Ιστορία της Βιολογίας

Τρίτη 9:30 - 12:00, Αίθουσα Β

Διδάσκων: Σταύρος Ιωαννίδης

Email: stavros.ioannidis.phil@gmail.com

Ώρες γραφείου: μετά από συνεννόηση
(κτήριο γραμματείας, ισόγειο, πρώτο γραφείο αριστερά)

http://eclass.uoa.gr/courses/PHS249/

Προτεινόμενα συγγράμματα

Mayr (2008) *Η ανάπτυξη της βιολογικής σκέψης*, MIET <- κλασικό έργο στην ιστορία της βιολογίας, πολύ λεπτομερές

Morange (2017) *Ιστορία της βιολογίας*, Utopia <- πολύ πιο σύντομο από τον Mayr, γενική επισκόπηση, χρήσιμο για το μάθημα

Βασική Βιβλιογραφία

<- εδώ αναφέρονται τα βιβλία που ιδανικά κανείς θα πρέπει να διαβάσει κατά τη διάρκεια του μαθήματος

- **Bowler** & **Morus** (2012) *Η ιστορία της νεότερης επιστήμης: μια επισκόπηση*, Πανεπιστημιακές Εκδόσεις Κρήτης

(κεφάλαια **5**: Η ηλικία της γης, **6**: Δαρβινική επανάσταση, **7**: Νέα βιολογία, **8**: Γενετική, **18**: Βιολογία και Ιδεολογία)

- **Morange** (2017) *Ιστορία της βιολογίας*, Utopia

- **Δαρβίνος** (2007) *Αυτοβιογραφία*, Εκδόσεις Γκοβόστη

- **Watson** (1990) *Η διπλή έλικα*, Τροχαλία

Άλλα σημαντικά συγγράμματα

[βιβλία για πιο λεπτομερή μελέτη: βλ. κυρίως τα **Darwin** (1859), **Κριμπάς** (2009), **Mayr** (1991), **Ridley** (2007)]

Δαρβίνος (1998) *Ταξιδεύοντας με το Μπιγκλ στη Γη του Πυρός & τα νησιά Γκαλαπάγκος*, Στοχαστής

Darwin (1859) *On the Origin of Species* (**1st ed**) (**εισαγωγή, κεφ. 1-4, 6, 14**)
http://darwin-online.org.uk/content/frameset?itemID=F373&viewtype=text&pageseq=1

Κριμπάς (2009) *Δαρβινισμός και η ιστορία του έως τις μέρες μας*, Ωκεανίδα

Mayr (1991) *Ο Δαρβίνος και η γένεση της σύγχρονης εξελικτικής σκέψης*, Σύναλμα

Mayr (2008) *Η ανάπτυξη της βιολογικής σκέψης*, MIET

Mukherjee (2017) *The Gene: An Intimate History*, Vintage

Ridley (2007) *Δαρβίνος*, Εκδόσεις Πατάκη

Sapp (2003) *Genesis: the evolution of biology*, Oxford University Press

Sturtevant (2001) *A History of Genetics*, Cold Spring Harbor Press

Διαδικτυακές πηγές

http://darwin-online.org.uk

https://www.darwinproject.ac.uk

http://wallace-online.org

http://www.mendelweb.org/home.html

Αξιολόγηση

-> **Γραπτή τελική εξέταση**

+ (προαιρετικά) συμπληρωματική εργασία με παρουσίαση στην τάξη

(τουλάχιστον 2.500 λέξεις, έως +3 βαθμοί)

+ (προαιρετικά) παρουσίαση σε **εργαστήριο ιστορίας βιολογίας**

(θα προσμετρηθεί θετικά στον τελικό βαθμό)

μη δαρβινικές θεωρίες εξέλιξης

μεντελιανοί vs βιομετριστές

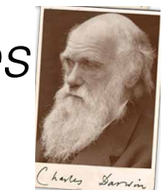
1750 1800 1850 1900 1950

1831-1836
ταξίδι Beagle

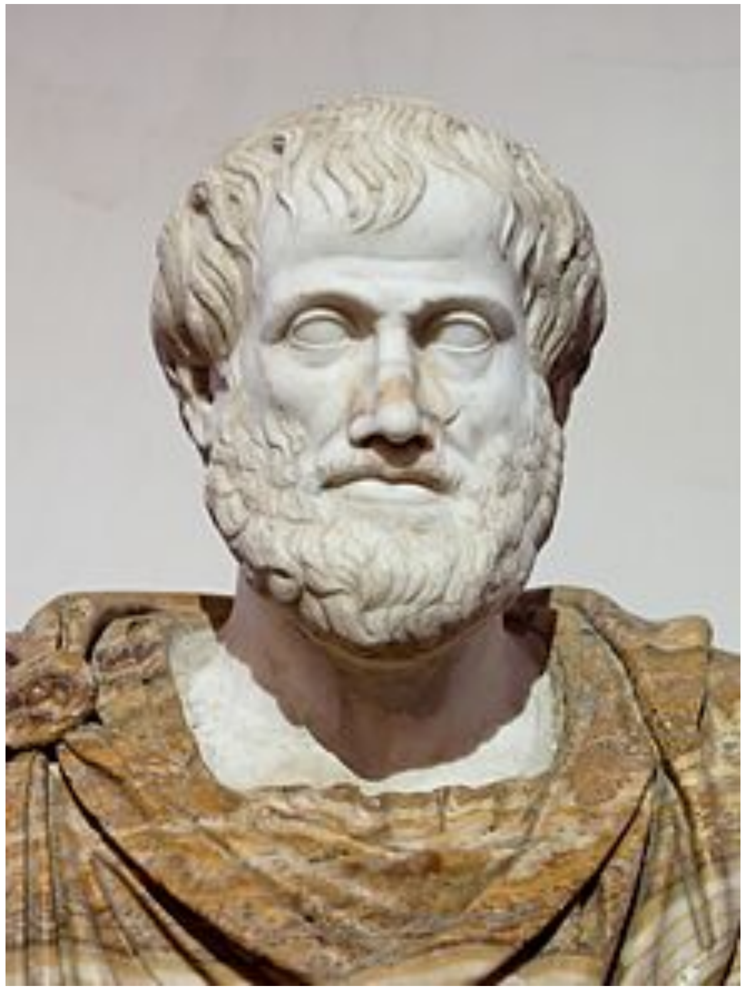
~1930-1950
Μοντέρνα Σύνθεση ή νεο-Δαρβινισμός ή συνθετική θεωρία

επανανακάλυψη του Mendel

1866, άρθρο Mendel 

1859, *Origin of Species* 

1809, *Philosophie Zoologique*




ME TILEME
METELIM
Polimedi

The **octopus** is a **stupid creature**, for it will approach a man's hand if it be lowered in the water; but it is **neat and thrifty** in its habits: that is, it lays up stores in its nest, and, after eating up all that is eatable, it ejects the shells and sheaths of crabs and shell-fish, and the skeletons of little fishes. It seeks its prey by so changing its colour as to render it like the colour of the stones adjacent to it; it does so also when alarmed. … The octopus as a rule **does not live the year out**. It has a natural tendency to run off into liquid; for, if beaten and squeezed, it keeps losing substance and at last disappears. … As a **proof** that they do not live into a second year there is the fact that, after the birth of the little octopuses in the late summer or beginning of autumn, it is seldom that a large-sized octopus is visible, whereas a little before this time of year the creature is at its largest. … The octopus is the only mollusc that ventures on to dry land; it walks by preference on rough ground; it is firm all over when you squeeze it, excepting in the neck.

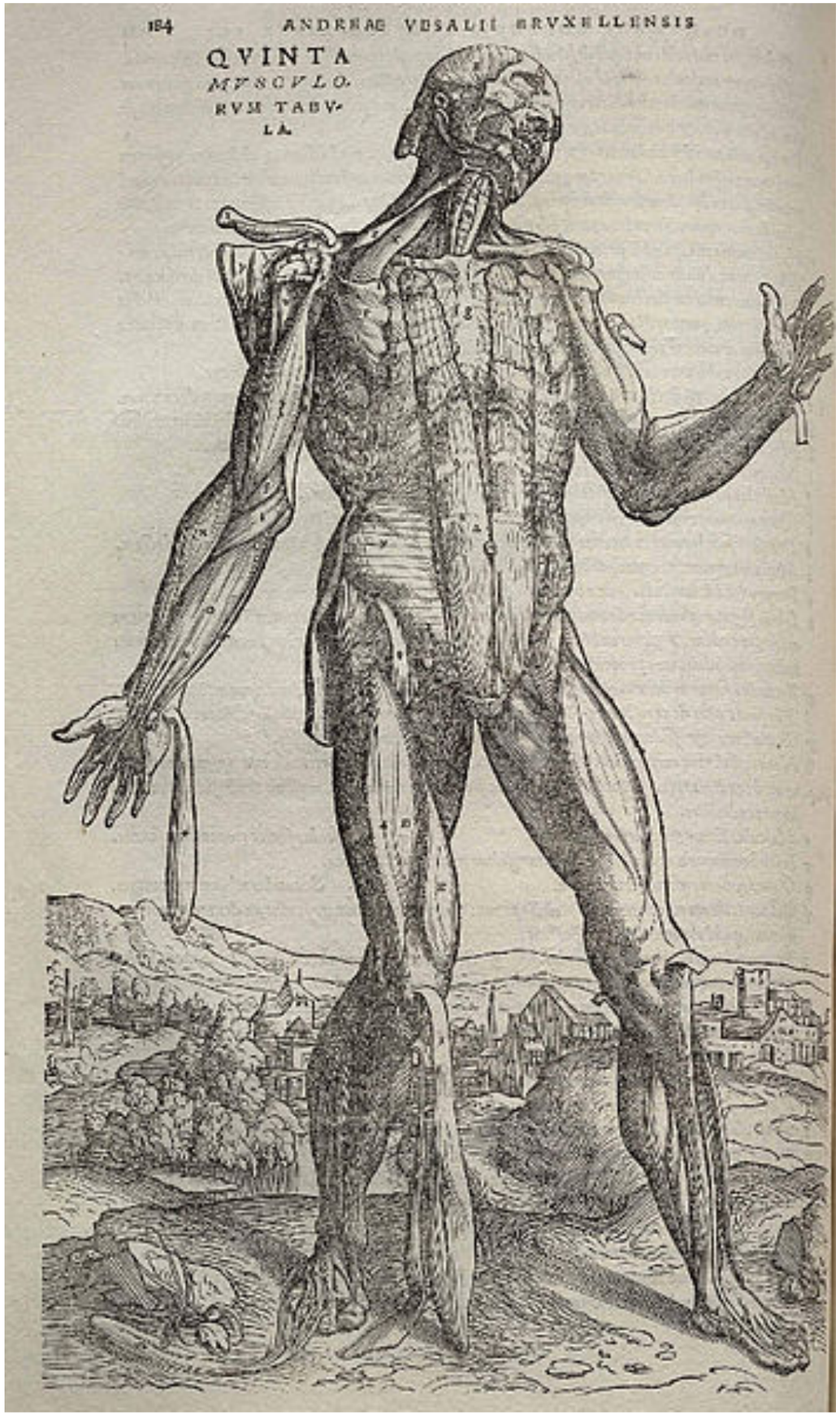
(Aristotle, History of Animals)

Andreas Vesalius (1514 – 1564), ***De humani corporis fabrica***, 1543 (On the fabric of the human body)

HVMANI COR-
SIMVL COMPACTO-
EX FACIE EXPRES-

PORIS OSSIVM
RVM, ANTERIORI
SIO.

QVINTA
MVSCVLO-
RVM TABV-
LA.



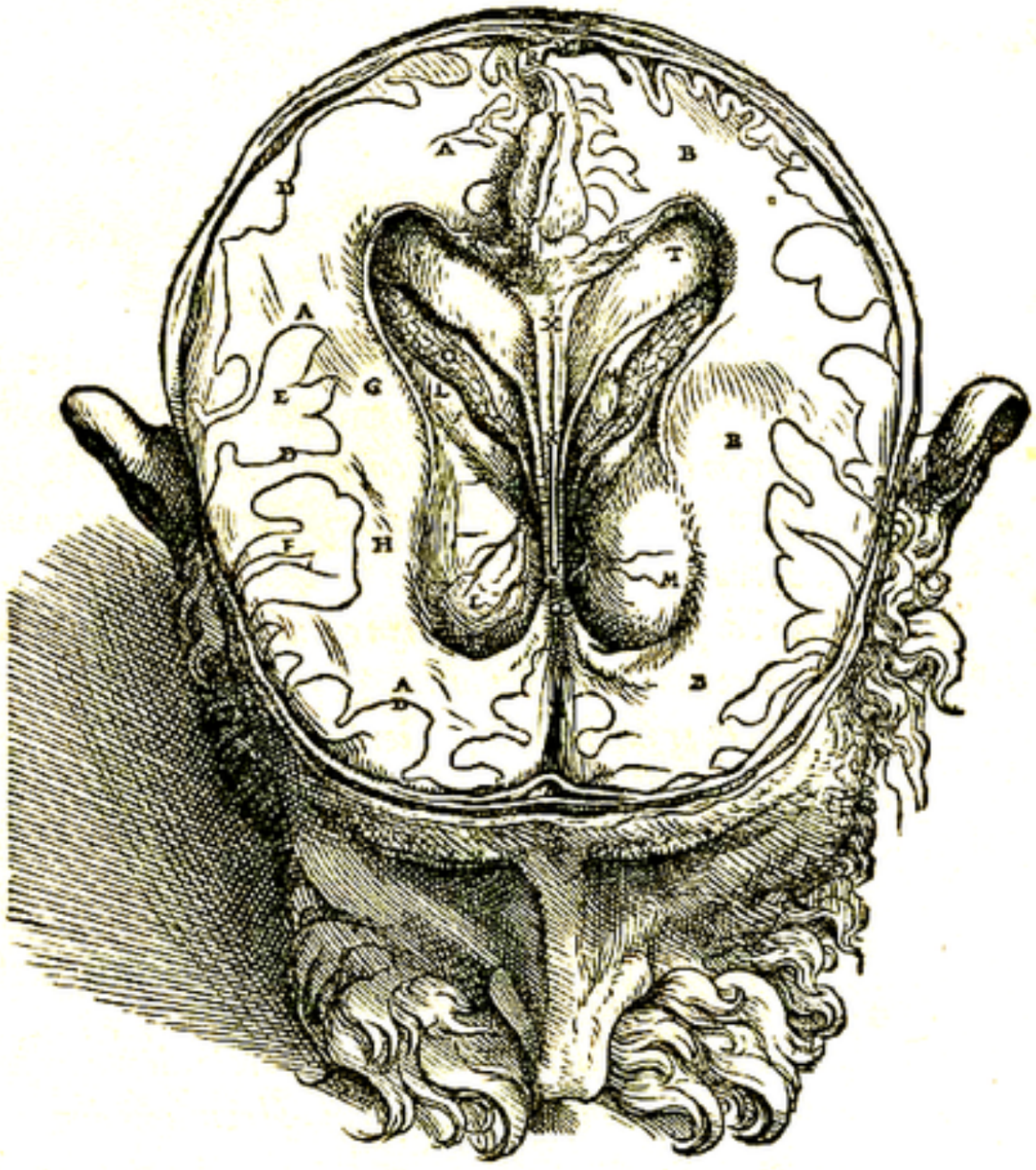
VIGESIMA SECVNDA QVINTI LIBRI FIGVRA.

