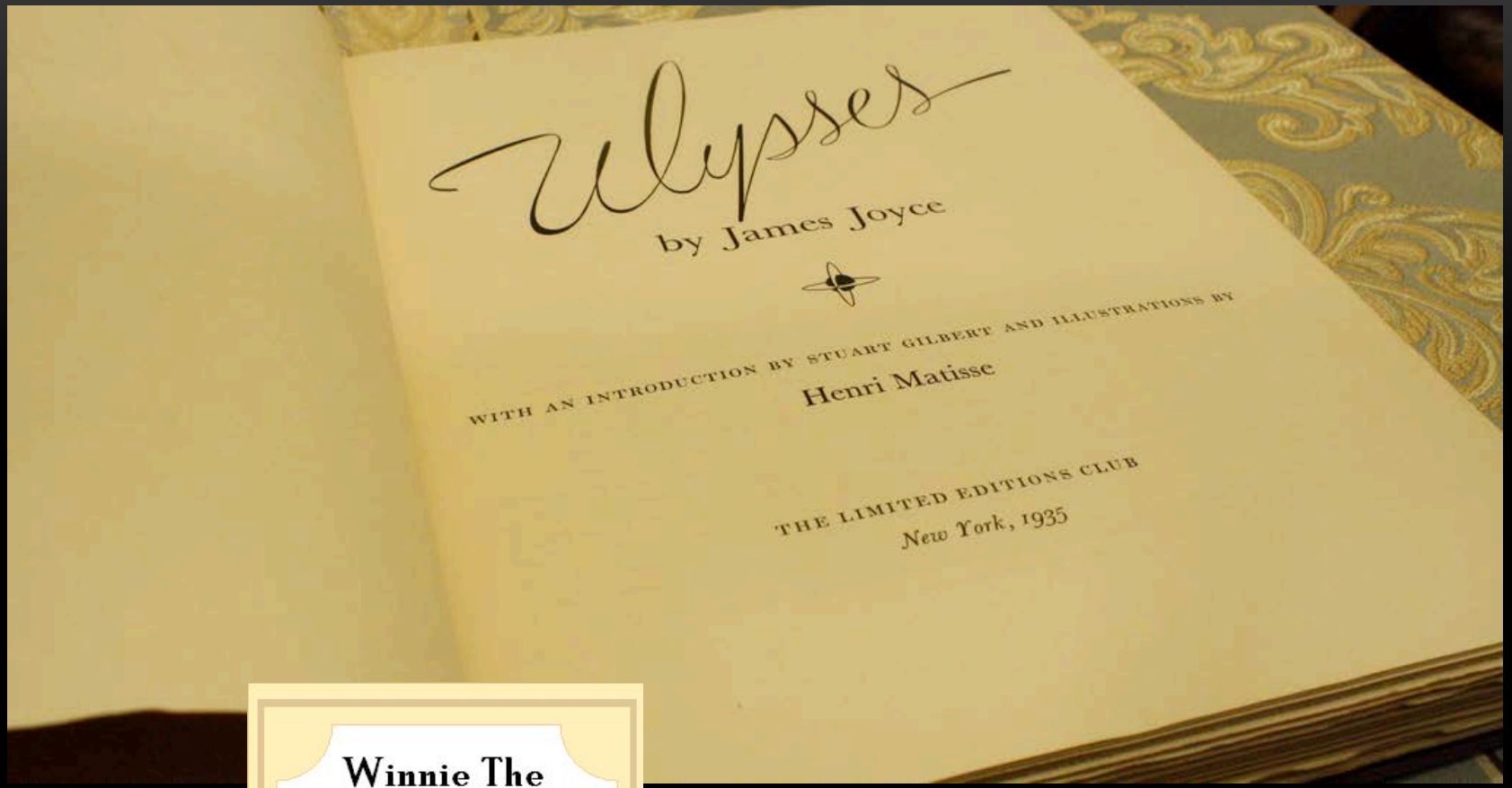


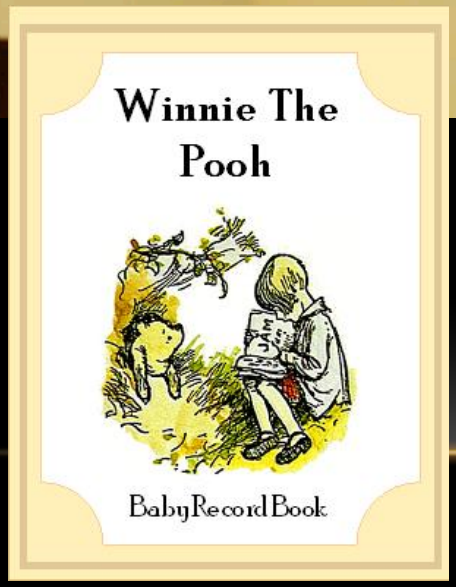
- Species IDs
- Phylogeny

DNA barcodes and species identifications

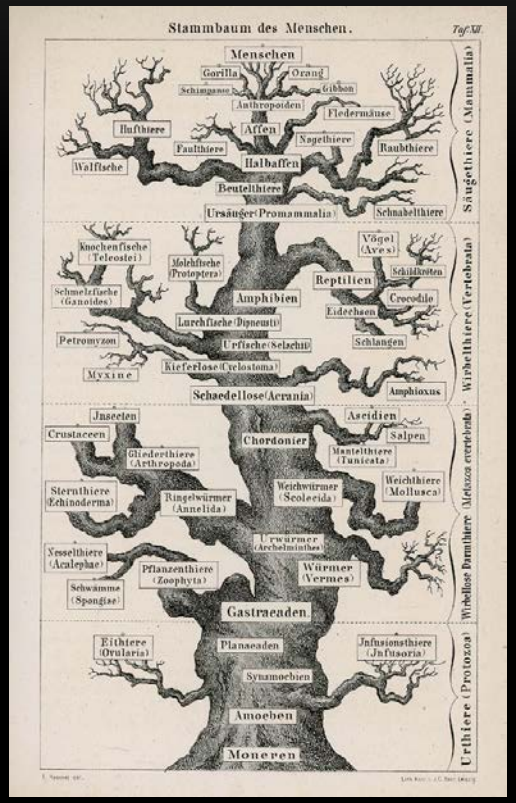
statelyplumpbuckmulligancamefromthestairheadbearingabowloflatheron
whichamirrorandarazorlaycrossedayellowdressinggownungirdledwassus
tainedgentlybehindhimbythemildmorningairheheldthebowlaloftandintoned
introiboadaltaredeihaltedhepeereddownthedarkwindingstairsandcalledup
coarselycomeupkinchcomeupyoufearfuljesuitsolemnlyhecameforwardand
mountedtheroundgunresthefacedaboutandblessedgravelythricethetow
erthesurroundingcountryandtheawakingmountainsthencatchingsightofste
phendedalushebenttowardshimandmaderapidcrossesintheairgurglinginhis
throatandshakinghisheadstephendedalusdispleasedandsleepyleanedhisarm
