

Hot Science Cool Talks

UT Environmental Science Institute

66

Remarkable Creatures

Dr. Sean B. Carroll

April 30, 2010

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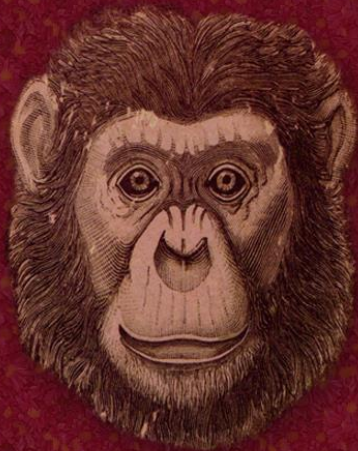


REMARKABLE
CREATURES

EPIC ADVENTURES

IN THE SEARCH FOR THE

ORIGINS OF SPECIES





Adventure:

“A mixture of spirit and deed”

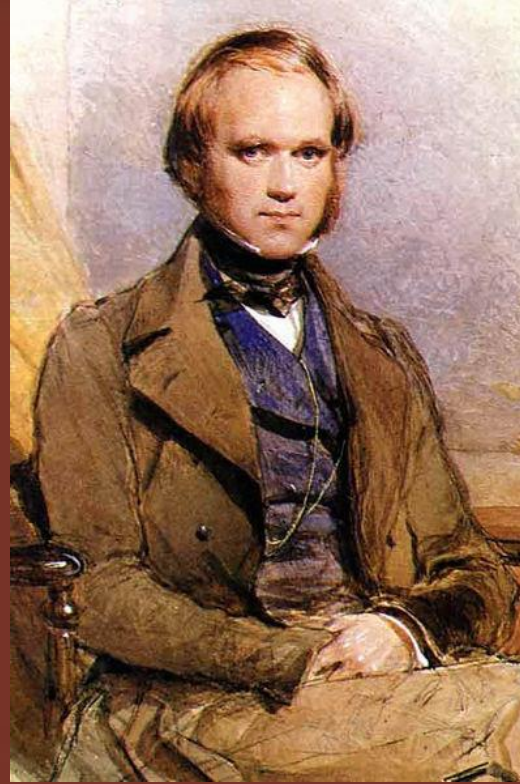
- C.W. Ceram



Alfred Wallace

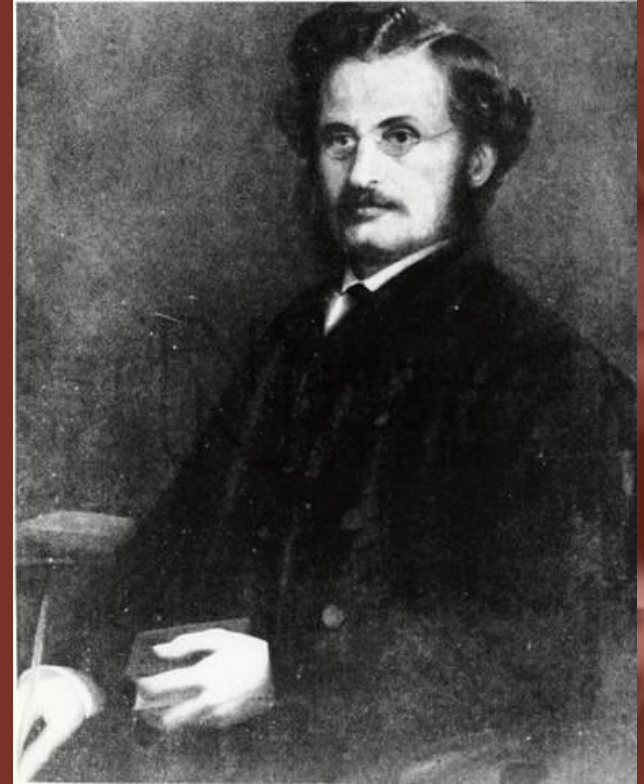
Amazon 1848-1852

Malay Archipelago
1854-1862



Charles Darwin

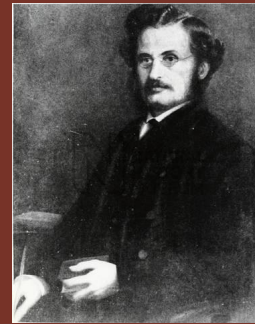
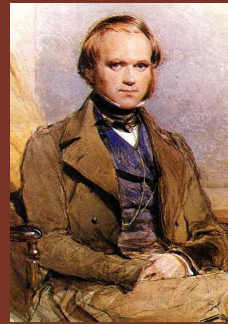
Around the world
1831-1836



Henry Walter Bates

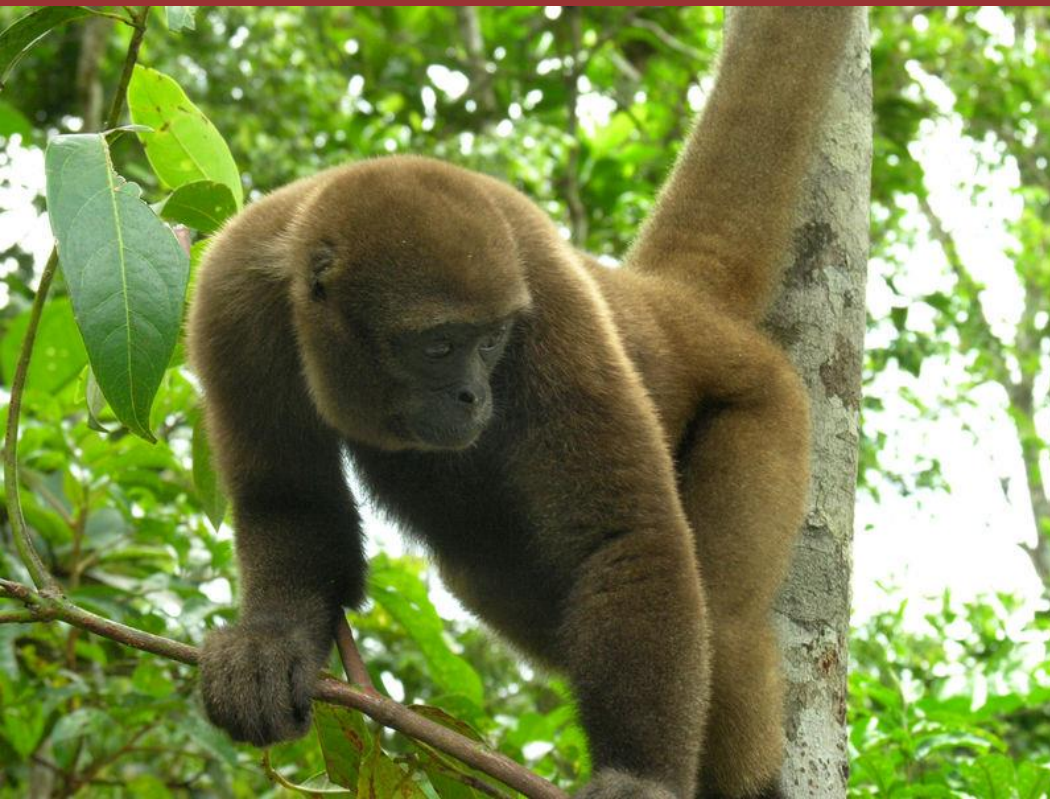
Amazon 1848-1859

The first golden age :
The Making of a Theory





Alfred Russel Wallace (c. 1848)



August 6, 1852

1130 km east of Bermuda

“I am afraid the ship’s
on fire. Come & see
what you think of it.”

“I got up a small tin
box with a few shirts
in it & put in my fish
drawings...”

Rainy Anderson Lat. N. 49.50 Long. W. 20 Sunday, Sept 19th. 1852.

[F102]
WP1/3/24

My dear Friend

Having now some prospect of being home in a week or ten days I will commence giving you an account of the peculiar circumstances which have already kept me at sea seventy days on a voyage which took us only 24 on our passage out. I hope you have received the letter I sent you from Paris dated July 4th P.M. in which I informed you that I had taken a passage in a vessel bound for London & was to sail in a few days. On Monday the 12th of July I went on board with all my baggage & some articles purchased or collected on my way down with the remainder (about 20) of my live stock. After being at sea about a week I had a slight attack of fever & almost thought I had got the yellow fever after all. However a little calmed out next night in a few days, but I continued weak some time & spent much of my time reading in the cabin which was very comfortable. On Friday the 6th of August we were in N. Lat. 30.50 W. Long. 52° about about 9 o'clock in the morning just after breakfast the Captain (who was the owner of the vessel) came into the cabin & said "I am afraid the ship's on fire. Come & see what you think of it." Going on deck I found a thick smoke coming out of the fore-castle, which we both thought seemed more like the steam from heating vegetable matter than the smoke of a fire. The fore hatchway was immediately opened to try and ascertain the origin of the smoke & a quantity of "ing." was thrown out but the smoke coming out steadily without any perceptible increase we went to the after hatchway & after throwing out a quantity of Stassala with which the upper part of the ship was loaded the smoke became so dense that the men could not stay down to throw out any more. Most of them were then set throwing in water & the rest proceeded to the cabin & opened the lazarett or stores place beneath its floor & found smoke issuing from the bulkheads which separated it from the hold which extended half way under the fore part of the cabins. Attempts were then made to break down this bulkhead, but it resisted all efforts the smoke being so suffocating as to prevent any one stopping in it more than a minute at a time.