VIGE

QVINTA SEPTIMI LIBRI FIGVRA.

PRAESENS figura quòd ad relictam in caluaria cerebri portionẽ attinet, nulla ex parte uariat: atq; id solũ habet proprium, quod callosum corpus hic anteriori sua sede à cerebro primùm liberauimus, ac dein eleuatum in posteriora reflexímus, septum dextri ac sinistri uentriculorum diuellentes, & corporis instar testudinis extructi superiorem superficiem ob oculos ponẽtes.

A b *A* ad Q. *A, A, A itaq; & B, B, B, ac dein D, D, D, & E & F, & G & H eadem hic indicant, quæ in quarta figura. Sic quoque & L, L, & M, M, & O & P & Q eadem insinuant.*



R, R, R Notatur inferior calloſi corporis ſuperficies. eſt enim id à ſua ſede motum, atque in poſteriora reflexum.

S, T, V Supe-

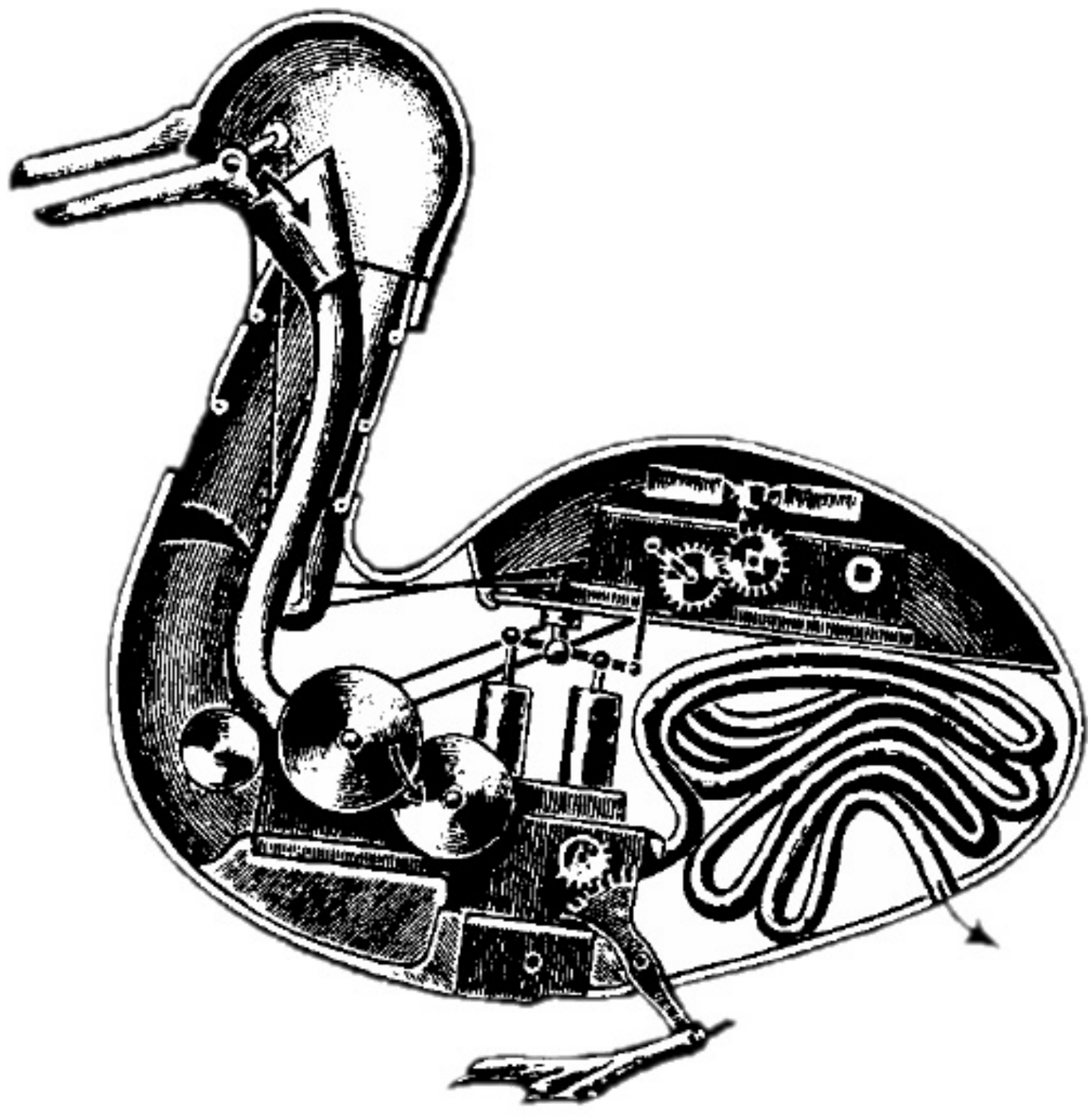
Περὶ Ψυχῆς

ἐστὶν ἡ **ψυχὴ** τῶν εἰρημένων τούτων **ἀρχὴ** καὶ τούτοις ὥρισται, **θρεπτικῷ, αἰσθητικῷ, διανοητικῷ, κινήσει**

a **soul** is a **principle** of the aforesaid powers and is defined by them, namely by **nutrition, perception, thought, movement**

διὸ καὶ οὐ δεῖ ζητεῖν εἰ ἓν ἡ **ψυχὴ** καὶ τὸ **σῶμα**, ὥσπερ οὐδὲ τὸν **κηρὸν** καὶ τὸ **σχῆμα**, οὐδ' ὅλως τὴν ἑκάστου **ὕλην** καὶ **τὸ οὗ ἡ ὕλη**

one should not ask if the **soul** and the **body** are one, any more than one should ask such a question of a piece of **wax** and its **shape** or in general of the **matter** of anything and **that of which it is the matter**



L'HOMME
DE RENE'
DESCARTES
ET VN TRAITTE'
DE LA FORMATION DV FOETVS
DV MESME AVTHEVR.

Auec les Remarques de LOVYS DE LA FORGE,
Docteur en Medecine, demeurant à la Fleche,
Sur le Traitté de l'Homme de RENE' DESCARTES;
& sur les Figures par luy inuentées.

Stanislas WEINER

UNIVERSITAS STUDIORUM MEDIOLANENSIS
BIBLIOTECA

A PARIS,
Chez CHARLES ANGOT, Libraire Iuré, ruë
S. Iacques, au Lion d'Or.

M. DC. LXIV.
AVEC PRIVILEGE DV ROY.

Schem. XXXII

MICROGRAPHIA:

OR SOME

Physiological Descriptions

OF

MINUTE BODIES

MADE BY

MAGNIFYING GLASSES

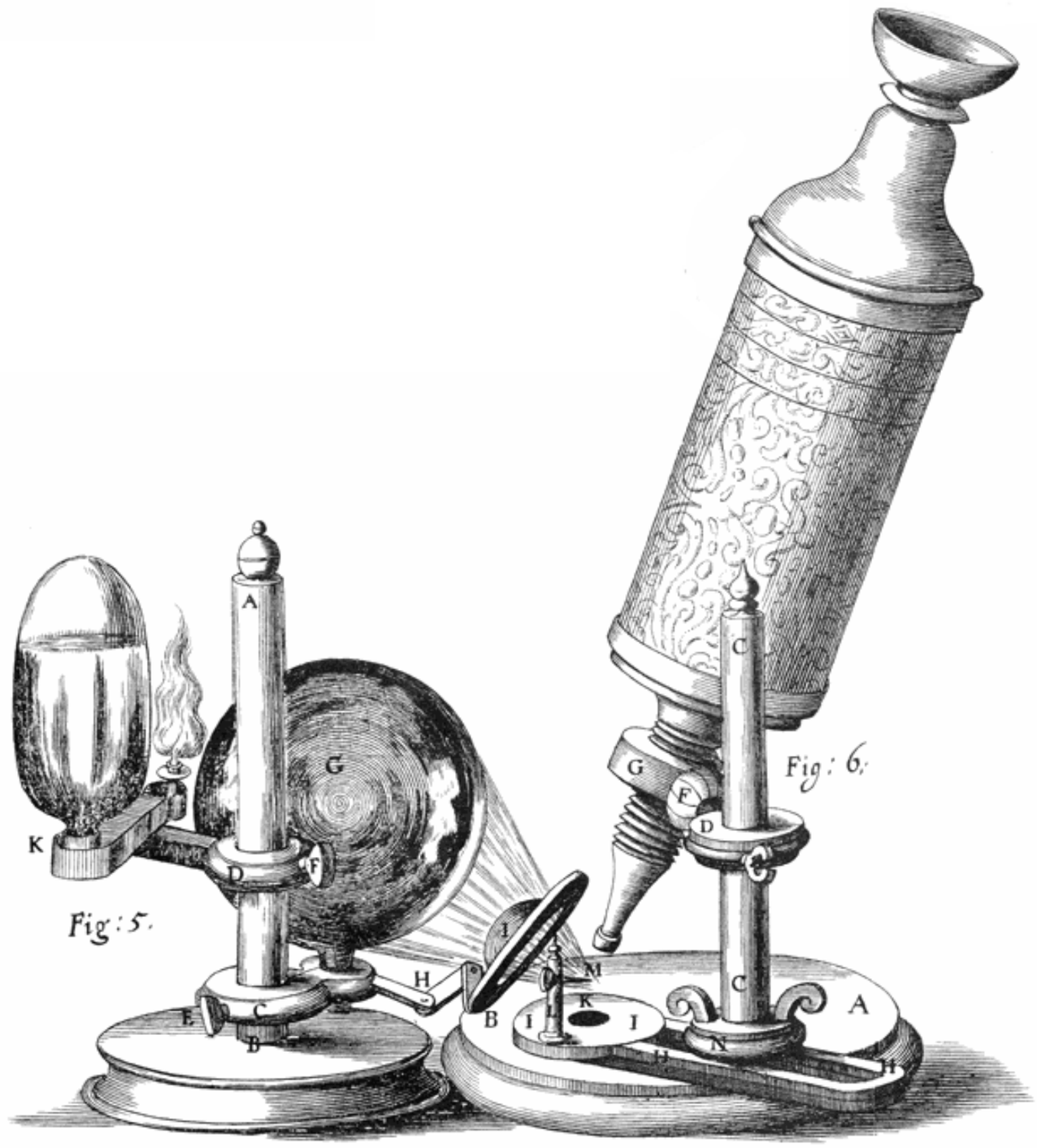
WITH

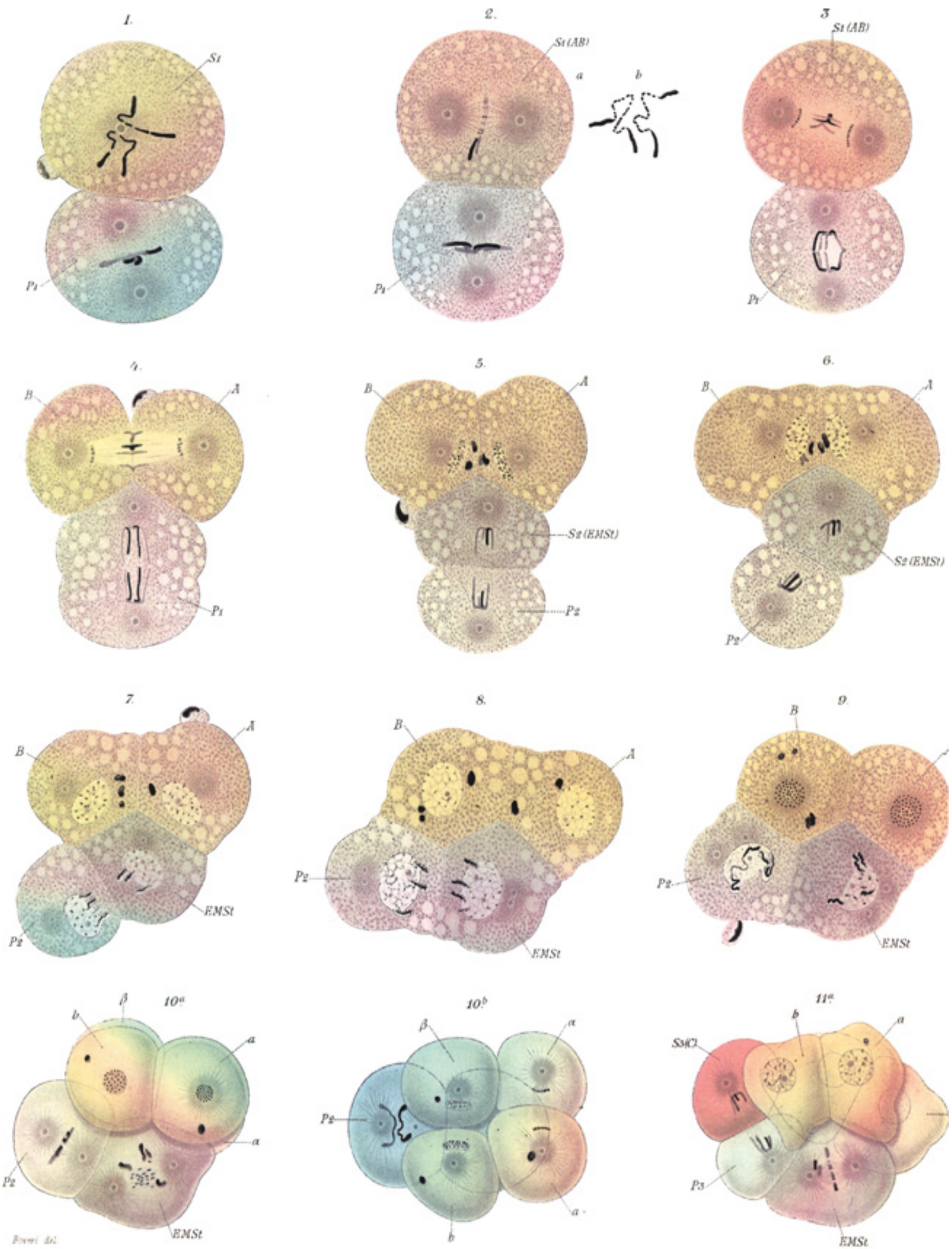
Observations and Inquiries thereupon.

By *R. HOOKE*, Fellow of the Royal Society.

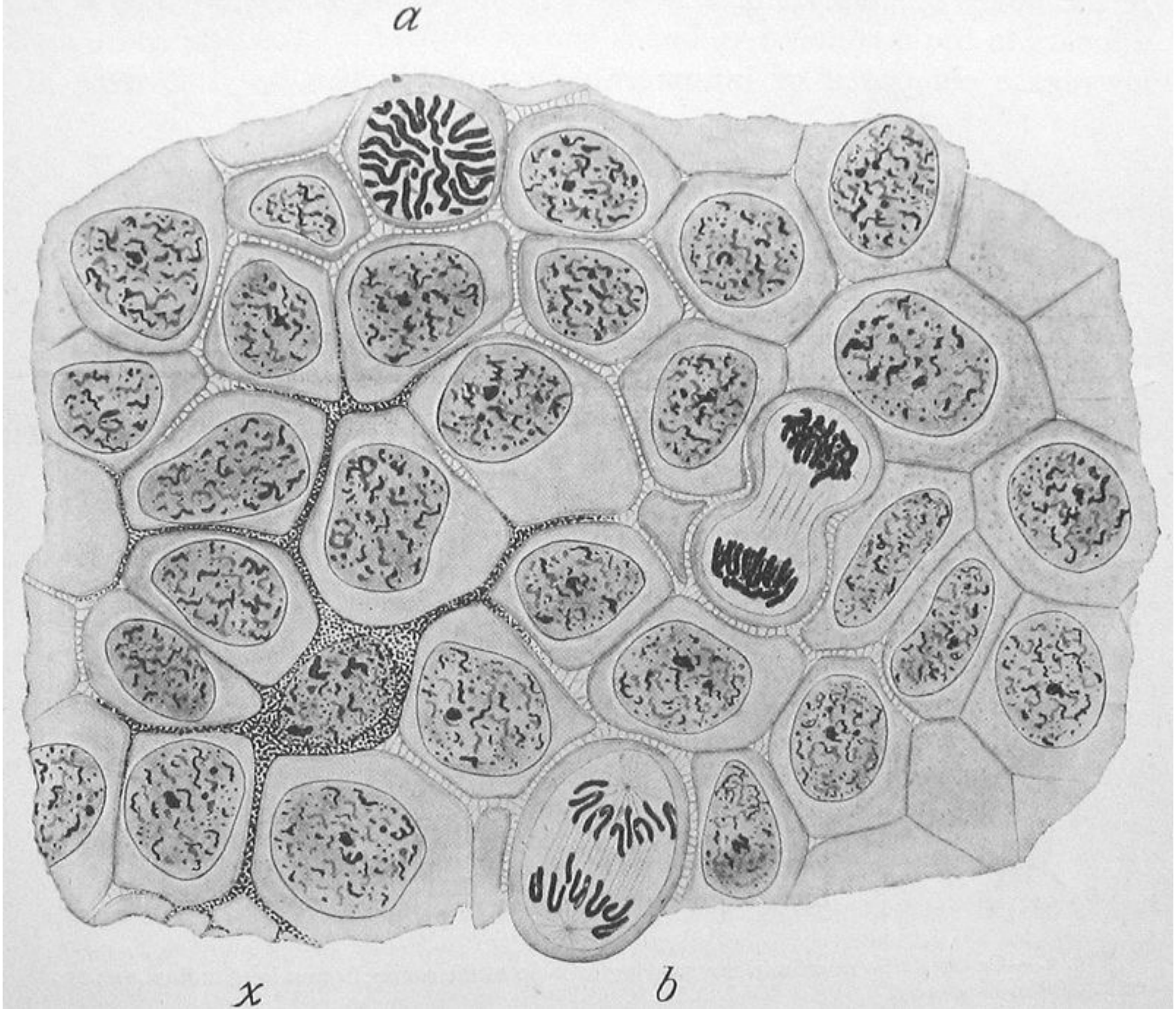
Nam poſſis oculo quantum contendere Lynceus,
Non tamen idcirco contemnas Lippus inungi. Horat. Ep. lib. 1.

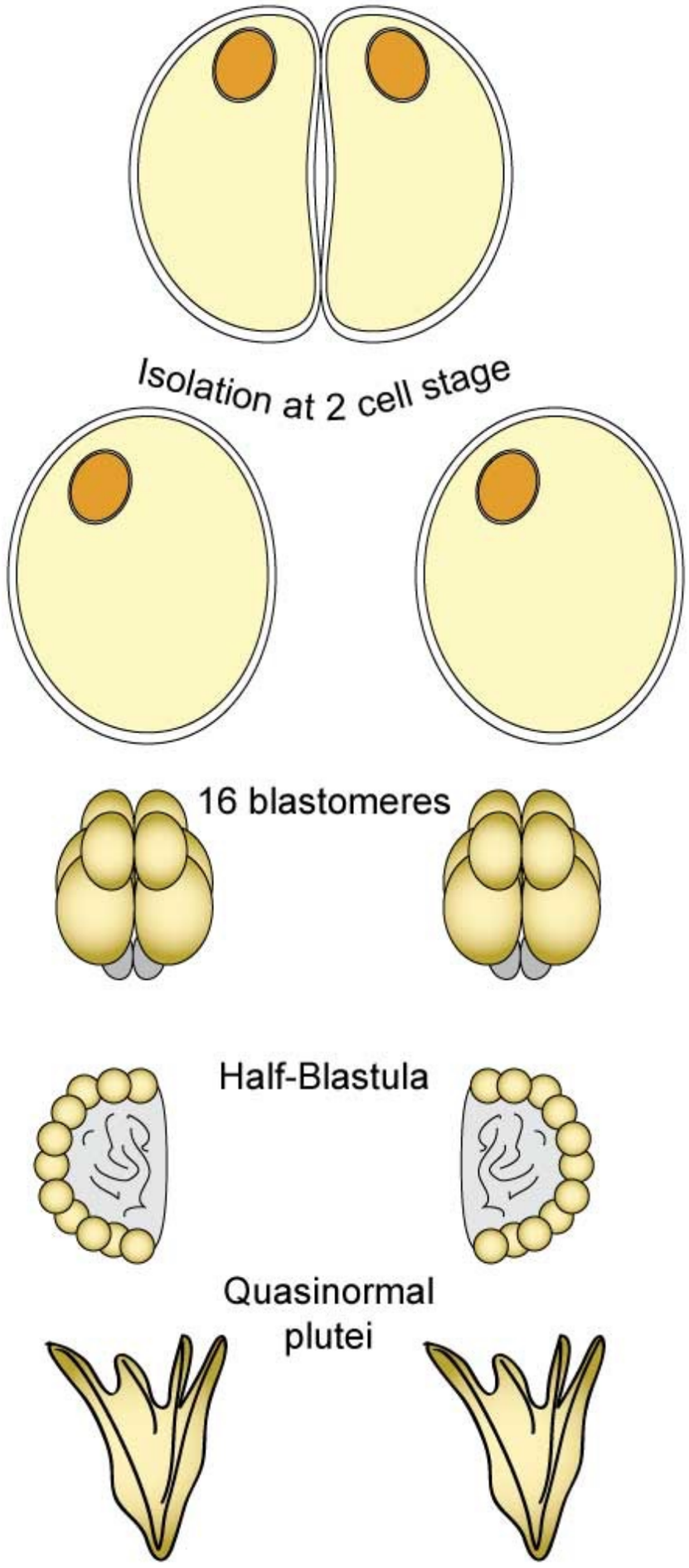
LONDON, Printed by *Jo. Martyn*, and *Ja. Allestry*, Printers to the Royal Society, and are to be sold at their Shop at the *Bell* in S. *Paul's* Church-yard. M DC LX V.

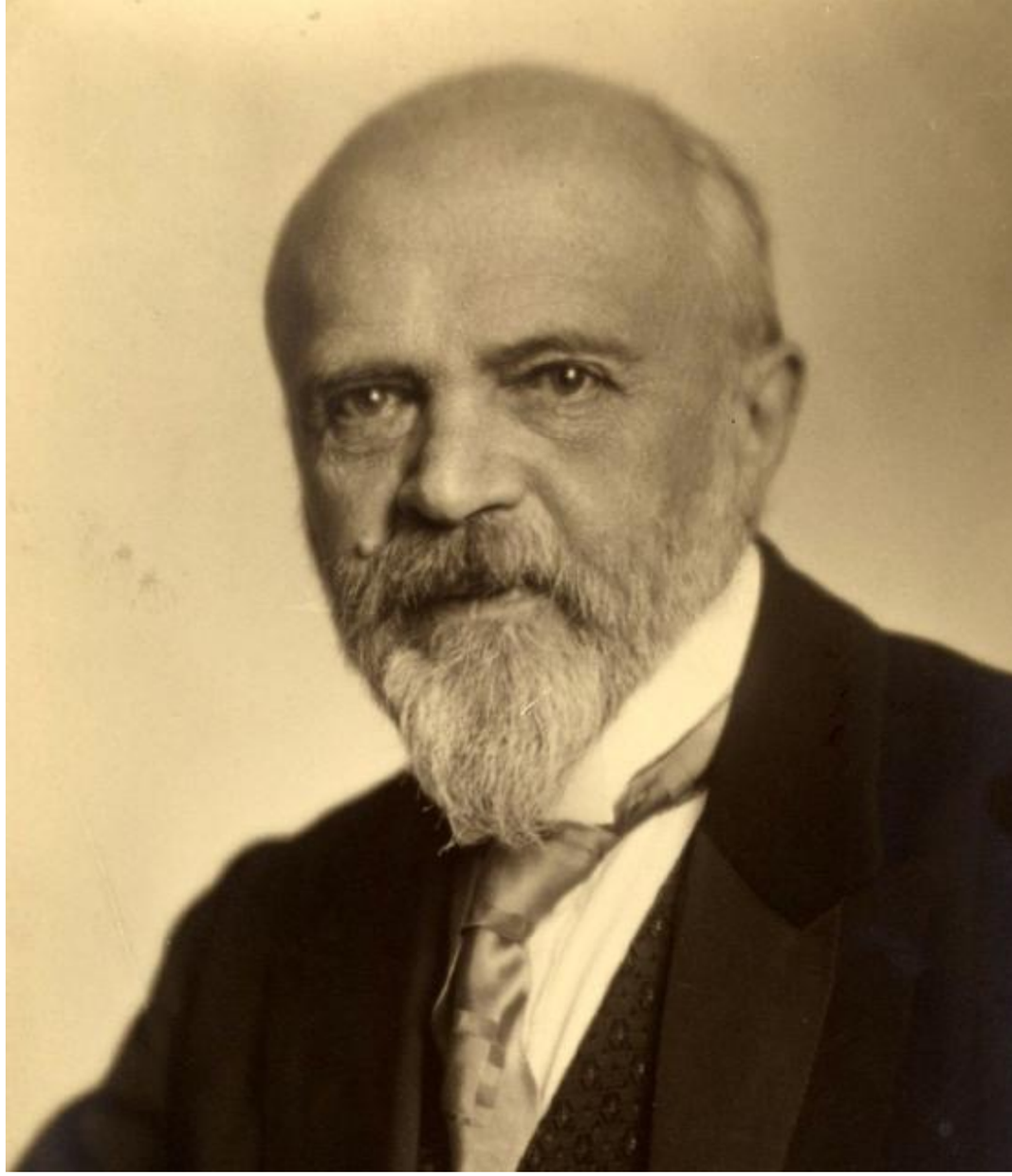




Ανάπτυξη
(από το στάδιο 2 κυττάρων έως το στάδιο των 7 κυττάρων) στο **Ascaris**
(Theodor and Marcella **Boveri**)