sonthetopofthestaircaeandlookedcoldlyattheshakinggug

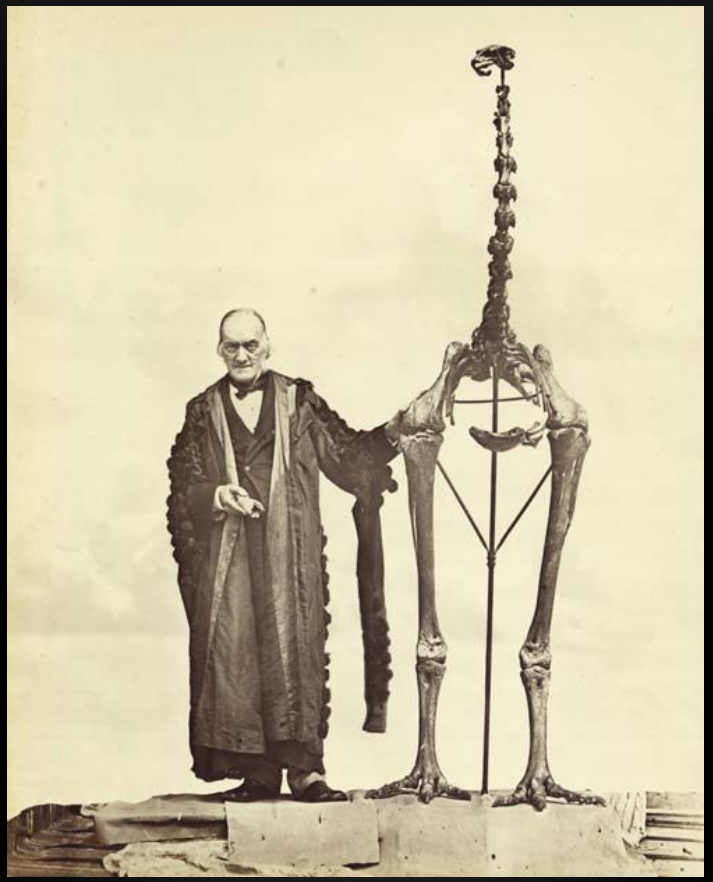
hereisedwardbearcomingdownstairsnowbumpbumpbumponthebackofhis
headbehindchristopherrobinitisasfarasheknowstheonlywayofcomingdown
stairsbutsomegtimeshefeelsthatthererealyisanotherwayifonlyhecouldstop
bumpingforamomentandthinkofitandthenhefeelsthatperhapsthereisntany
howhereheisatthebottomandreadytobeintroducedtoyouwinniethepoohwheni
firstheardhisnameisaidjustasyouaregoingtosaybutithougthhewasaboysodidi
saidchristopherrobinthenyoucantcallhimwinnieidontbutyousaidheswin
netherpoohdontyouknowwhatthermeansahyesnowidoisaidquicklyandihopey
oudotoobecauseitisalltheexplanationyouaregoingtogetsometimeswinniethe
poohlikesagameofsomesortwhenhecomesdownstairsandsom