My collections however
were in the hold ...all the
reward of my four years of
privation & danger were
lost....



THE BRIG "HELEN" ON FIRE.

O 2

SHIPWRECKS AND DISASTERS AT SEA

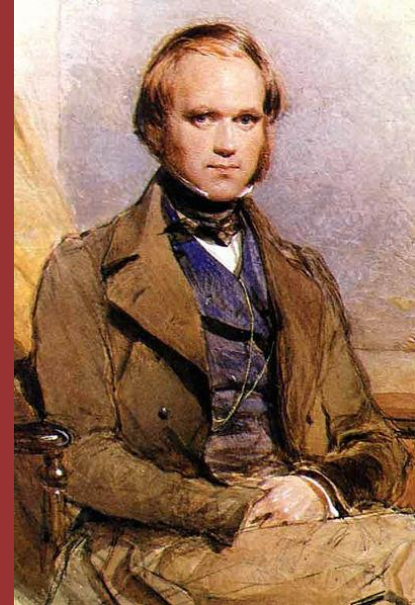
...Day after day we continued in the boats. - We were scorched by the sun, my hands nose & ears being completely skinned, and drenched every day by the seas & spray. We were constantly wet & had no comfort at night. We had [a] short allowance of water, which left us constantly thirsty.”



THE BRIG "HELEN" ON FIRE.

O 2

SHIPWRECKS AND DISASTERS AT SEA



VOYAGES
OF THE
ADVENTURE
AND
BEAGLE.

VOL. III.

DARWIN.

FAUNA
8^{1/2}

96

COLBURN
LONDON

NARRATIVE
OF THE
SURVEYING VOYAGES

OF HIS MAJESTY'S SHIPS

ADVENTURE AND BEAGLE,

BETWEEN

THE YEARS 1826 AND 1836,

DESCRIBING THEIR

EXAMINATION OF THE SOUTHERN SHORES

OF

SOUTH AMERICA,

AND

THE BEAGLE'S CIRCUMNAVIGATION OF THE GLOBE.

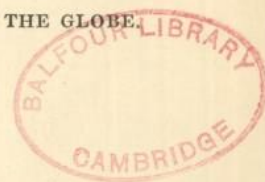
IN THREE VOLUMES.

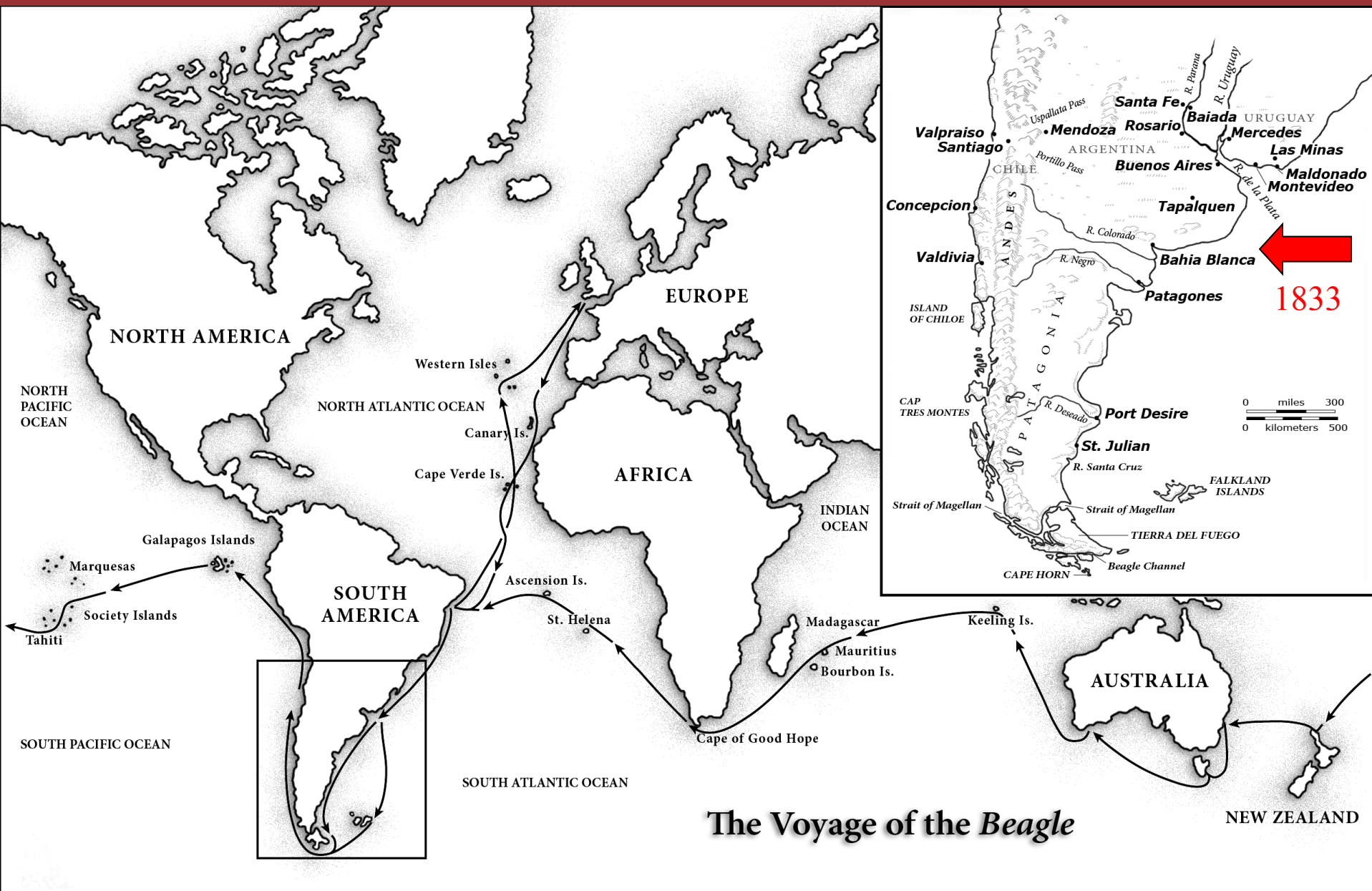
VOL. III.

LONDON:

HENRY COLBURN, GREAT MARLBOROUGH STREET.

1839.







Top View of the Skull of the Tacedon.
One-third the Nat. Size.
Published by Smith, Elder & Co. 25, Abchurch Lane, London.

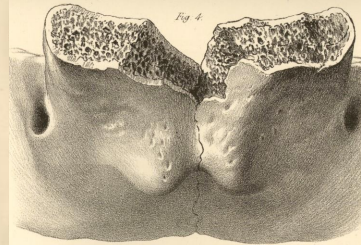


Fig 4

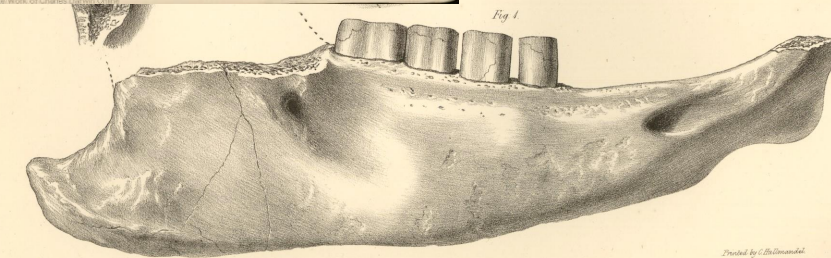
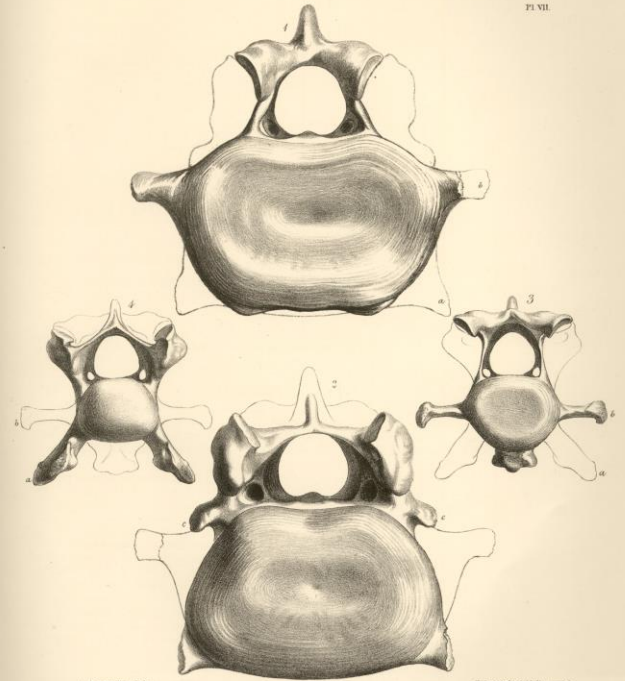


Fig 1

Mylodon.
Fig 1. Nat. Size. Fig 2. 3/4. Nat. Size.