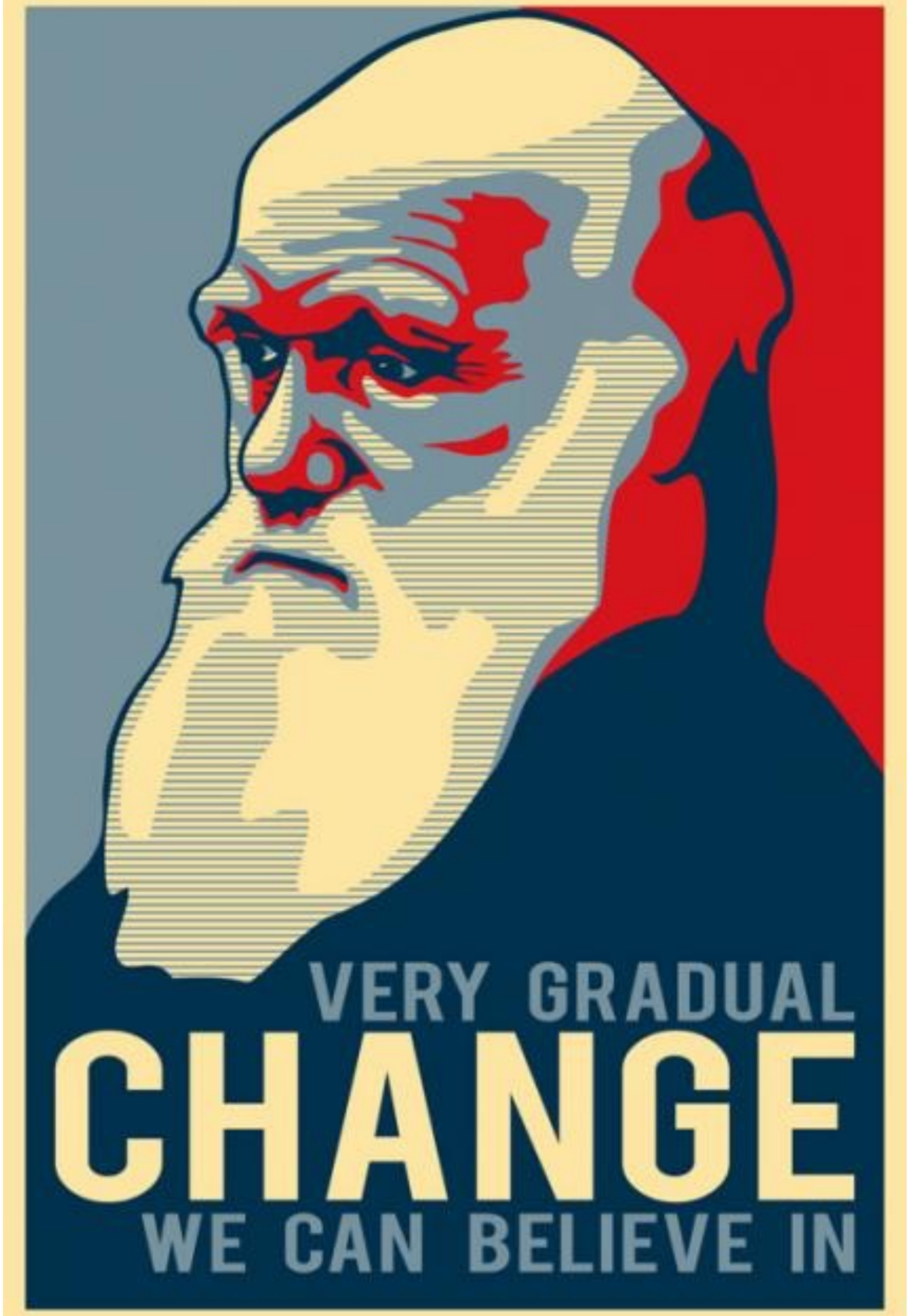

a
x
b



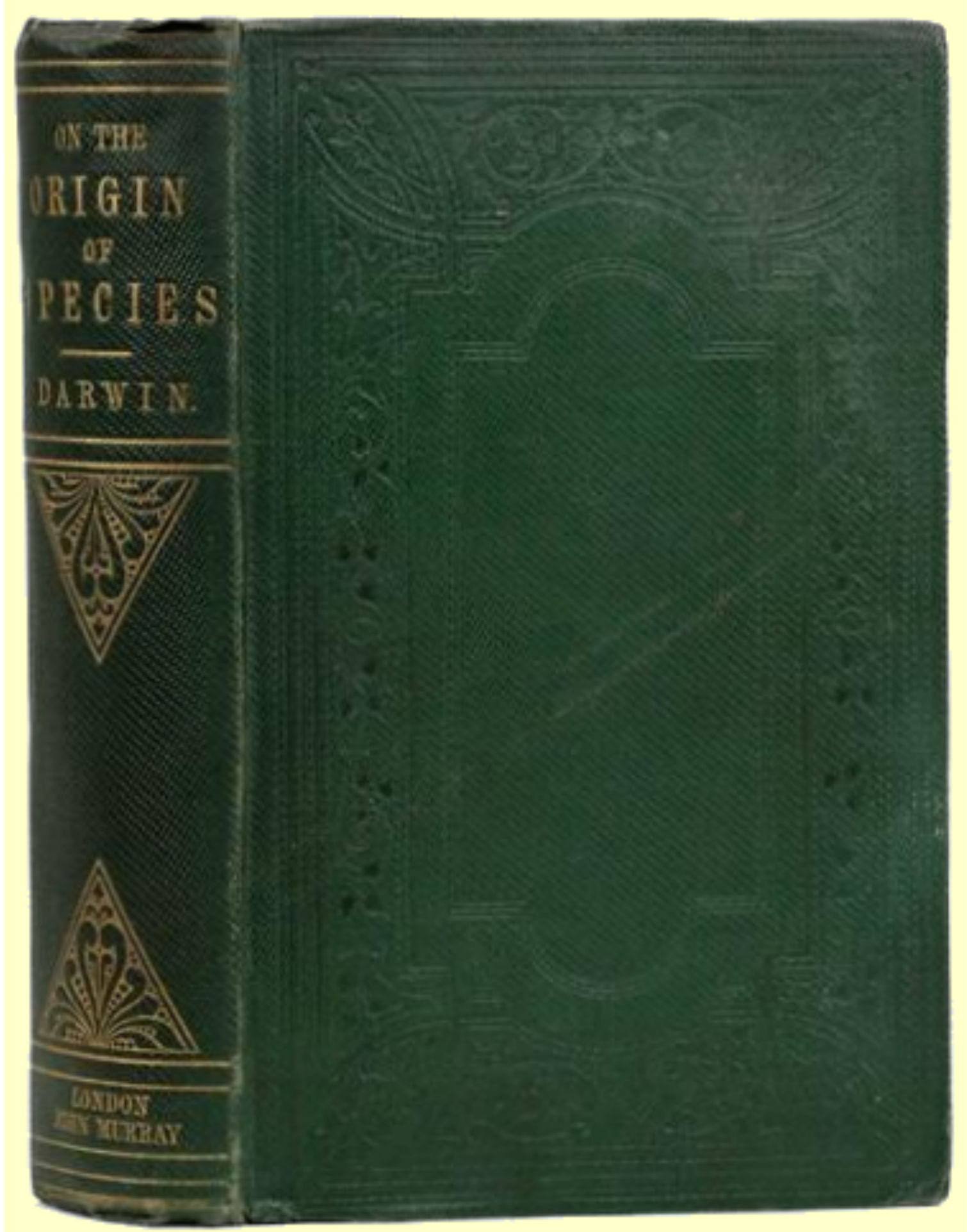


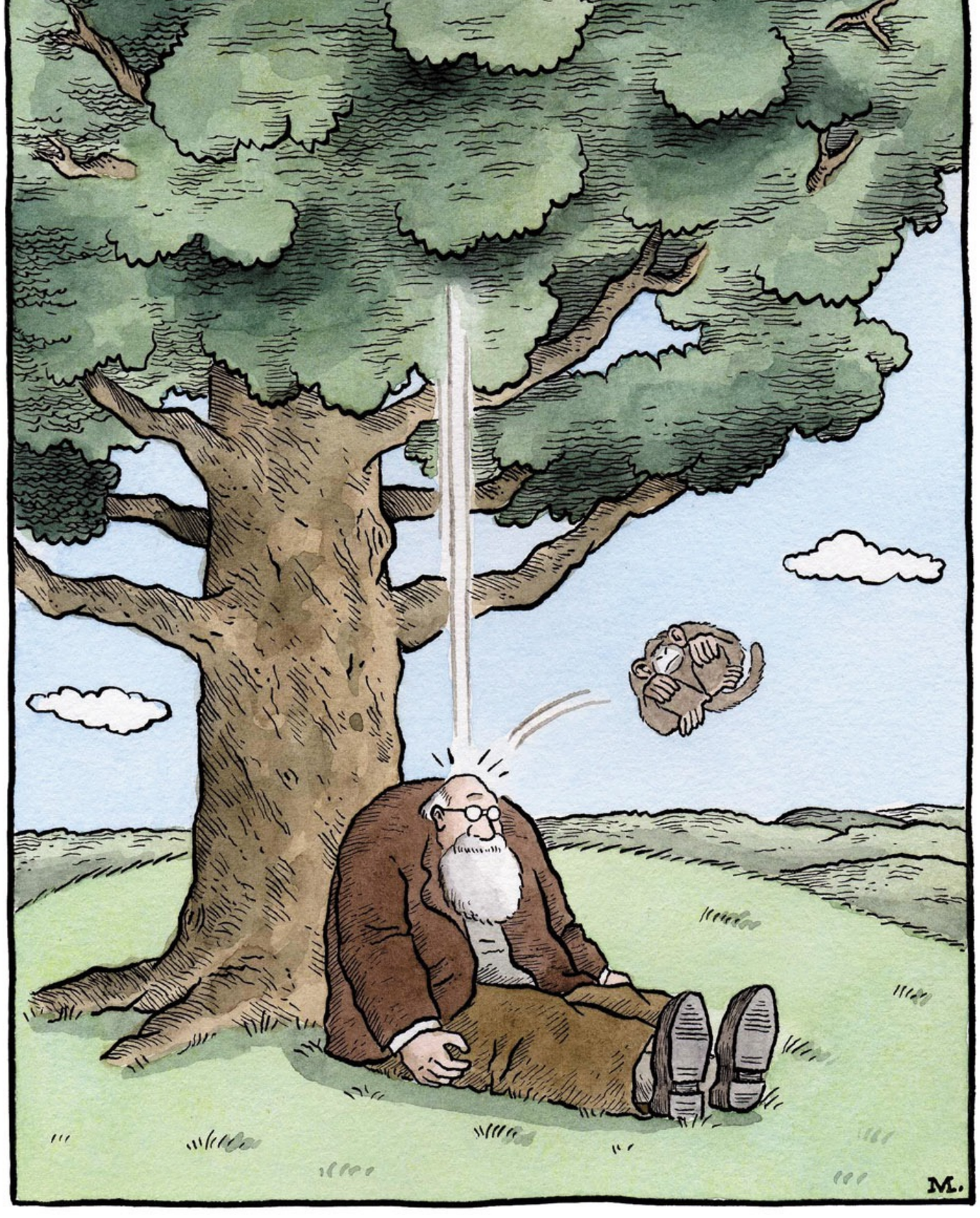
Πάνω: Hans **Driesch** (1867–1941)

Αριστερά: το πείραμα του Driesch με το έμβρυο αχινού (**1891**)