Ulysses
by James Joyce
WITH AN INTRODUCTION BY STUART GILBERT AND ILLUSTRATIONS BY
Henri Matisse
THE LIMITED EDITIONS CLUB
New York, 1935


Winnie The Pooh
Baby Record Book

Phylogenetic relationships among species

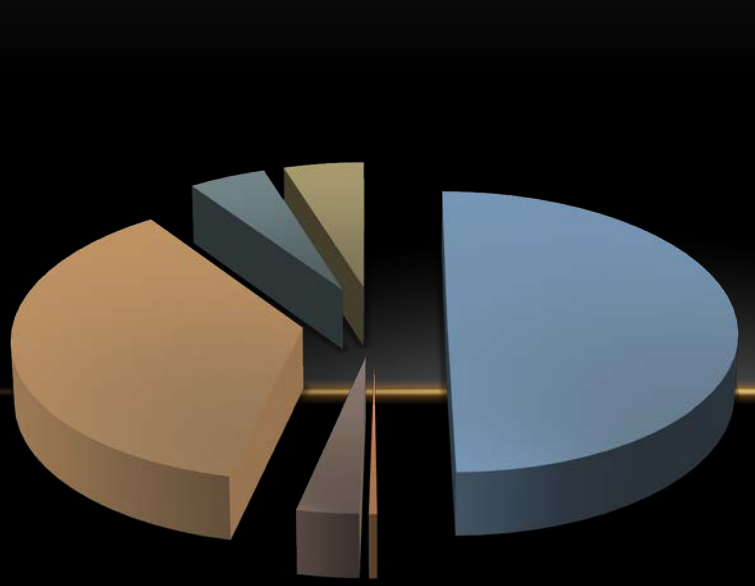




What would it take to describe 10,000,000 additional species in 50 years or less?

1 order of magnitude acceleration of annual rate of description to 200,000 spp/yr

Decadal Survey of Astronomy and Astrophysics, 2012-2021



- Ground Large ($4.21 billion)
- Ground Medium ($37 million)
- Ground Small ($270 million)
- Space Large ($3.1 billion)
- Space Medium ($400 million)
- Space Small ($415 million)

Source: *Nature*, 19 August 2010. Total=$8.4B
Same period. NSF= $7.3B. DEB=$1.3B.

Systematics and Biodiversity (2012), **10(1)**: 1–20

Taylor & Francis

Perspective

Mapping the biosphere: exploring species to understand the origin, organization and sustainability of biodiversity

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(Received 21 January 2012; accepted 6 February 2012)