C. Schlegel del et lithog.

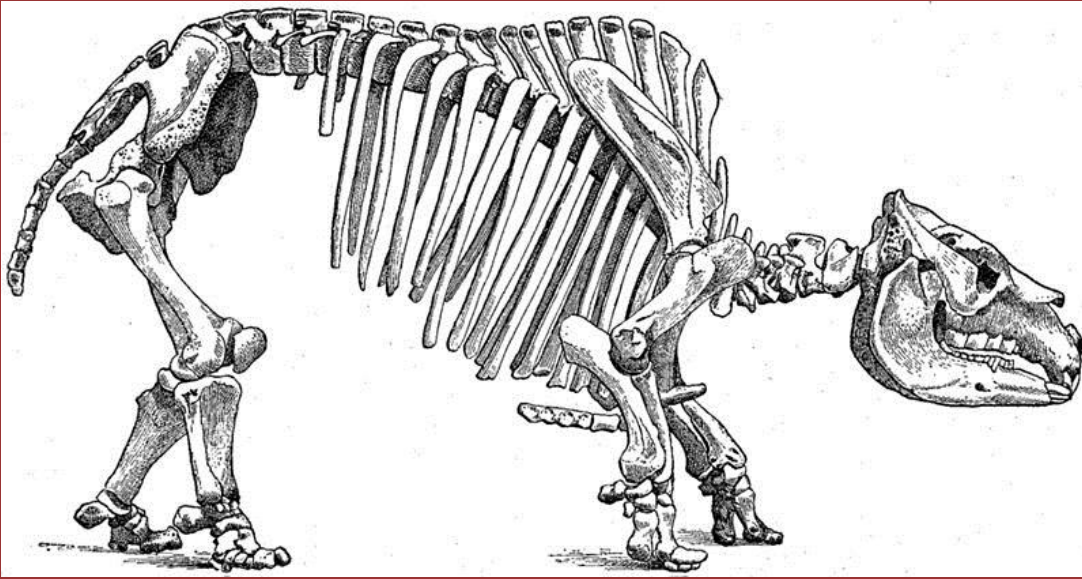
Nat. Size

Engraved by C. Meunier del.

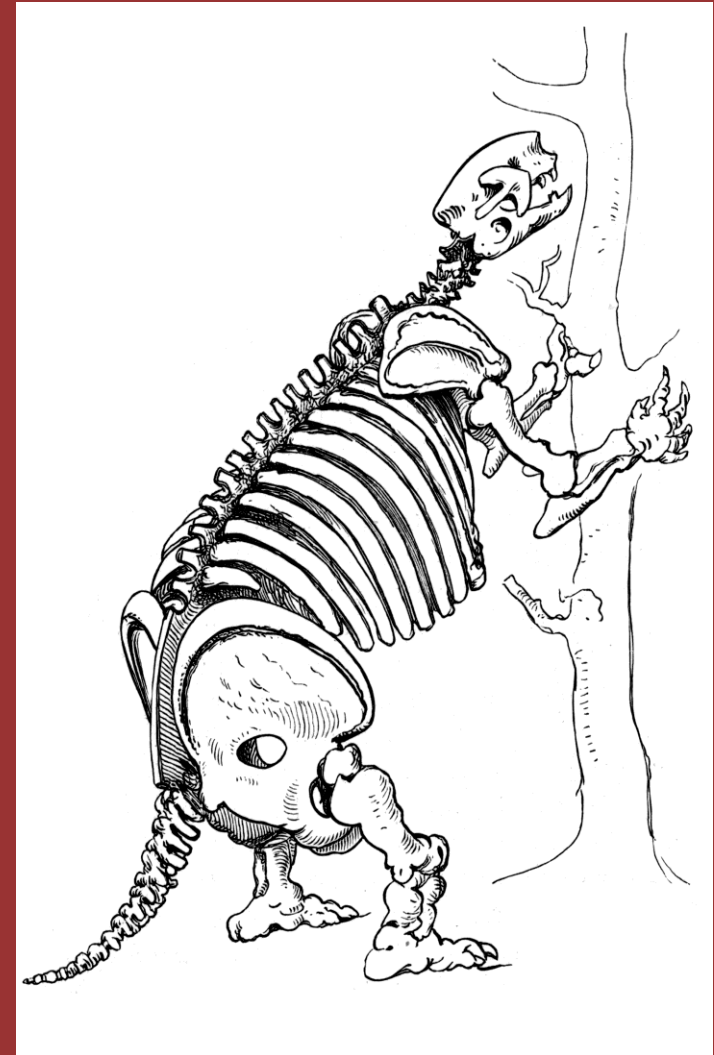
Cervical Vertebrae of
1. 2. Macrauchenia 3/4. Antioquia.
Published by Smith, Elder & Co. 25, Abchurch Lane, London.

South American mammal fossils

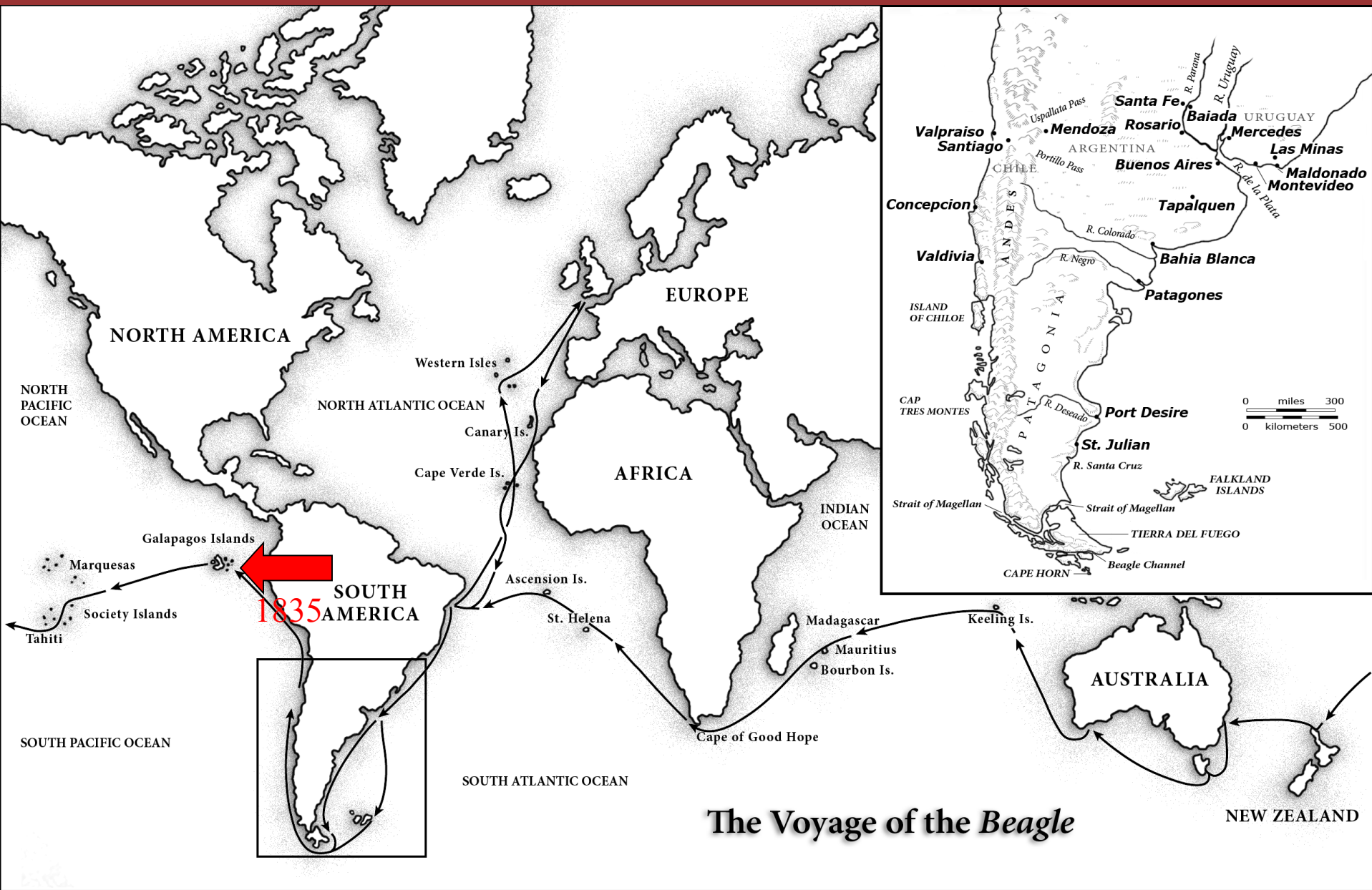
South American Megafauna
- mammal fossils



Toxodon platensis



Mylodon darwinii





Galapagos Mockingbirds



Birds Pl. 16.