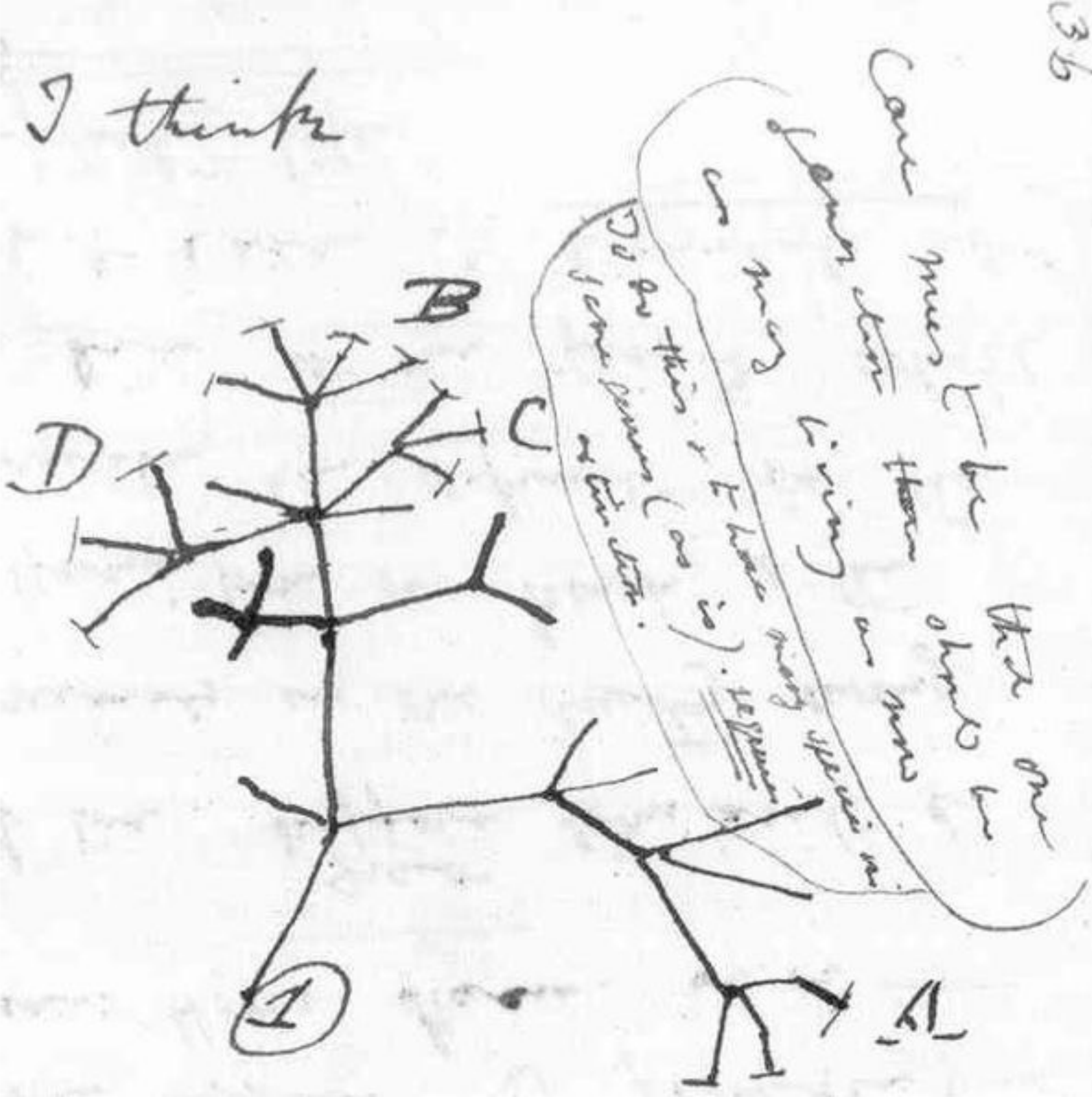

VERY GRADUAL
CHANGE
WE CAN BELIEVE IN

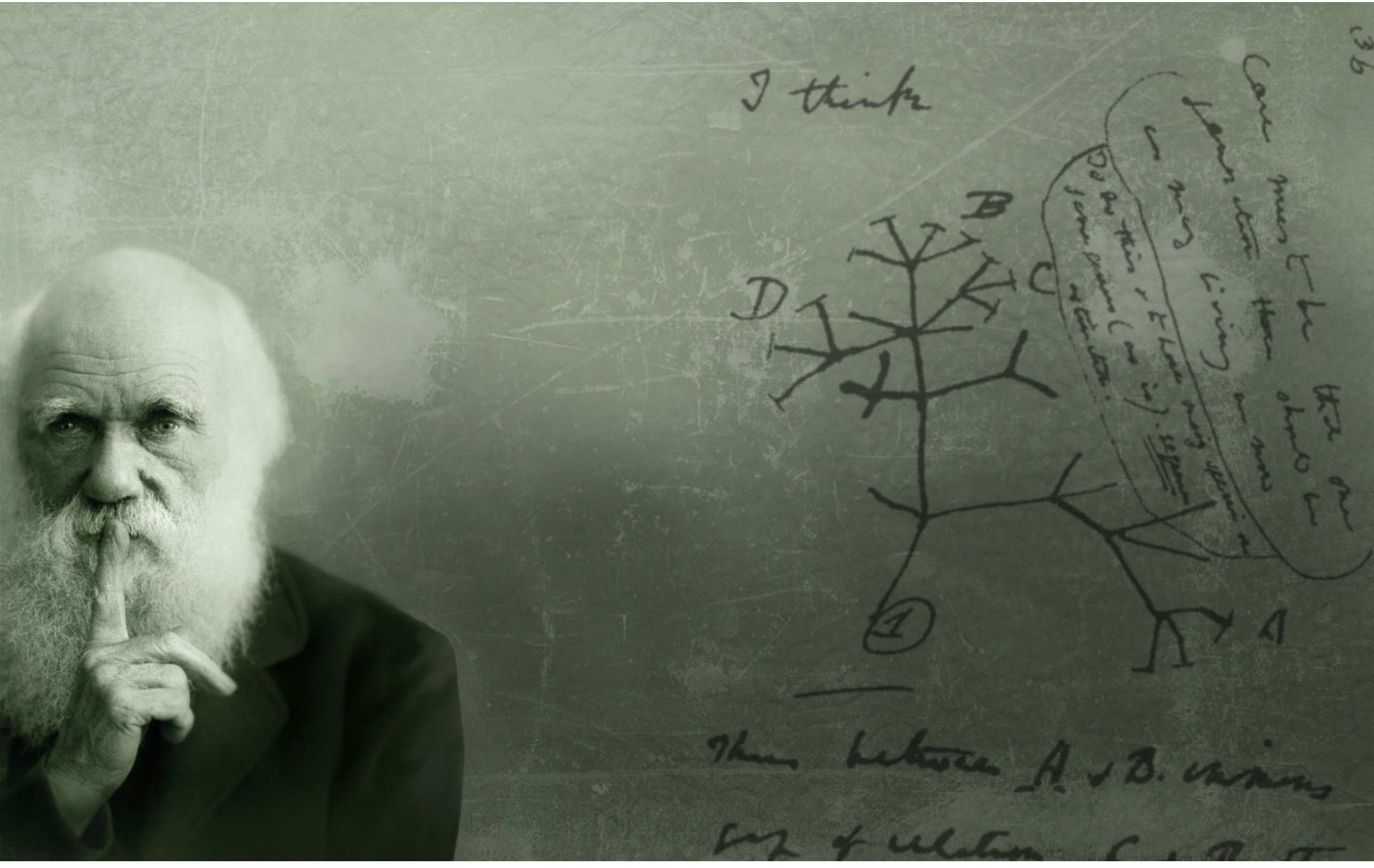
1859
Η Καταγωγή των Ειδών



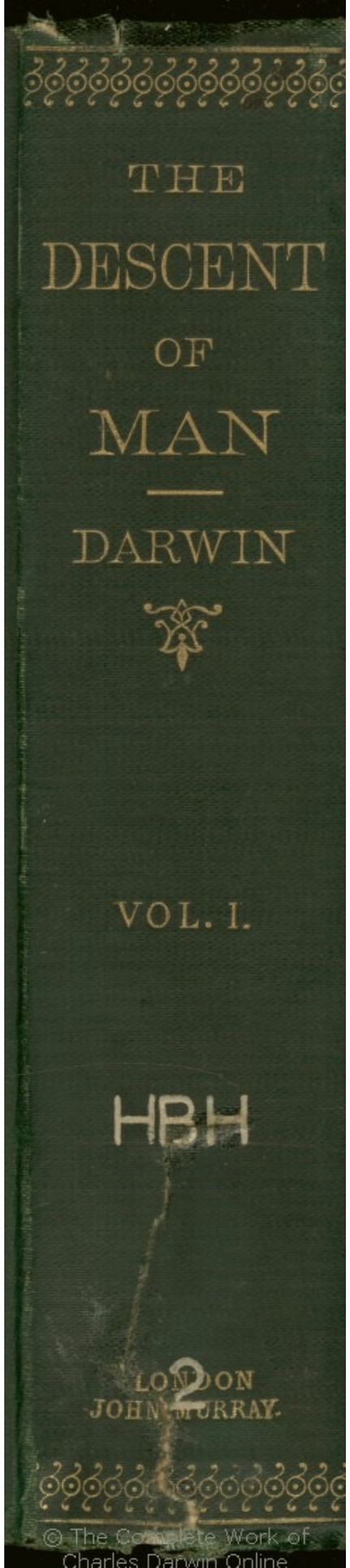


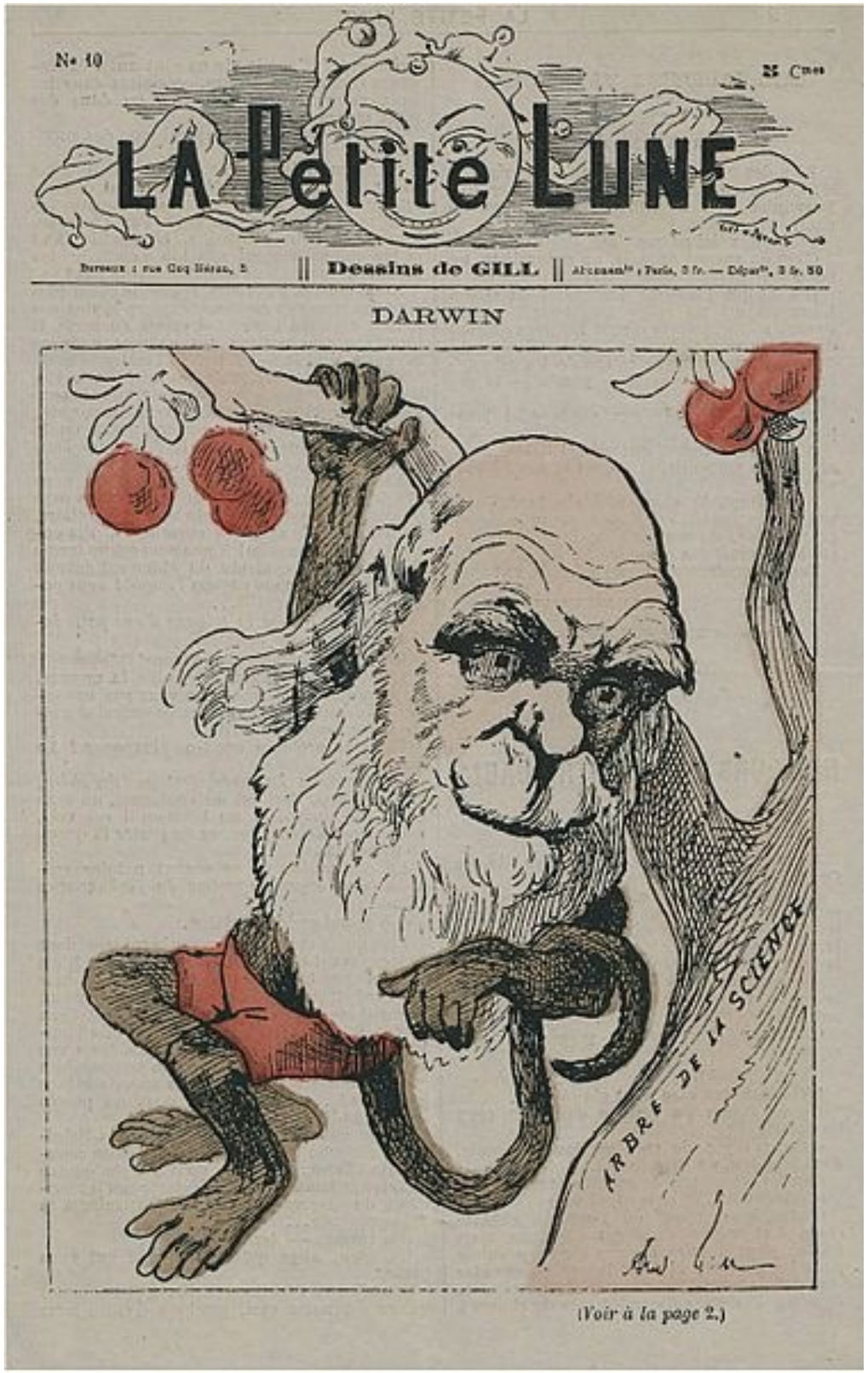
How Darwin really came upon his theory of evolution