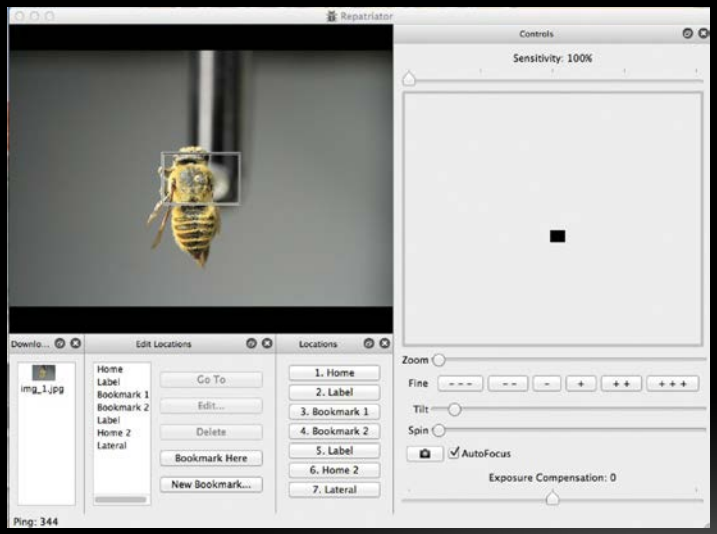
We have allowed taxonomy to be define narrowly when it is in fact by nature multifaceted and trans-disciplinary

Infrastructure

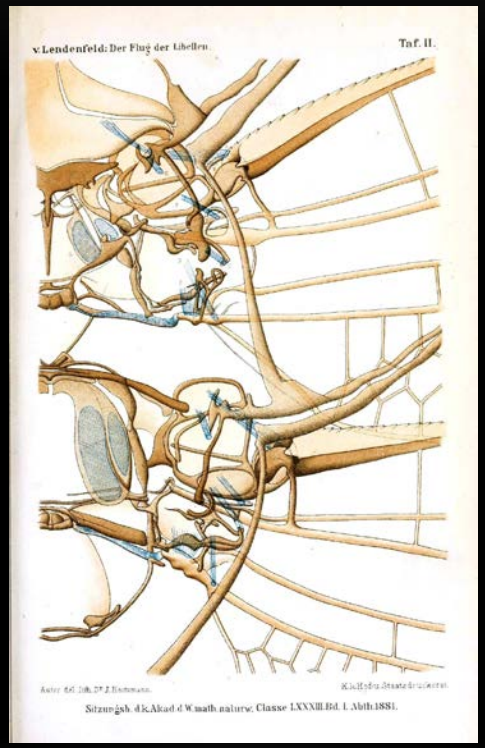
- Collections (traditional)
- Collections (DNA, recordings, etc.)
- Cyber-infrastructure
  - Classification Commons
  - Access to research resources

Taxonomy

- Morphology
- Ontogeny
- Paleontology
- DNA
- Nomenclature
- Monography
- Geography
- Phylogenetics


Repatriator
Controls
Sensitivity: 100%
Downlo...
Edit Locations
Locations
img_1.jpg
Home
Label
Bookmark 1
Bookmark 2
Label
Home 2
Lateral
Go To
Edit...
Delete
Bookmark Here
New Bookmark...
1. Home
2. Label
3. Bookmark 1
4. Bookmark 2
5. Label
6. Home 2
7. Lateral
Zoom
Fine
Tilt
Spin
AutoFocus
Exposure Compensation: 0
Ping: 344

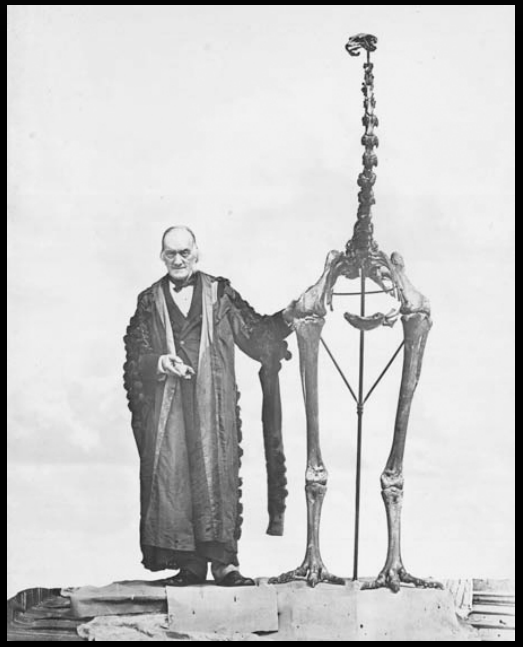
MORPHOLOGY IS END, NOT (OUTDATED) MEANS

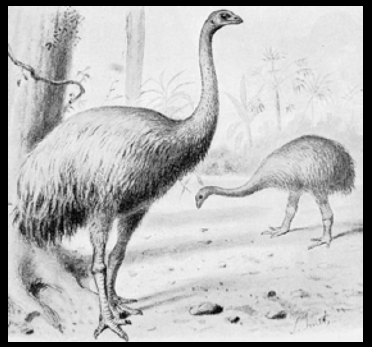


DUALITY OF TAXONOMY

- Inventory, describe, name, and phylogenetically classify millions of species that are results and record of evolutionary history
- Explore and understand sequence and history of character transformations from common ancestral single-celled species to billions of derived characters seen among living species