Mimus trifasciatus



Birds Pl. 17.

Mimus melanotis



Birds Pl. 18.

Mimus parvulus

“When I see these Islands in sight of each other, & possessed of but a scanty stock of animals, tenanted by these birds, but slightly differing in structure & filling the same place in Nature, I must suspect they are only varieties...

– *If there is the slightest foundation for these remarks, the zoology of Archipelagoes – will be well worth examining; for such facts would undermine the stability of species.*”

- Ornithology Notes (1836)

274

Ornithology - Galapagos

apparent difference between the Woff-like Fox of East & West Falkland Is. — If there is the slightest foundation for these remarks the zoology of Archipelagoes will be well worth examining; for such facts ^{would} undermine the stability of species

3309	Yellow-breasted Tyrannus	Female	Chatham Is. ^{Farid}
3310	Scarlet do	Male	
3311	Wren	Female	
3312	Fringilla	Male	
3313	do	(sex unknown)	
3314	do	Female	} f. Supra
3315	do	do	
3316	do	Male	
3317	do	Male	
3318	do	Male	
3319	do	Male	

3320 } (Seton's 3320: Male, jet black) (3321: 3322. Males)
 3321 } (3323. Female). This is the only bird, out of the number
 3322 } which compose the ^{large} irregular flock, which can be distinguished
 3323 } from its habits. — Its most frequent resort is hopping & climbing about the great cacti, to feed with its sharp beak, on the fruit & flowers. — Commonly however it alights on the ground, & with the Fringilla in the same manner, seeks for seeds. The rarity of the jet black specimens is well exemplified in this case; out of the many ^{hundreds} which I daily saw, there I never could observe a single black one, besides the one preserved. Mr. Bynoe however has another specimen; Fuller in vain tried to procure one. — I should add, that specimen (3320) was shot when picking together with a brown one, the fruit of a Cactus.

3324	Fringilla	Male	(young?)
3325	do	Female	

Darwin's Notebook "B" 1837

On Page 20

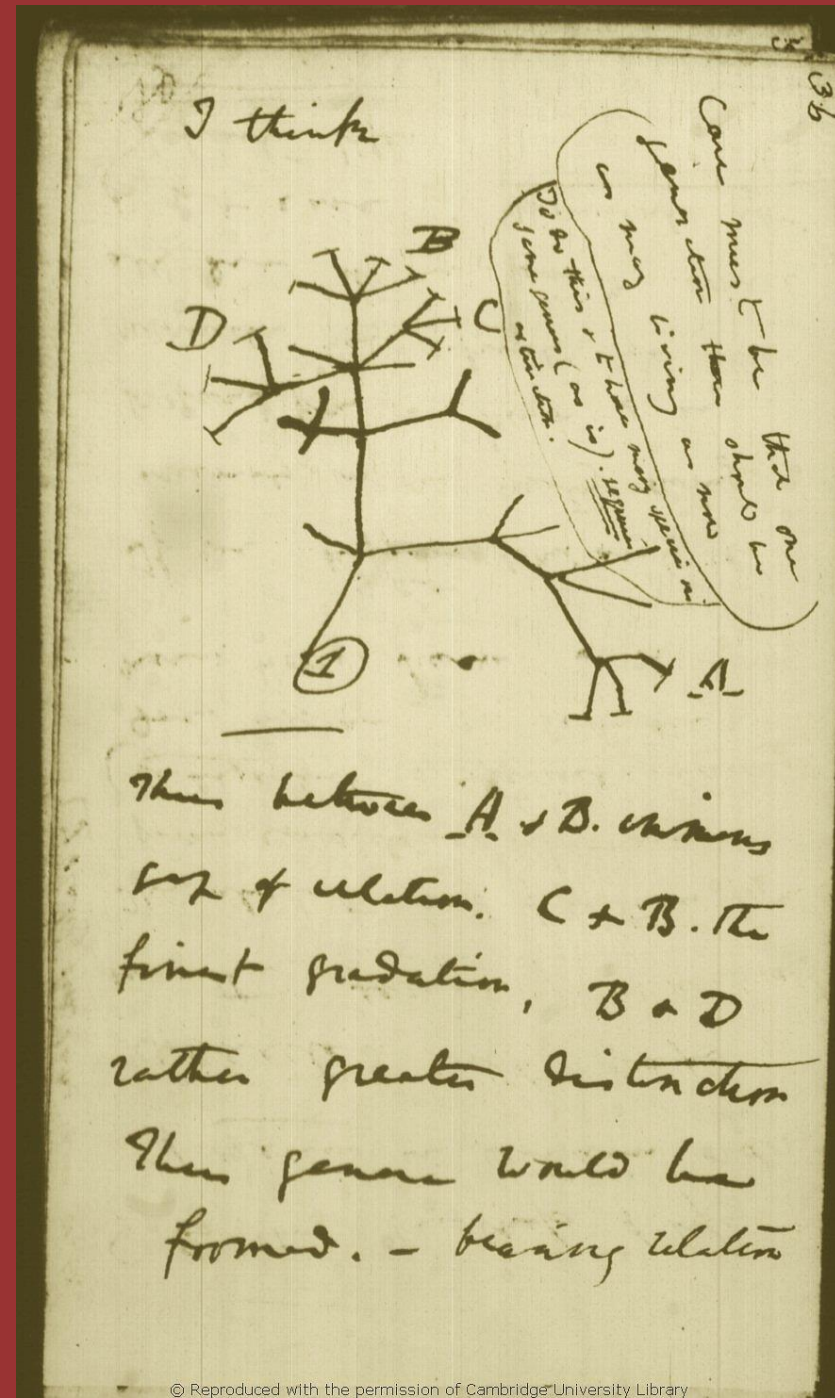
"We may look at Megatherium, armadillos, and sloths as all offsprings of some still older type ..."

On page 21:

"Organized beings represent a tree irregularly branched some branches far more branched -- As many terminal buds dying as new ones generated..."

On page 35:

"similarity of animals in one country owing to springing from one branch..."



: "we can allow satellites, planets, suns, universes, nay whole systems of universes to be governed by laws, but the smallest insect, we wish to be created at once by special act..."

12
36
we can allow ^{satellites} planets, suns, universes,
nay whole systems of universes ~~to~~ to
be governed by laws, but the smallest insect,
we wish to be created at once by
special act, provided with its instincts
its plan is nature's. ^{by} ~~it~~ — ~~we~~...
~~must be a special act, or result of law. yet we place of believe~~
The astronomer, when he talks of satellites, or
the savage ~~sees not a stream of fire, but a piece of~~
Our faculties are more fitted to recognize ^{about} ~~the~~ ~~structure~~
the wonderful structure of a beetle than
a Universe. is nature's

Notebook "N" October 30, 1838

THE DODGE

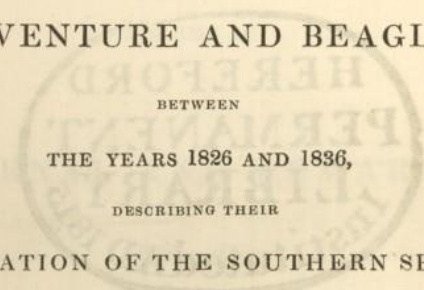
“...It is clear, that if several islands have each their peculiar species of the same genera, when these are placed together, they will have a wide range of character.

.. But there is not space in this work, to enter on this curious subject.”

(composed in 1837, published 1839)

NARRATIVE
OF THE
SURVEYING VOYAGES
OF HIS MAJESTY'S SHIPS
ADVENTURE AND BEAGLE,
BETWEEN
THE YEARS 1826 AND 1836,
DESCRIBING THEIR
EXAMINATION OF THE SOUTHERN SHORES
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IN THREE VOLUMES.
VOL. III.

LONDON:
HENRY COLBURN, GREAT MARLBOROUGH STREET.
1839.



...Ten days & ten nights passed ... when a vessel was seen and by night we were on board her, much rejoiced to have escaped a death on the wide ocean whence none would ever have come to tell the tale...

Fifty times since I left Para have I vowed if I once reached England never to trust myself on the ocean.

But good resolutions soon fade..."



THE BRIG "HELEN" ON FIRE.

O 2

SHIPWRECKS AND DISASTERS AT SEA

W. H. G. KINGSTON

Arrived in Singapore April 1854



The Malay Archipelago

Made 96 crossings totaling 14,000 miles; Collected 120,660 specimens



Birdwing
butterflies



“Sarawak Law” (1855)

“ The most closely allied species [are] found in geographical proximity...