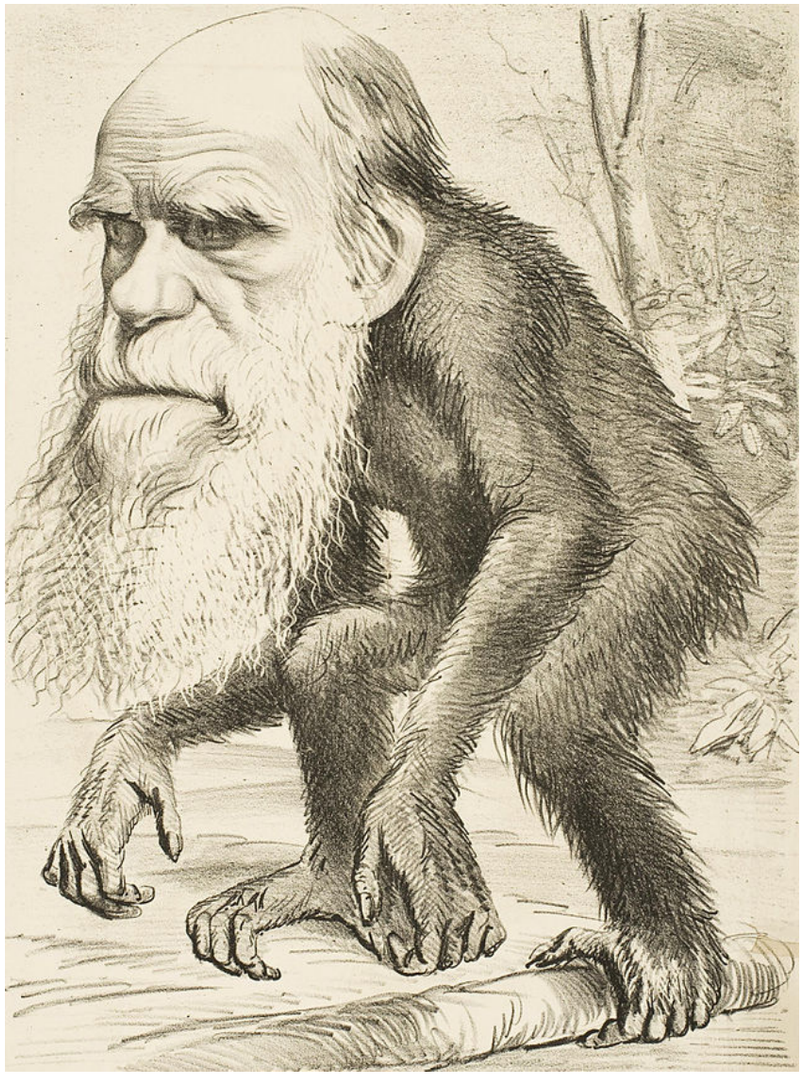

36
I think
B
C
D
1
A


I think
B
C
D
A

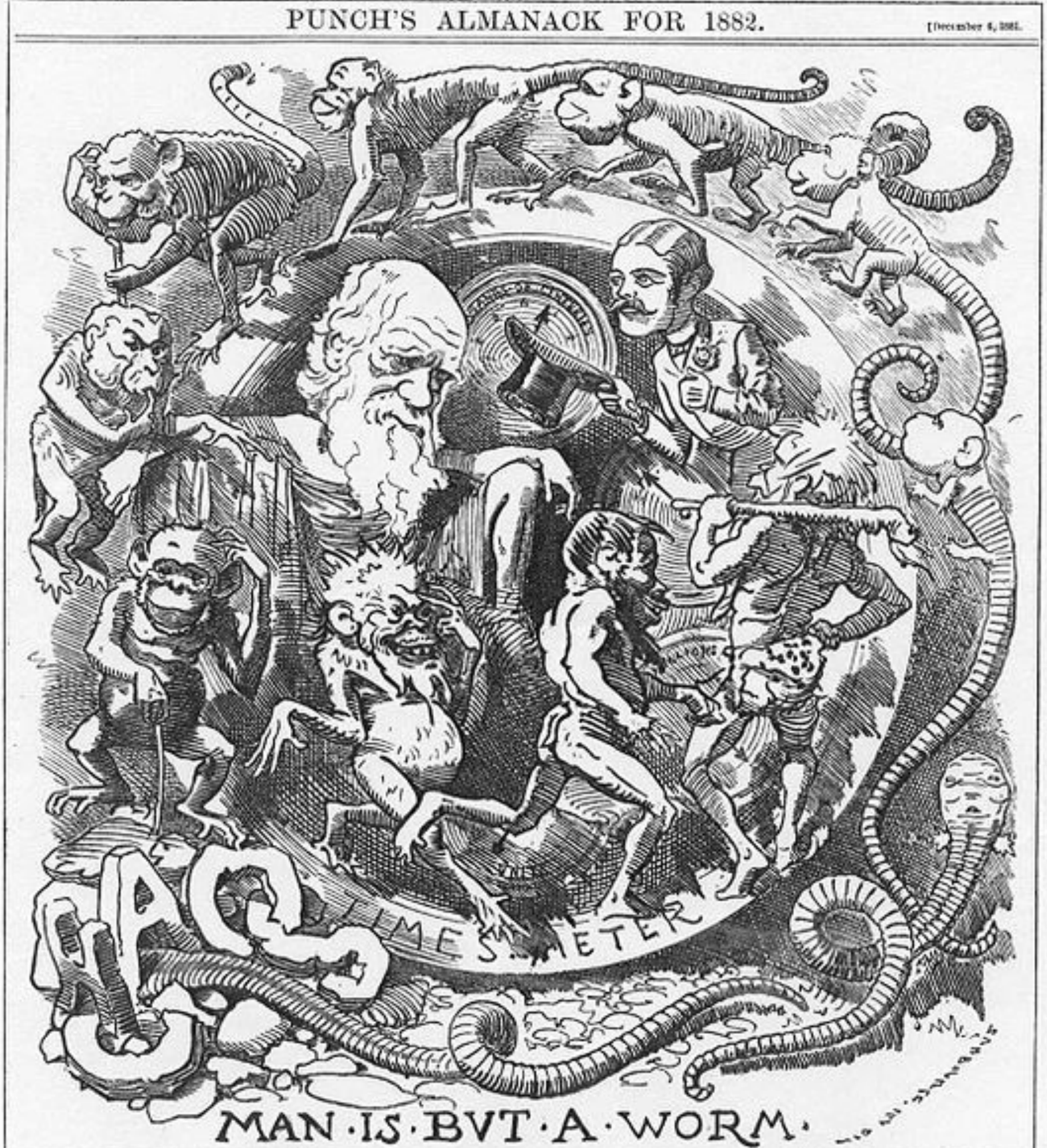
1871 Η Καταγωγή του Ανθρώπου

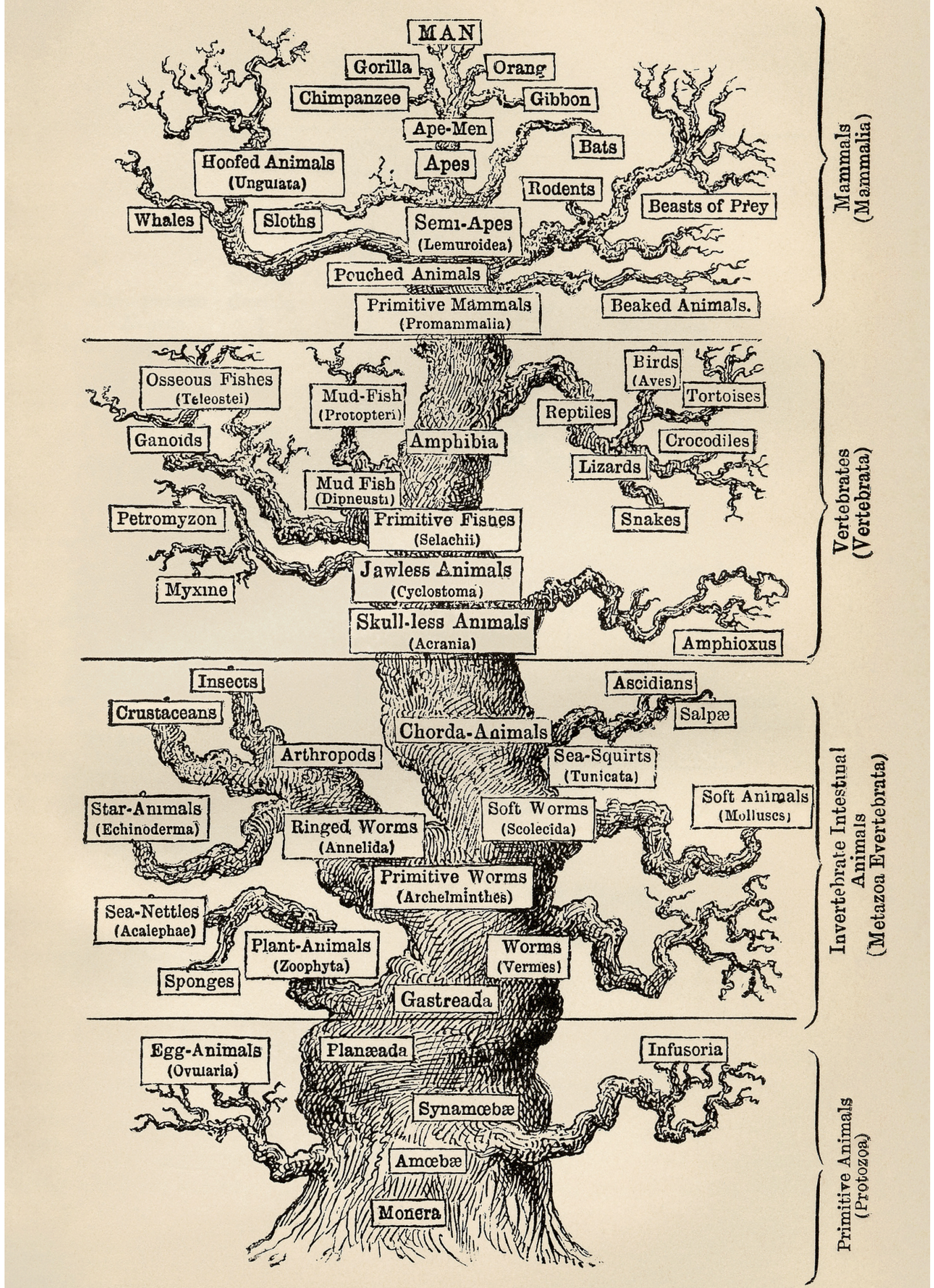


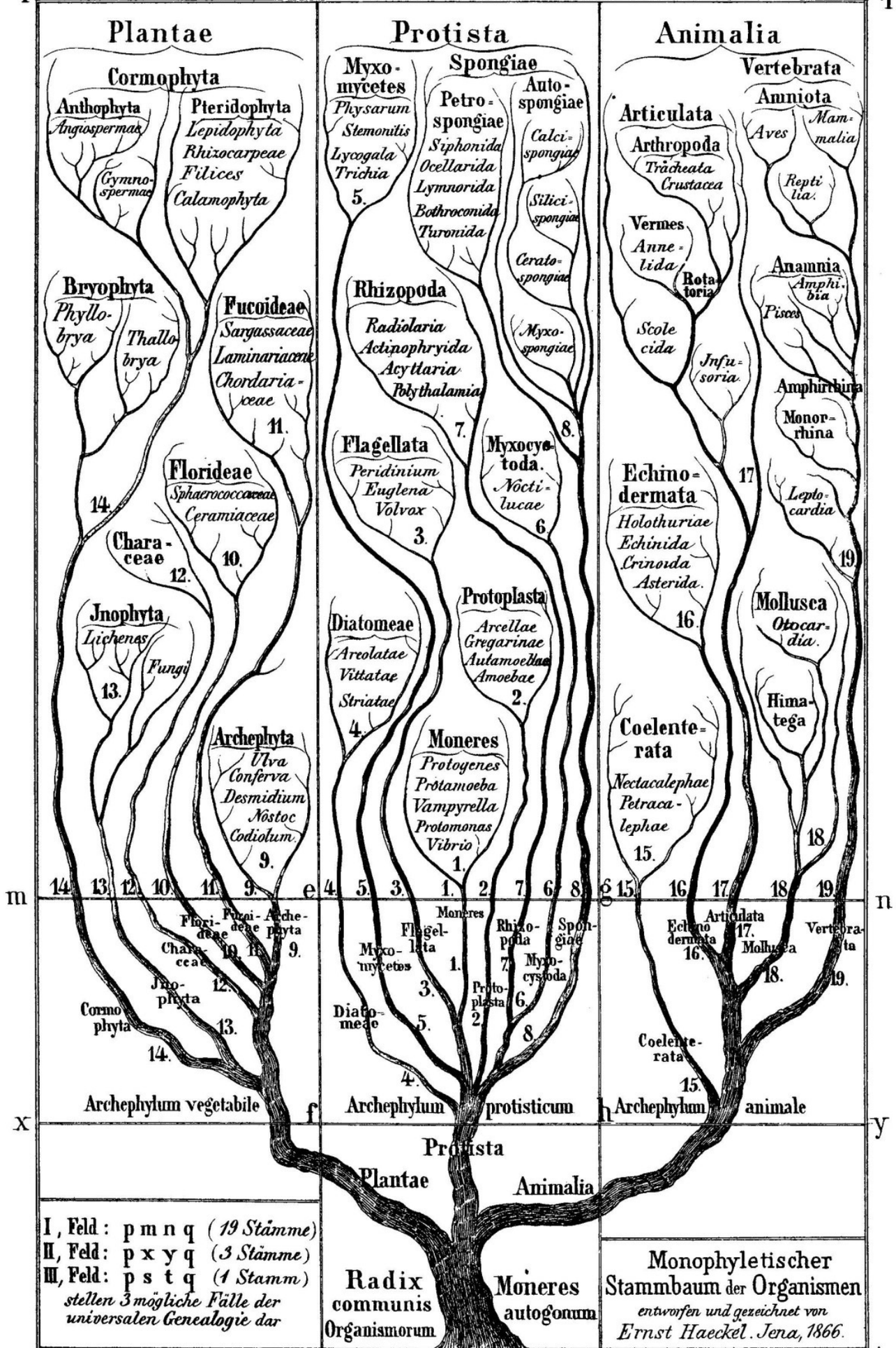


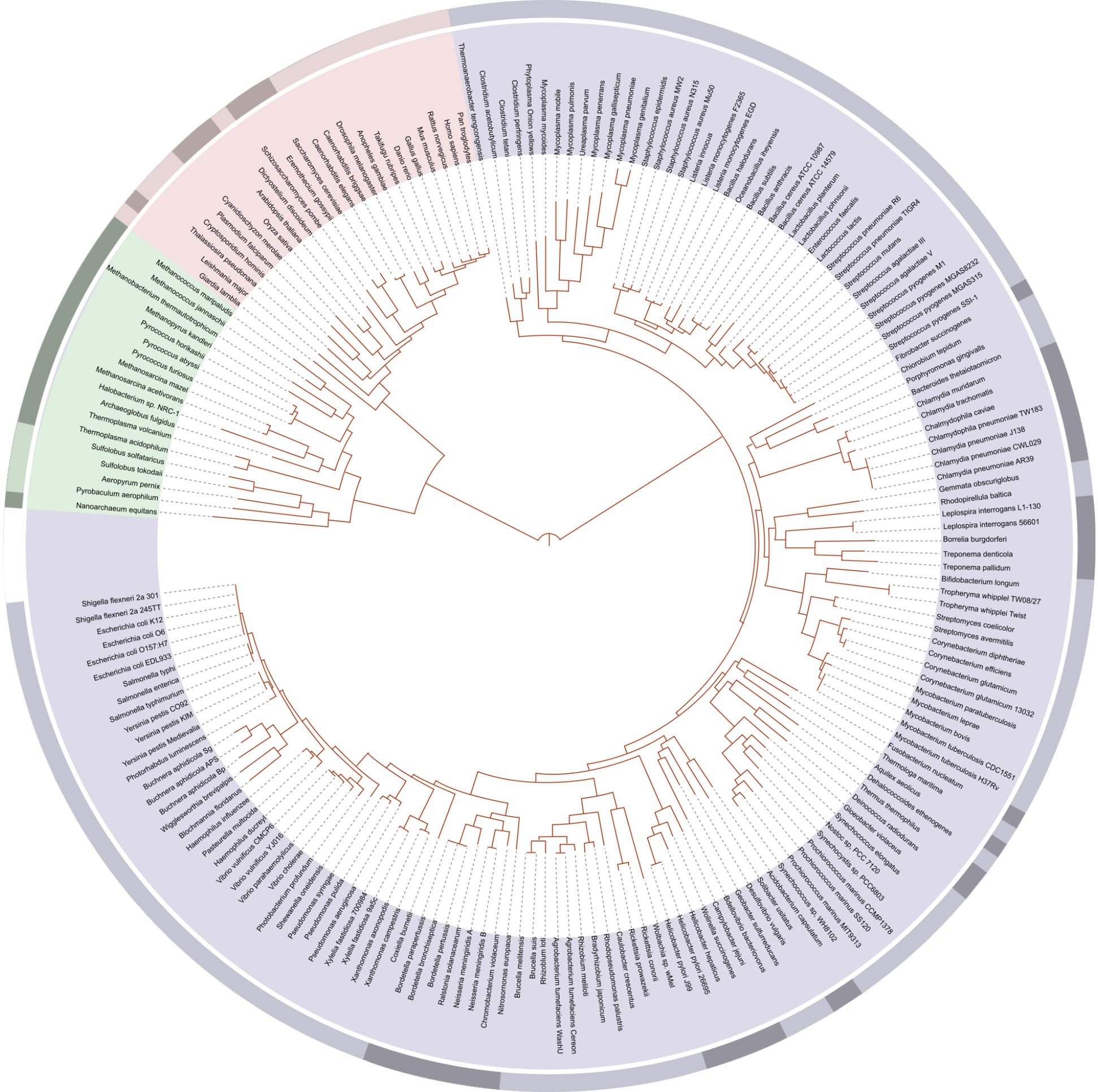


Πάνω, 'A Venerable Orang-outang', γελοιογραφία του Δαρβίνου που δημοσιεύτηκε στο σατιρικό περιοδικό *The Hornet* το **1871**.


ACTS
MAN·IS·BVT·A·WORM·


MAN
Gorilla
Orang
Chimpanzee
Gibbon
Ape-Men
Apes
Bats
Hoofed Animals
(Ungulata)
Rodents
Beasts of Prey
Whales
Sloths
Semi-Apes
(Lemuroidea)
Pouched Animals
Primitive Mammals
(Promammalia)
Beaked Animals.
Mammals
(Mammalia)
Osseous Fishes
(Teleostei)
Mud-Fish
(Protopteri)
Birds
(Aves)
Tortoises
Reptiles
Ganoids
Amphibia
Crocodiles
Lizards
Mud Fish
(Dipneusti)
Petromyzon
Primitive Fishes
(Selachii)
Snakes
Jawless Animals
(Cyclostoma)
Myxine
Skull-less Animals
(Acrania)
Amphioxus
Vertebrates
(Vertebrata)
Insects
Ascidians
Crustaceans
Salpæ
Chorda-Animals
Arthropods
Sea-Squirts
(Tunicata)
Star-Animals
(Echinoderma)
Soft Worms
(Scolecida)
Soft Animals
(Molluscs)
Ringed Worms
(Annelida)
Primitive Worms
(Archelminthes)
Sea-Nettles
(Acalephae)
Plant-Animals
(Zoophyta)
Worms
(Vermes)
Sponges
Gastreada
Invertebrate Intestinal
Animals
(Metazoa Evertebrata)
Egg-Animals
(Ovularia)
Planæada
Infusoria
Synamœbæ
Amœbæ
Monera
Primitive Animals
(Protozoa)


Plantae
Protista
Animalia
Cormophyta
Anthophyta
Angiospermae
Gymnospermae
Pteridophyta
Lepidophyta
Rhizocarpeae
Filices
Calamophyta
Bryophyta
Phyllobrya
Thallobrya
Fucoideae
Sargassaceae
Laminariaceae
Chordariaceae
11.
Florideae
Sphaerococcaceae
Ceramiaceae
10.
14.
Characeae
12.
Jnophyta
Lichenes
Fungi
13.
Archephyta
Ulva
Conferva
Desmidium
Nostoc
Codiolum
9.
Myxomycetes
Physarum
Stemonitis
Lycogala
Trichia
5.
Spongiae
Petrospongiae
Siphonida
Ocellarida
Lymnorida
Bothroconida
Turonida
Autospongiae
Calcispongiae
Silicispongiae
Ceratospongiae
Myxospongiae
Rhizopoda
Radiolaria
Actipophryida
Acyttaria
Polythalamia
7.
8.
Flagellata
Peridinium
Euglena
Volvox
3.
Myxocystoda.
Noctilucae
6.
Protoplasta
Arcellae
Gregarinae
Autamoebae
Amoebae
2.
Diatomeae
Areolatae
Vittatae
Striatae
4.
Moneres
Protogenes
Protamoeba
Vampyrella
Protomonas
Vibrio
1.
Vertebrata
Amniota
Aves
Mammalia
Reptilia.
Anamnia
Amphibia.
Pisces
Articulata
Arthropoda
Tracheata
Crustacea
Vermes
Annelida
Rotatoria
Scolecida
Infusoria.
Amphirhina
Monorrhina
Leptocardia
19
Echinodermata
Holothuriae
Echinida
Crinoida
Asterida.
16.
17
Mollusca
Otocardia.
Himatega
18.
Coelenterata
Nectacalephae
Petracalephae
15.
m
n
e
f
g
h
x
y
14 13 12 10 11 9 4 5 3 1 2 7 6 8 15 16 17 18 19
Archephylum vegetabile
Archephylum protisticum
Archephylum animale
Protista
Plantae
Animalia
I, Feld: p m n q (19 Stämme)
II, Feld: p x y q (3 Stämme)
III, Feld: p s t q (1 Stamm)
stellen 3 mögliche Fälle der universalen Genealogie dar
Radix communis Organismorum
Moneres autogonum
Monophyletischer Stammbaum der Organismen
entworfen und gezeichnet von
Ernst Haeckel. Jena, 1866.


Thermoanaerobacter tengcongensis
Clostridium acetobutylicum
Clostridium tetani
Clostridium perfringens
Phytoplasma Onion yellows
Mycoplasma mobile
Mycoplasma mycoides
Mycoplasma pulmonis
Ureaplasma parvum
Mycoplasma penetrans
Mycoplasma gallisepticum
Mycoplasma pneumoniae
Mycoplasma genitalium
Staphylococcus epidermidis
Staphylococcus aureus MW2
Staphylococcus aureus N315
Staphylococcus aureus Mu50
Listeria innocua
Listeria monocytogenes F2365
Listeria monocytogenes EGD
Bacillus halodurans
Oceanobacillus iheyensis
Bacillus subtilis
Bacillus anthracis
Bacillus cereus ATCC 10987
Bacillus cereus ATCC 14579
Lactobacillus plantarum
Lactobacillus johnsonii
Enterococcus faecalis
Lactococcus lactis
Streptococcus pneumoniae R6