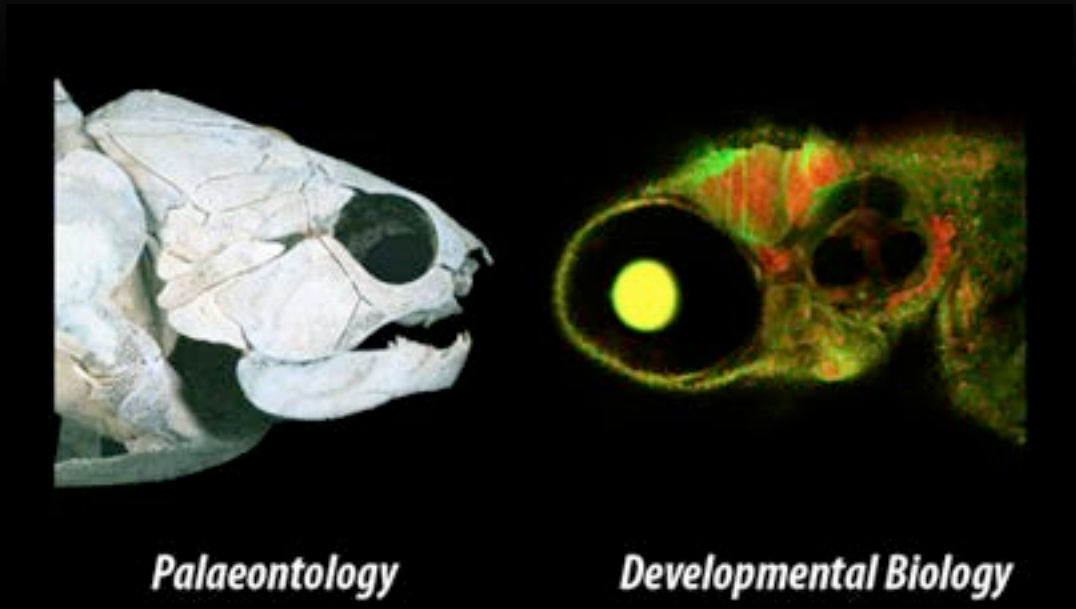
A FEW ADDITIONAL REASONS TO DESCRIBE MORPHOLOGY





RECOGNIZE OBJECTS OF NATURAL SELECTION

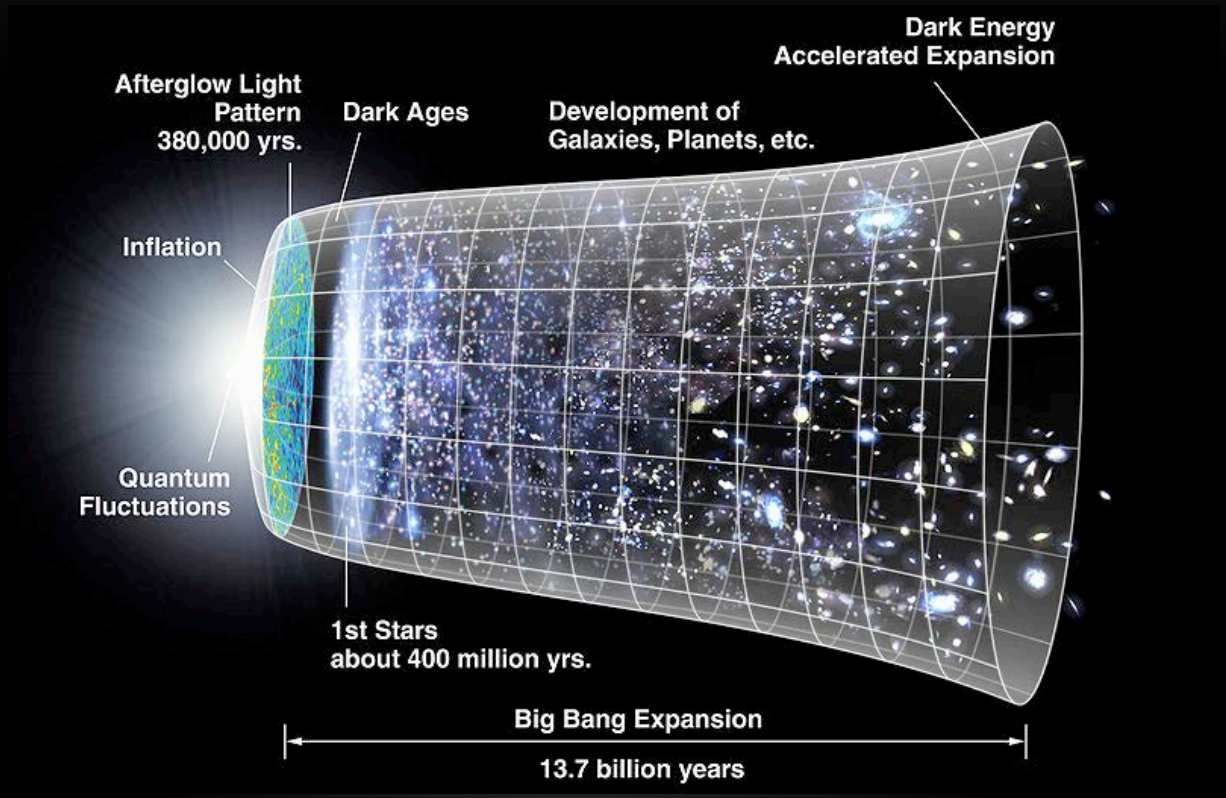
DIRECT COMPARISON WITH FOSSIL SPECIES TRACK DEVELOPMENTAL SEQUENCE (ONTOGENY)



MINE ADAPTATIONS FOR BIOMIMICRY

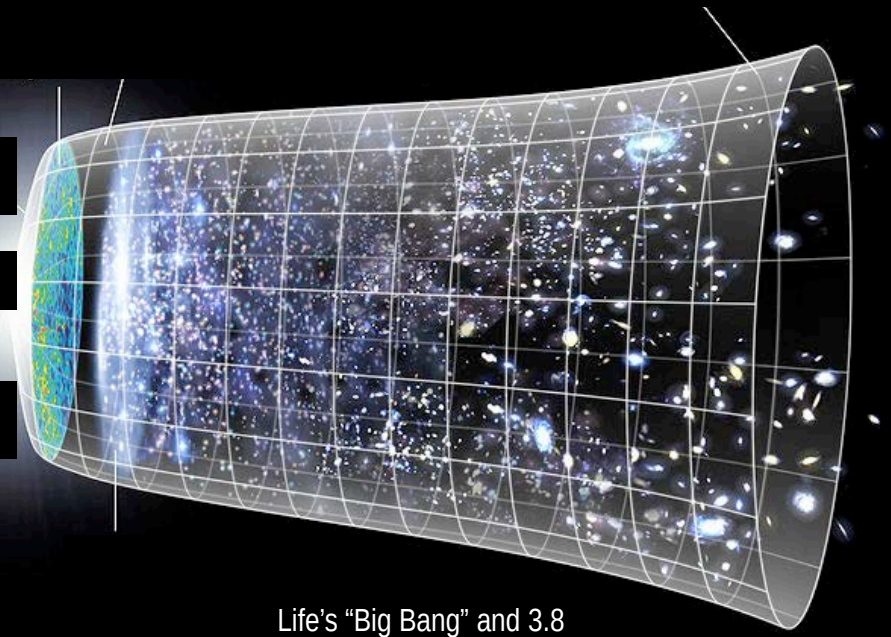
EYEBALL ENTOMOLOGY

COSMOLOGY: EXPLORE & DESCRIBE KINDS OF OBJECTS AND THEIR PROPERTIES IN UNIVERSE, UNDERSTAND THEIR ORIGINS AND HISTORIES



TAXONOMY: EXPLORE & DESCRIBE KINDS OF LIVING THINGS IN BIOSPHERE AND THEIR PROPERTIES, UNDERSTAND THEIR ORIGINS AND HISTORIES

Reconstruct Phylogeny *and* History of Character Transformations



Ancestral “Eve” Species

12 Million Eukaryotic Species +
Billions and Billions of Apomorphies

Life’s “Big Bang” and 3.8 Billion Year Expanding Universe of Biological Diversity