Every species has come into existence coincident both in space and time with a pre-existing closely allied species...

the best mode of representing the natural arrangement of species...a branching tree”

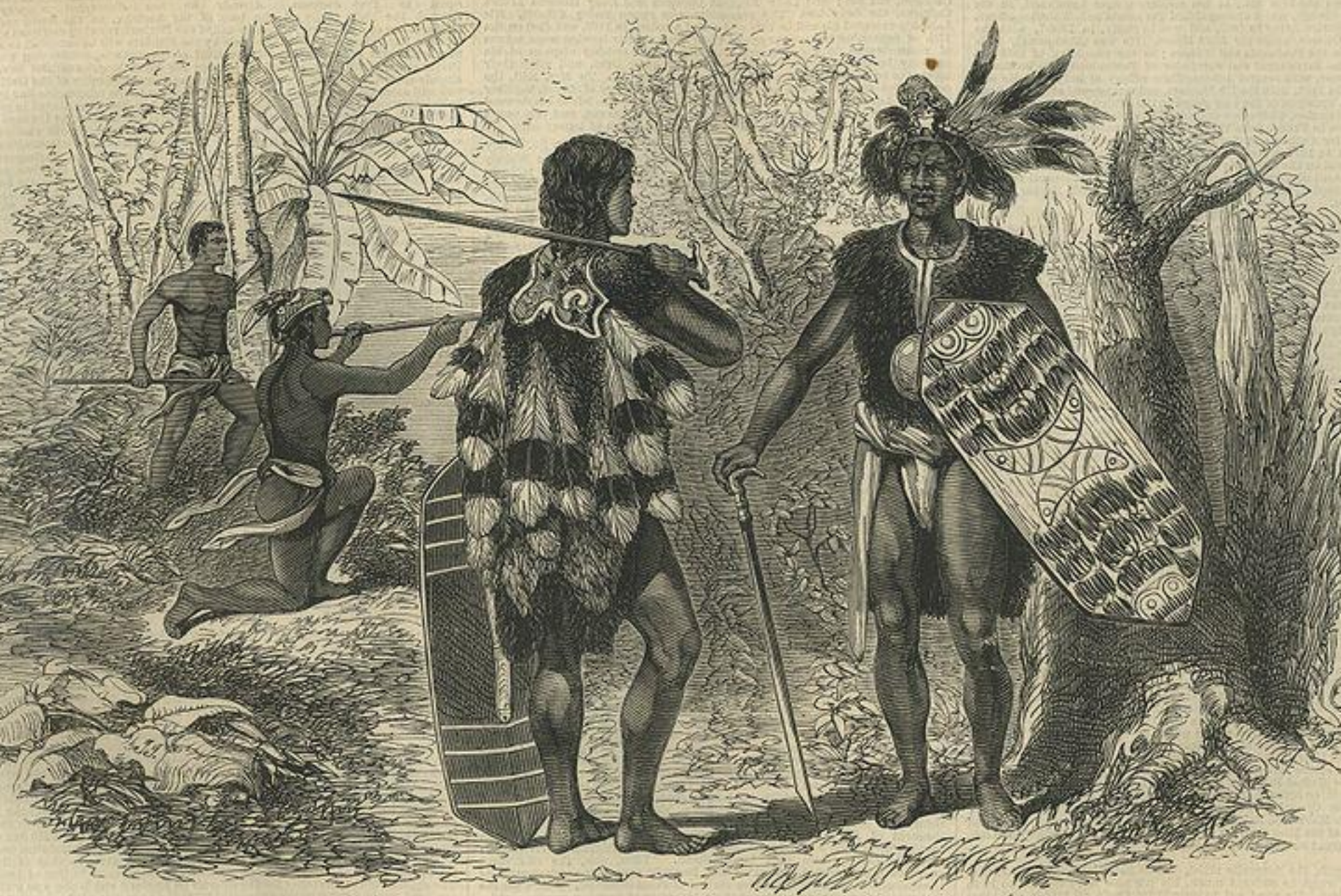
[From the ANNALS AND MAGAZINE OF NATURAL HISTORY for
September 1855.]

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.

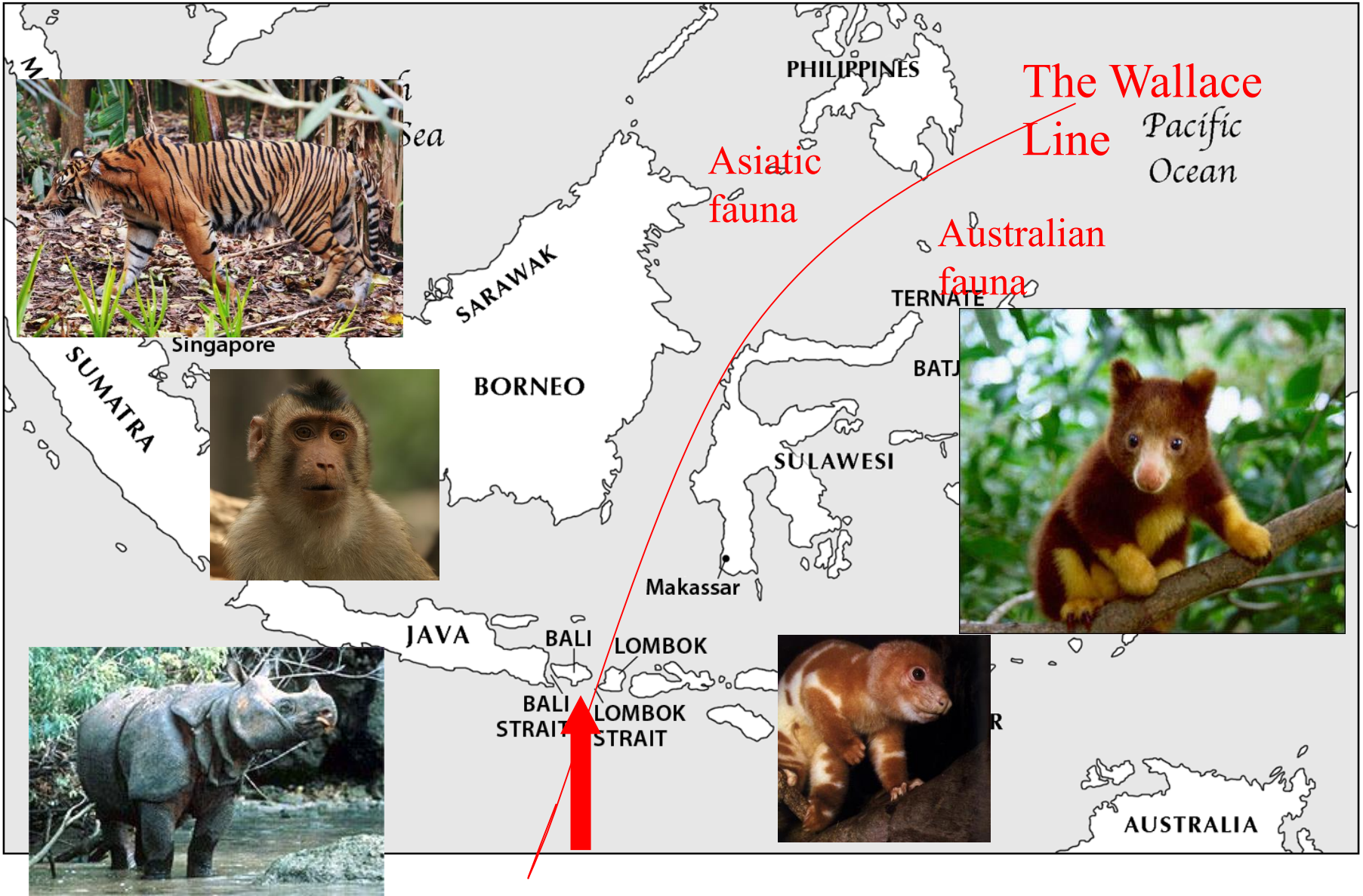
The facts proved by geology are briefly these:—That during an immense, but unknown period, the surface of the earth has undergone successive changes; land has sunk beneath the ocean, while fresh land has risen up from it; mountain chains have been elevated; islands have been formed into continents, and continents submerged till they have become islands; and these changes have taken place, not once merely, but perhaps hun-



DYAKS IN THEIR WAR DRESS.