Streptococcus pneumoniae TIGR4
Streptococcus mutans
Streptococcus agalactiae III
Streptococcus agalactiae V
Streptococcus pyogenes M1
Streptococcus pyogenes MGAS8232
Streptococcus pyogenes MGAS315
Streptococcus pyogenes SSI-1
Fibrobacter succinogenes
Chlorobium tepidum
Porphyromonas gingivalis
Bacteroides thetaiotaomicron
Chlamydia muridarum
Chlamydia trachomatis
Chalmydophila caviae
Chlamydophila pneumoniae TW183
Chlamydia pneumoniae J138
Chlamydia pneumoniae CWL029
Chlamydia pneumoniae AR39
Gemmata obscuriglobus
Rhodopirellula baltica
Leplospira interrogans L1-130
Leplospira interrogans 56601
Borrelia burgdorferi
Treponema denticola
Treponema pallidum
Bifidobacterium longum
Tropheryma whipplei TW08/27
Tropheryma whipplei Twist
Streptomyces coelicolor
Streptomyces avermitilis
Corynebacterium diphtheriae
Corynebacterium efficiens
Corynebacterium glutamicum
Corynebacterium glutamicum 13032
Mycobacterium paratuberculosis
Mycobacterium leprae
Mycobacterium bovis
Mycobacterium tuberculosis CDC1551
Mycobacterium tuberculosis H37Rv
Fusobacterium nucleatum
Thermologa maritima
Aquilex aeolicus
Dehalococcoides ethenogenes
Thermus thermophilus
Deinococcus radiodurans
Gloeobacter violaceus
Synechococcus elongatus
Nostoc sp. PCC 7120
Synechocystis sp. PCC6803
Prochlorococcus marinus CCMP1378
Prochlorococcus marinus MIT9313
Prochlorococcus marinus SS120
Synechococcus sp. WH8102
Acidobacterium capsulatum
Solibacter usitatus
Desulfovibrio vulgaris
Geobacter sulfurreducans
Campylobacter jejuni
Wolinella succinogenes
Helicobacter hepaticus
Helicobacter pylori 26695
Helicobacter pylori J99
Wolbachia sp. wMel
Rickettsia conorii
Rickettsia prowazekii
Caulobacter crescentus
Rhodopseudomonas palustris
Bradyrhizobium japonicum
Rhizobium meliloti
Agrobacterium tumefaciens Cereon
Agrobacterium tumefaciens WashU
Brucella melitensis
Brucella suis
Rhizobium loti
Nitrosomonas europaea
Chromobacterium violaceum
Neisseria meningiridis B
Neisseria meningiridis A
Ralstonia solanacearum
Bordetella pertussis
Bordetella bronchiseptica
Bordetella parapertussis
Coxiella burnetii
Xanthomonas campestris
Xanthomonas axonopodis
Xylella fastidiosa 9a5c
Xylella fastidiosa 700964
Pseudomonas aeruginosa
Pseudomonas putida
Pseudomonas syringae
Shewanella oneidensis
Photobacterium profundum
Vibrio cholerae
Vibrio parahaemolyticus
Vibrio vulnificus YJ016
Vibrio vulnificus CMCP6
Haemophilus ducreyi
Haemophilus multocida
Pasteurella multocida
Haemophilus influenzae
Blochmannia floridanus
Wigglesworthia brevipalpis
Buchnera aphidicola Bp
Buchnera aphidicola APS
Buchnera aphidicola Sg
Photorhabdus luminescens
Yersinia pestis Medievalia
Yersinia pestis KIM
Yersinia pestis CO92
Salmonella typhimurium
Salmonella enterica
Salmonella typhi
Escherichia coli EDL933
Escherichia coli O157:H7
Escherichia coli O6
Escherichia coli K12
Shigella flexneri 2a 245TT
Shigella flexneri 2a 301
Nanoarchaeum equitans
Pyrobaculum aerophilum
Aeropyrum pernix
Sulfolobus tokodaii
Sulfolobus solfataricus
Thermoplasma acidophilum
Thermoplasma volcanium
Archaeoglobus fulgidus
Halobacterium sp. NRC-1
Methanosarcina acetivorans
Methanosarcina mazei
Pyrococcus furiosus
Pyrococcus abyssi
Pyrococcus horikashii
Methanopyrus kandleri
Methanobacterium thermautotrophicum
Methanococcus jannaschii
Methanococcus maripaludis
Giardia lamblia
Leishmania major
Thalassiosira pseudonana
Cryptosporidium hominis
Plasmodium falciparum
Cyanidioschyzon merolae
Oryza sativa
Arabidopsis thaliana
Dictyostelium discoideum
Schizosaccharomyces pombe
Eremothecium gossypii
Saccharomyces cerevisiae
Caenorhabditis elegans
Drosophila melanogaster
Anopheles gambiae
Takifugu rubripes
Danio rerio
Gallus gallus
Mus musculus
Rattus norvegicus
Homo sapiens
Pan troglodytes