Dyak trophies



The Wallace Line
Pacific Ocean

Asiatic fauna

Australian fauna

Singapore

JAVA

BALI

LOMBOK

BALI STRAIT

LOMBOK STRAIT

AUSTRALIA

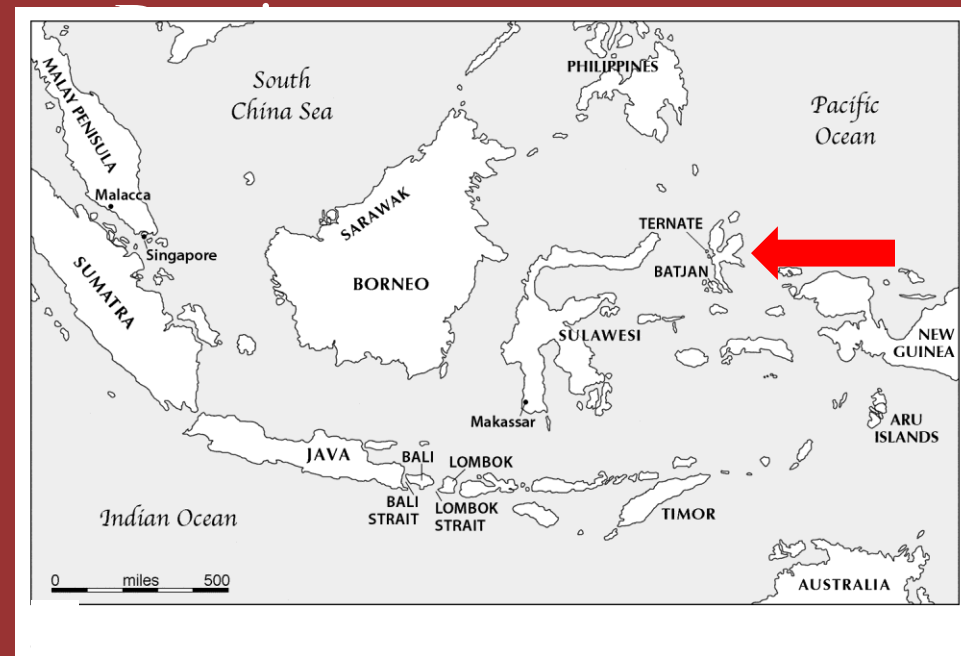
Wallace

February 1858, Ternate

“The life of wild animals is a struggle for existence...and to provide for their infant offspring...

Perhaps all the variations...must have some definite effect, however slight, in the habits or capacities of the individuals...a variety having slightly increased powers...must inevitably in time acquire a superiority in numbers.”

- On the Tendency of Species to Depart Indefinitely from the Original Type



struggle very often falls on the egg & seed, or on the seedling, ...any variation, however infinitely slight, if it did promote during any part of life even in the slightest degree, the welfare of the being, such variation would tend to be preserved or selected.”

On the Tendency of Species to form Varieties; and on the Perpetuation of Varieties and Species by Natural Means of Selection. By CHARLES DARWIN, Esq., F.R.S., F.L.S., & F.G.S., and ALFRED WALLACE, Esq. Communicated by Sir CHARLES LYELL, F.R.S., F.L.S., and J. D. HOOKER, Esq., M.D., V.P.R.S., F.L.S., &c.

[Read July 1st, 1858.]

London, June 30th, 1858.

MY DEAR SIR,—The accompanying papers, which we have the honour of communicating to the Linnean Society, and which all relate to the same subject, viz. the Laws which affect the Production of Varieties, Races, and Species, contain the results of the investigations of two indefatigable naturalists, Mr. Charles Darwin and Mr. Alfred Wallace.

These gentlemen having, independently and unknown to one another, conceived the same very ingenious theory to account for the appearance and perpetuation of varieties and of specific forms on our planet, may both fairly claim the merit of being original thinkers in this important line of inquiry; but neither of them having published his views, though Mr. Darwin has for many

The Darwin-Wallace
Joint Papers to the
Linnean Society
July 1, 1858

November 24, 1859

ON THE
ORIGIN
OF
SPECIES
—
DARWIN.



LONDON
JOHN MURRAY

ON
THE ORIGIN OF SPECIES

BY MEANS OF NATURAL SELECTION,

OR THE

PRESERVATION OF FAVOURED RACES IN THE STRUGGLE
FOR LIFE,

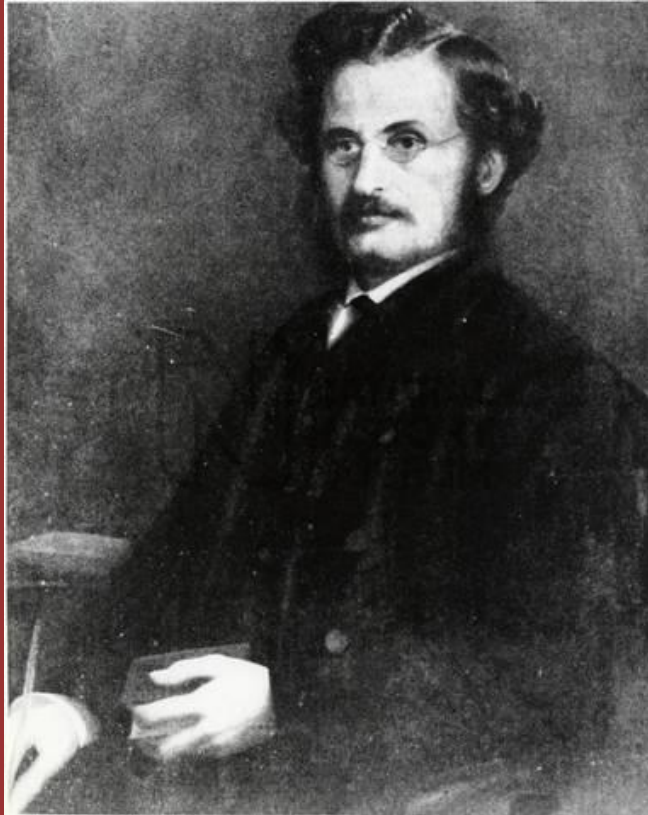
By CHARLES DARWIN, M.A.,

FELLOW OF THE ROYAL, GEOLOGICAL, LINNEAN, ETC., SOCIETIES;
AUTHOR OF 'JOURNAL OF RESEARCHES DURING H. M. S. BEAGLE'S VOYAGE
ROUND THE WORLD.'



LONDON:
JOHN MURRAY, ALBEMARLE STREET.
1859.

The right of Translation is reserved.



Henry Walter Bates

- Returned from the Amazon in summer of 1859, after *eleven* years
- Collected 14,712 species in all, more than 8000 new to science

Henry Walter Bates to Darwin:

“I think I have got a glimpse into the laboratory where Nature manufactures her new species.”



Longicorn beetle



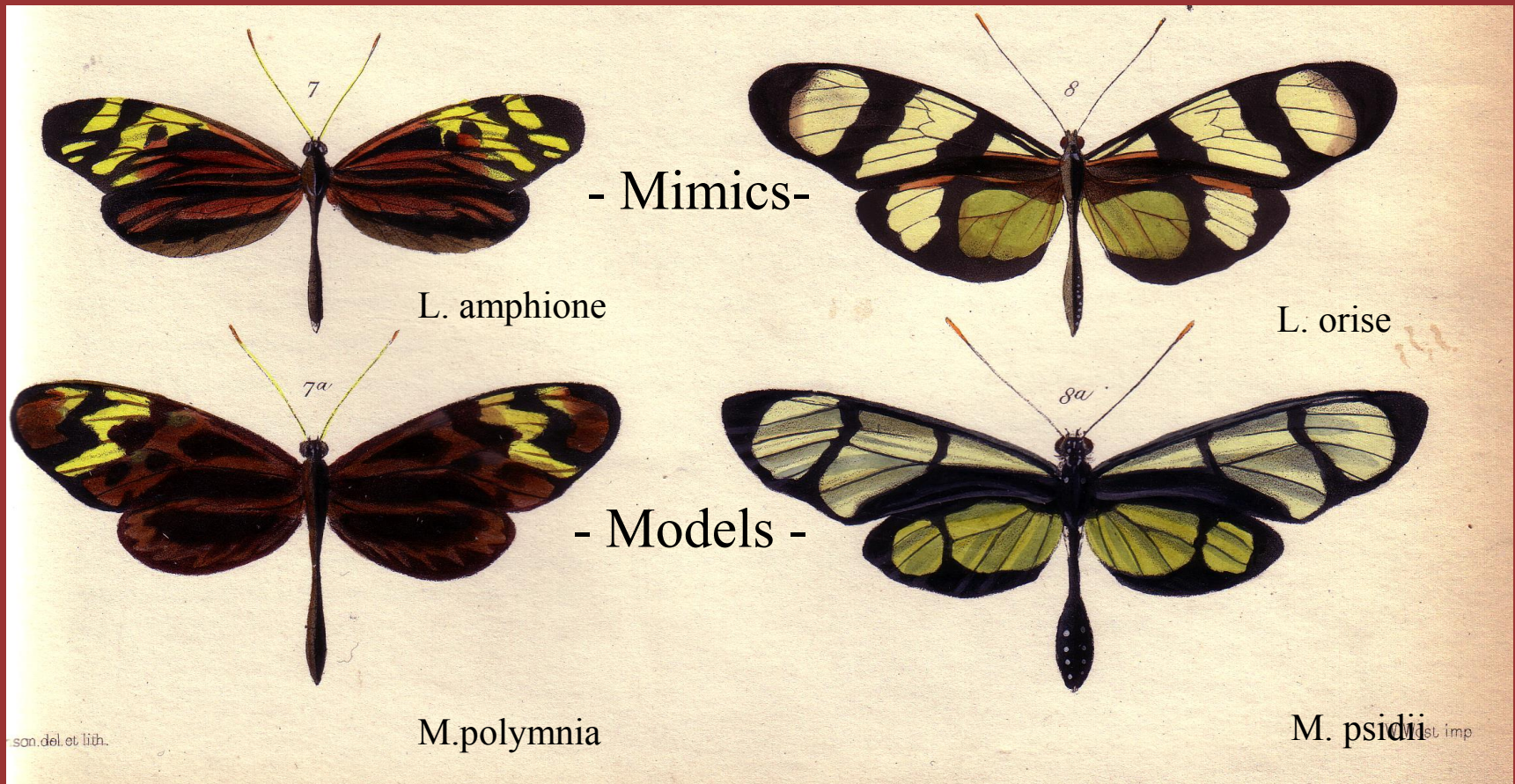
Wasp

Spicebush
caterpillar



Photo by Mary Jo Fackler

“To exist at all in a given locality, our *Leptalis*... must wear a certain dress and those of its varieties that do not come up to the mark are rigidly sacrificed... I believe the case offers a most beautiful proof of the theory of natural selection.”



Batesian Mimicry

(Bates, 1862)

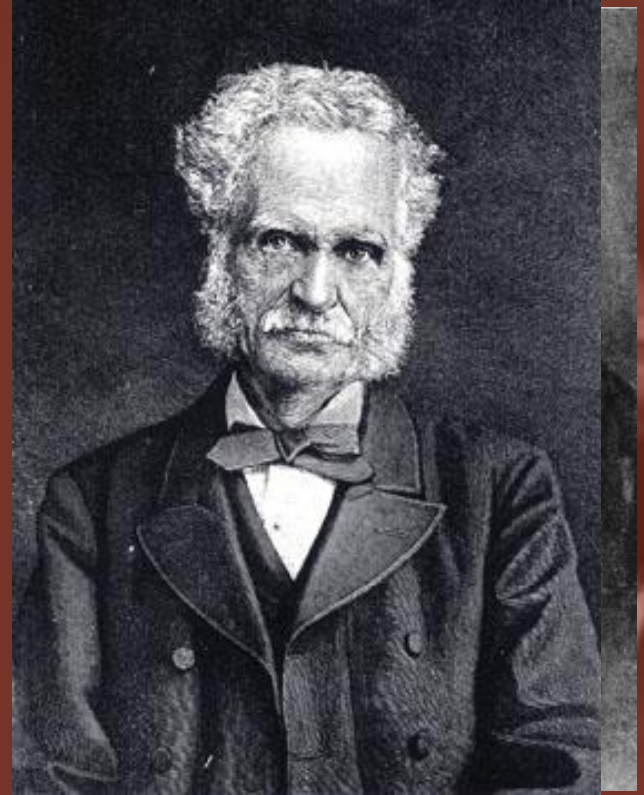
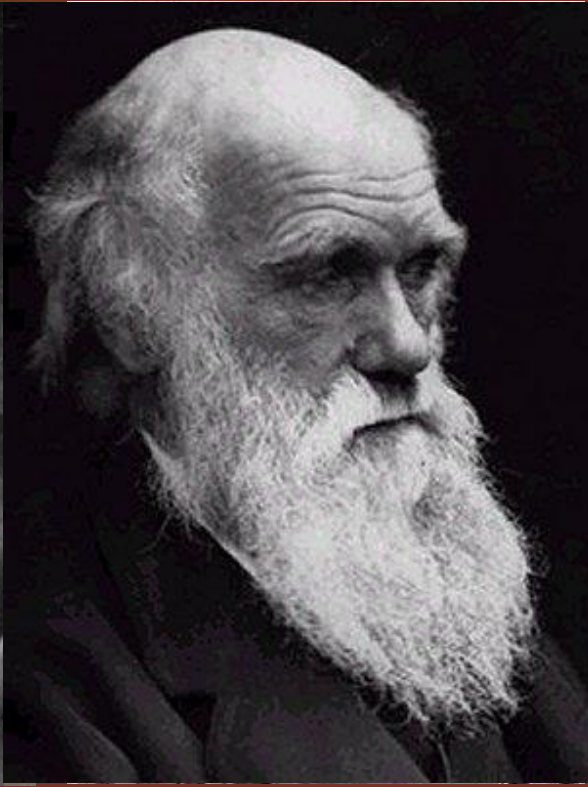
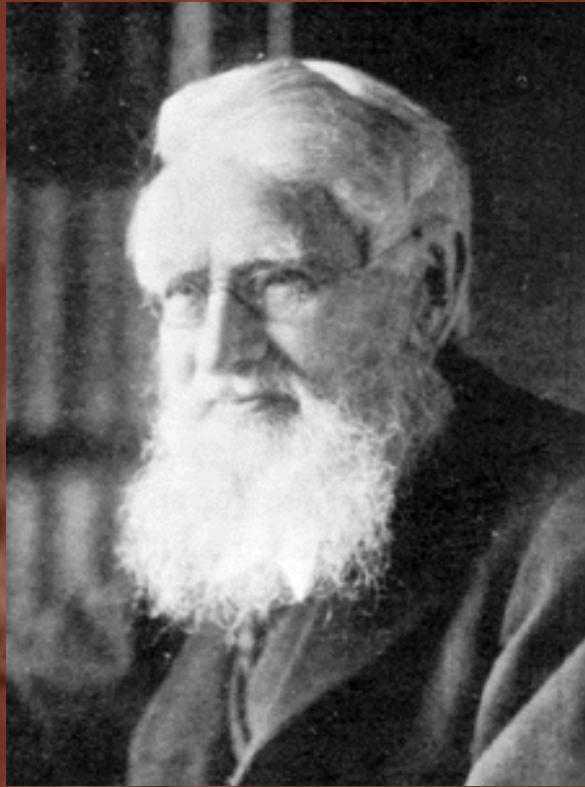
Darwin to Bates :

“In my opinion it is one of the most remarkable and admirable papers I ever read in my life.”

Nov. 20. 1862 From Bently Kent
Printed in Darwin's
Life. II, 391.

Dear Bates

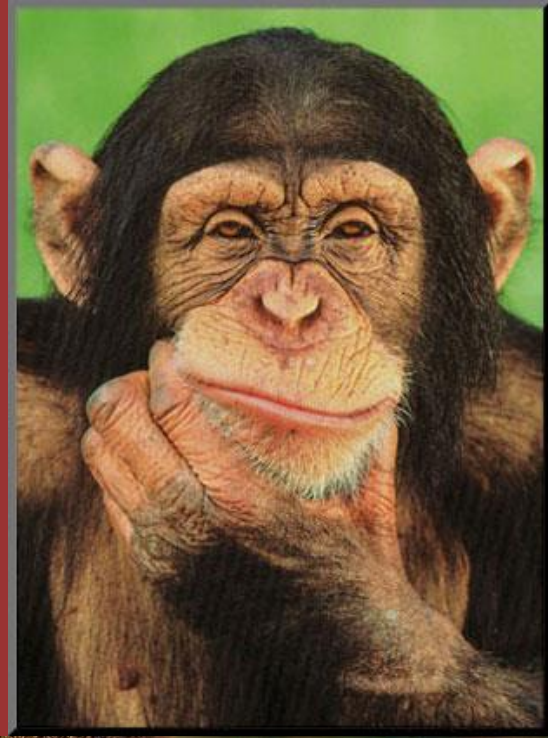
I have just finished after several reads
your Paper. In my opinion it is one
of the most remarkable & admirable
papers I ever read in my life. The
mimetic cases are truly marvellous &
you correct excellently a host of analogies
facts. The illustrations are beautiful &
very well chosen; but it would
have saved a reader at a little trouble, if
the name of each had been engrained below
each separate figure & no doubt this would
have put the engraver into fits, as it
would have destroyed beauty of Plate. I
am all yours



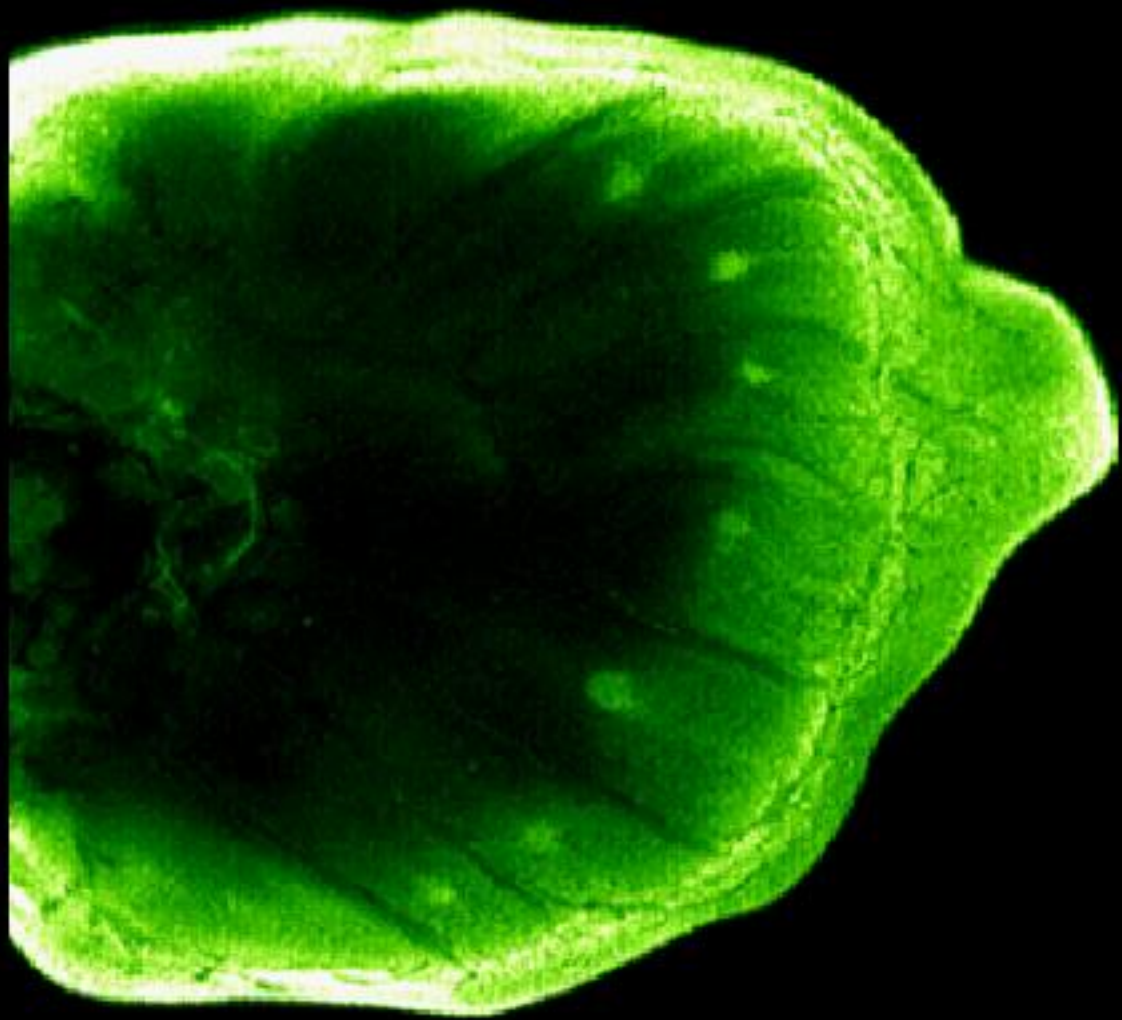


The **SECOND** golden age :

Glimpses FROM The Laboratory
into HOW new species are made







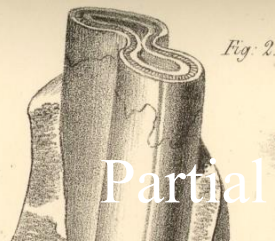


Fig. 2.



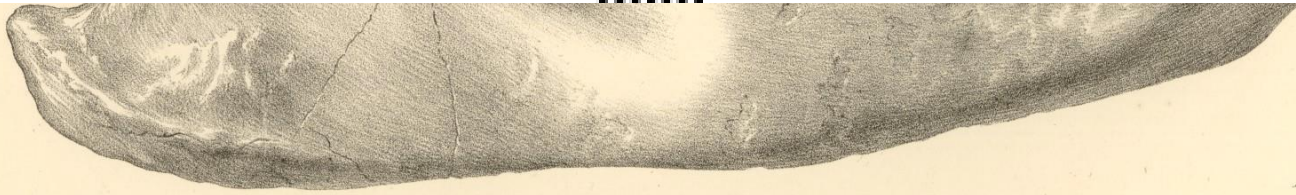
Fig. 3.



Fig. 4.

Partial DNA sequence of *Myiodon darwini*

	10	20	30	40	50	60	70	80	90
Myiodon	TACGATTAAC	CCAAATTAAT	ATTCA-CCGG	CGTAAAACGT	GTTTAAGGAA	ATCGAAC--A	AATAAAGCTA	AACCAAGACT	AAGCCGTAAA
2-t Sloth	.....	.....	.C...T...	.....G...	.....G.AT.	.C.C.....	.....T..	.....	.G.....
3-t Sloth	.....	...C....	..CT.....	A.....T..	.....G.ATT	T.A.....-	.....T.C	.....AG..	.G.....
Armadillo	.....G.	.....	.GC.T.A...	-.....G...	.....G.T.	.AACT...T	.....T..	TTTTT...	.T..T....
Anteater	.....	...C....	.AC.T.T...	.....GA..	.....G.AC.	T.A-T..AC	.....TC.	TTGCT...	.....
Cow	.....	...GC..C	.GGAGTA...	.....	...A...C.C	CA--T...C.	...GG.T..	TTCTA...	...T....
			*****	*	***	*****	***		
	100	110	120	130	140	150	160	170	180
Myiodon	AAGCTACAGT	CAAAATAAAA	TAAACA-ACG	AAAGTGGCTT	TAACAAACCC	GAACACACGA	TAGCTAAGAC	CCAAACTGGG	ATTAGATACC
2-t Sloth	.....	.....	.C..G...T	.....A...	.....CT..	.....	.....	.....	.....
3-t Sloth	...C....	.....	ACCT.....	.....A...	...G...T..	...T...T..	.....G..T	T.....	.....
Armadillo	...CC....	T.....	AT.C.CC...	.....A...	...G...T..	.....	...C..G..	.....	.....
Anteater	...AC....	AT..C..G.	.C.....	.....A...	...G..C.T.	.....	C...G..G.	.....	.....
Cow	...C.TGA.	T.....	AT..ATG...	.....A.CC	...CA.T.G.	...-G...T.	.....	.....	.....
			*****			***			
	190	200	210	220	230	240	250	260	270
Myiodon	CCACTATGCT	TAGCCCTAAA	CCAAGACATT	TGACAA-ACT	AAAATGTTCCG	CCAGAGTACT	ACTAGCAACA	GCCTAAAACCT	TAAAGGACTT
2-t Sloth	.....C	.....	..C.A....	.A.TC....	.....	...C....	.....	.....	.....
3-t Sloth	.....C	.....	...A...C.	.A.C.A..C	...G...CT.	.....	...T....	...T.G....	C.....
Armadillo	.....C	G.....	...A...G.	...CGT...A	...C..C...	.....	.....	...T....	C..G....
Anteater	.....C	T.G....	.AC.A.T...	CC.AC...A	...G..A...	.....	.....	...TA....	C.....
Cow	.....	.....	.AC...T.A.	.ACAT.A..A	...T.A...	.....	.....	...T....	C.....



C. Schaeffel et lithog.

Printed by C. Hullmandel.

Myiodon.
Fig. 4. 9/16th Size. Fig. 2, 3, 4. Nat. Size.

Wallace to Bates

Ternate, Dec. 24, 1860

“I know not how or to whom to express fully my admiration for Darwin's book. ...- its overwhelming argument, & its admirable tone & spirit.

“Mr Darwin has created a new science and a new philosophy, & I believe that never has such a complete illustration of a new branch of human knowledge been due to the labours & researches of a single man.”

Ternate Dec: 24th. 1860

Dear Bates

Many thanks for your bag & interesting letter. I have myself suffered much in the same way as you describe & I think more severely. The kind of "tedium vitae" you mention I also occasionally experience here. I impute it to a too monotonous existence.

I know not how or to whom to express fully my admiration of Darwin's book. To him it would seem flattery & others self praise; - but I do honestly believe that with however much patience I had worked up & experimented on the subject I could never have approached the completeness of his book, - its vast accumulation of evidence, - its overwhelming argument, & its admirable tone & spirit. I really feel thankful that it has ^{not} been



Dr. Sean Carroll



Sean B. Carroll is an award-winning scientist, author, and educator. He is currently Professor of Molecular Biology and Genetics and an Investigator with the Howard Hughes Medical Institute at the University of Wisconsin. His research has centered on the genes that control animal body patterns and play major roles in the evolution of animal diversity. Major discoveries from his laboratory have been featured in TIME, US News & World Report, The New York Times, Discover, and Natural History.