450 POSTE VATICANE

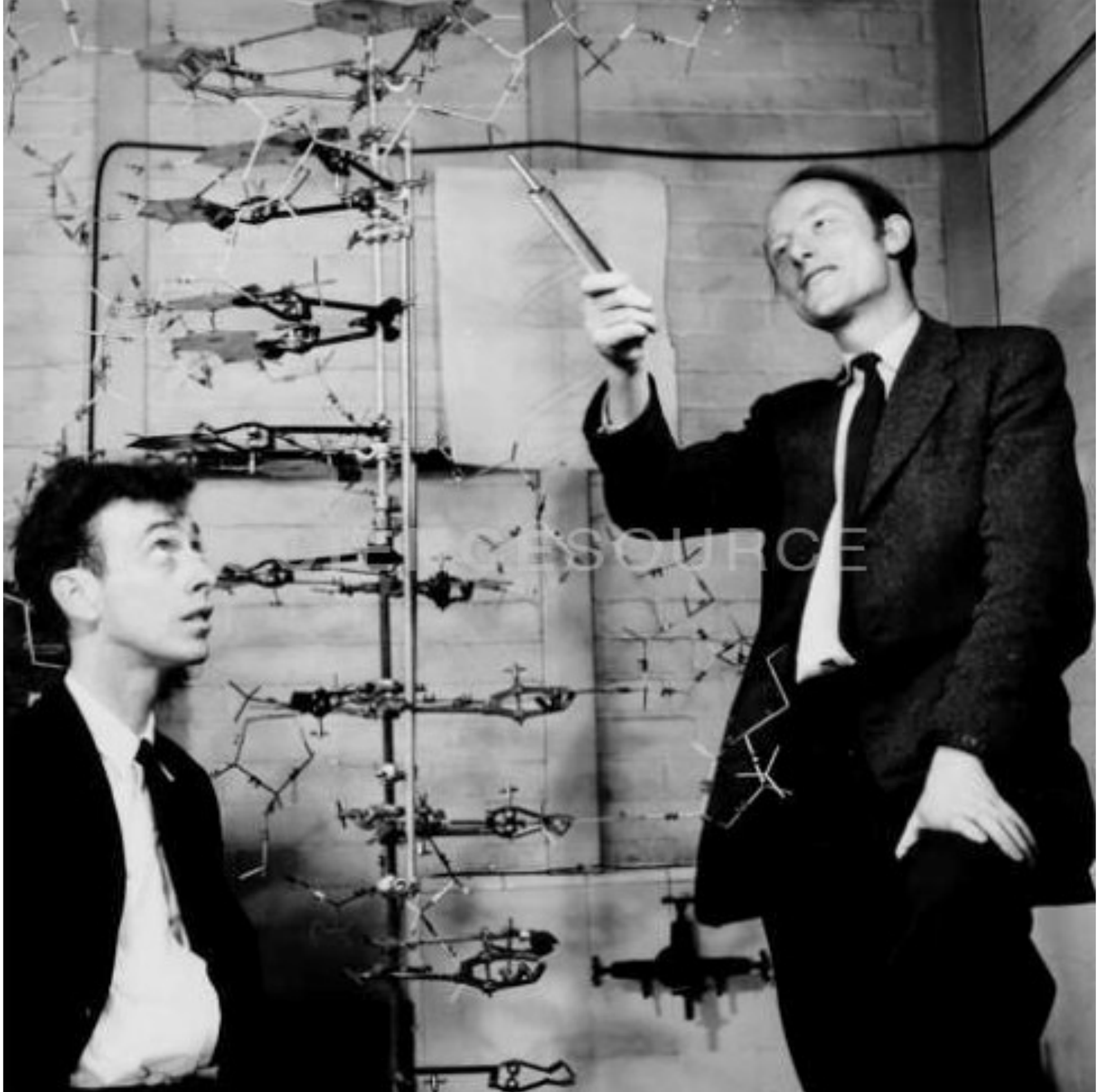
M. CODONI

I.P.Z.S.-ROMA-1984


Towels

White-eyed mutant fly

Red-eyed wild-type fly



equipment, and to Dr. G. E. R. Deacon and the captain and officers of R.R.S. *Discovery II* for their part in making the observations.

[1] Young, F. B., Gerrard, H., and Jevons, W., *Phil. Mag.*, **40**, 149 (1920).
[2] Longuet-Higgins, M. S., *Mon. Not. Roy. Astro. Soc., Geophys. Supp.*, **5**, 285 (1949).
[3] Von Arx, W. S., Woods Hole Papers in Phys. Oceanog. Meteor., **11** (3) (1950).
[4] Ekman, V. W., *Arkiv. Mat. Astron. Fysik. (Stockholm)*, **2** (11) (1905).

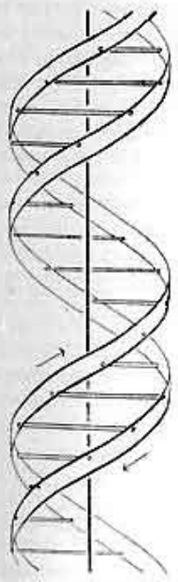
MOLECULAR STRUCTURE OF NUCLEIC ACIDS

A Structure for Deoxyribose Nucleic Acid

WE wish to suggest a structure for the salt of deoxyribose nucleic acid (D.N.A.). This structure has novel features which are of considerable biological interest.

A structure for nucleic acid has already been proposed by Pauling and Corey[1]. They kindly made their manuscript available to us in advance of publication. Their model consists of three intertwined chains, with the phosphates near the fibre axis, and the bases on the outside. In our opinion, this structure is unsatisfactory for two reasons: (1) We believe that the material which gives the X-ray diagrams is the salt, not the free acid. Without the acidic hydrogen atoms it is not clear what forces would hold the structure together, especially as the negatively charged phosphates near the axis will repel each other. (2) Some of the van der Waals distances appear to be too small.

Another three-chain structure has also been suggested by Fraser (in the press). In his model the phosphates are on the outside and the bases on the inside, linked together by hydrogen bonds. This structure as described is rather ill-defined, and for this reason we shall not comment on it.



This figure is purely diagrammatic. The two ribbons symbolize the two phosphate—sugar chains, and the horizontal rods the pairs of bases holding the chains together. The vertical line marks the fibre axis

We wish to put forward a radically different structure for the salt of deoxyribose nucleic acid. This structure has two helical chains each coiled round the same axis (see diagram). We have made the usual chemical assumptions, namely, that each chain consists of phosphate diester groups joining β-D-deoxyribofuranose residues with 3′,5′ linkages. The two chains (but not their bases) are related by a dyad perpendicular to the fibre axis. Both chains follow right-handed helices, but owing to the dyad the sequences of the atoms in the two chains run in opposite directions. Each chain loosely resembles Furberg's[2] model No. 1; that is, the bases are on the inside of the helix and the phosphates on the outside. The configuration of the sugar and the atoms near it is close to Furberg's 'standard configuration', the sugar being roughly perpendicular to the attached base. There is a residue on each chain every 3·4 A. in the *z*-direction. We have assumed an angle of 36° between adjacent residues in the same chain, so that the structure repeats after 10 residues on each chain, that is, after 34 A. The distance of a phosphorus atom from the fibre axis is 10 A. As the phosphates are on the outside, cations have easy access to them.

The structure is an open one, and its water content is rather high. At lower water contents we would expect the bases to tilt so that the structure could become more compact.

The novel feature of the structure is the manner in which the two chains are held together by the purine and pyrimidine bases. The planes of the bases are perpendicular to the fibre axis. They are joined together in pairs, a single base from one chain being hydrogen-bonded to a single base from the other chain, so that the two lie side by side with identical *z*-co-ordinates. One of the pair must be a purine and the other a pyrimidine for bonding to occur. The hydrogen bonds are made as follows: purine position 1 to pyrimidine position 1; purine position 6 to pyrimidine position 6.

If it is assumed that the bases only occur in the structure in the most plausible tautomeric forms (that is, with the keto rather than the enol configurations) it is found that only specific pairs of bases can bond together. These pairs are: adenine (purine) with thymine (pyrimidine), and guanine (purine) with cytosine (pyrimidine).

In other words, if an adenine forms one member of a pair, on either chain, then on these assumptions the other member must be thymine; similarly for guanine and cytosine. The sequence of bases on a single chain does not appear to be restricted in any way. However, if only specific pairs of bases can be formed, it follows that if the sequence of bases on one chain is given, then the sequence on the other chain is automatically determined.

It has been found experimentally[3,4] that the ratio of the amounts of adenine to thymine, and the ratio of guanine to cytosine, are always very close to unity for deoxyribose nucleic acid.

It is probably impossible to build this structure with a ribose sugar in place of the deoxyribose, as the extra oxygen atom would make too close a van der Waals contact.

The previously published X-ray data[5,6] on deoxyribose nucleic acid are insufficient for a rigorous test of our structure. So far as we can tell, it is roughly compatible with the experimental data, but it must be regarded as unproved until it has been checked against more exact results. Some of these are given in the following communications. We were not aware of the details of the results presented there when we devised our structure, which rests mainly though not entirely on published experimental data and stereochemical arguments.

It has not escaped our notice that the specific pairing we have postulated immediately suggests a possible copying mechanism for the genetic material.

Full details of the structure, including the conditions assumed in building it, together with a set of co-ordinates for the atoms, will be published elsewhere.

We are much indebted to Dr. Jerry Donohue for constant advice and criticism, especially on interatomic distances. We have also been stimulated by a knowledge of the general nature of the unpublished experimental results and ideas of Dr. M. H. F. Wilkins, Dr. R. E. Franklin and their co-workers at

Nobel Prize in Physiology or Medicine (**1962**) **-Crick, Watson & Wilkins**

"for their discoveries concerning the **molecular structure of nucleic acids** and its significance for **information transfer in living material**"

-Το Oxford English Dictionary περιέχει τη λέξη '**anatiferous**':

"producing **ducks or geese**, that is producing **barnacles**, formerly supposed to grow on trees and dropping off into the water below, to turn into **tree-geese**"

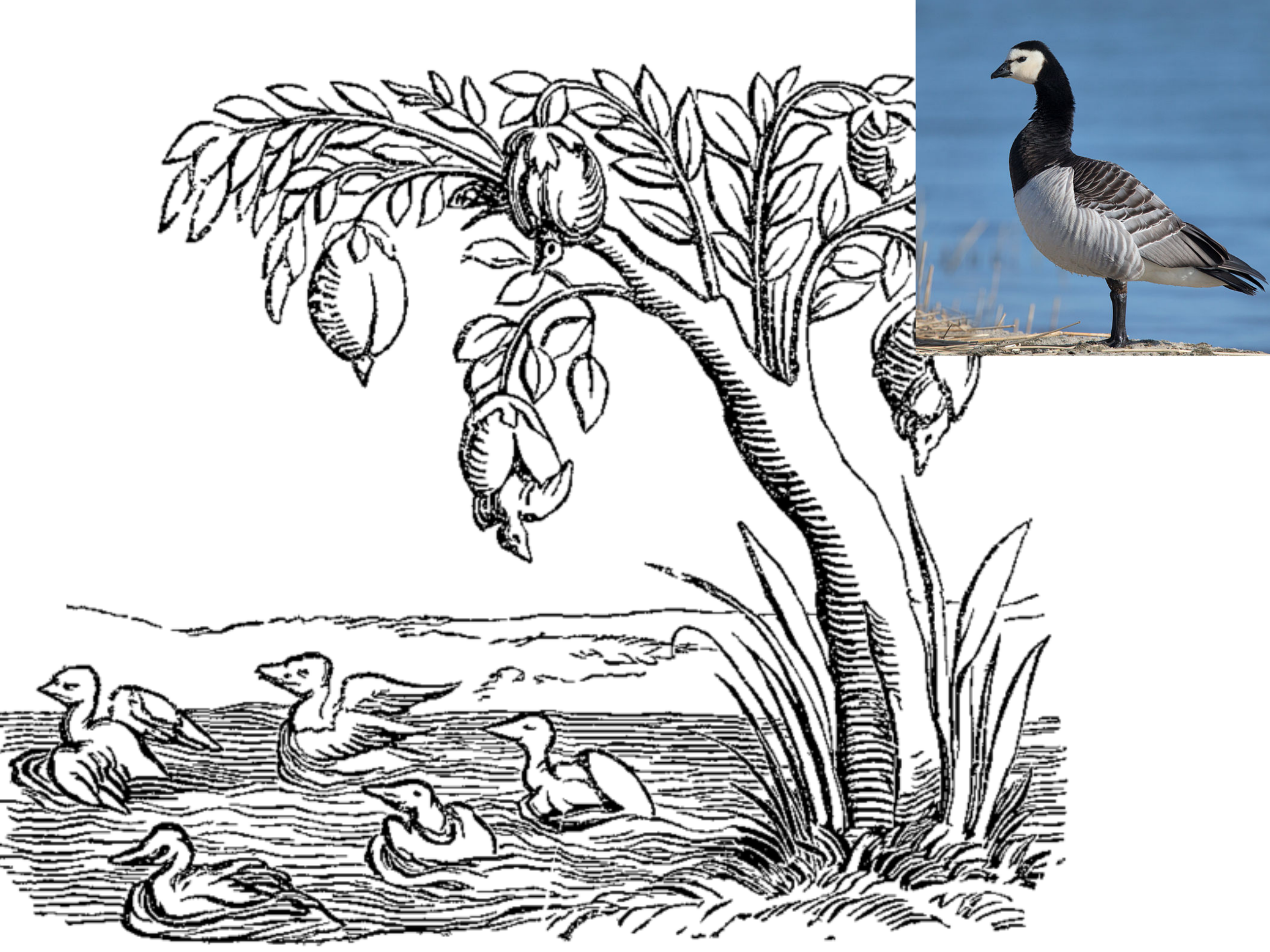
(Hacking 1983 : 70)

-Ο **Scaliger** (**16ος** αιώνας) αναφέρει "as a thing he himself has seen" the stories "falsely told of the Phoenix but veraciously of the Bernacle [sic] Goose"

(Raven 1953 : 204)

‘I have often seen **with my own eyes** more than a thousand **minute embryos of birds** of this species on the seashore, hanging from one piece of timber, **covered with shells, and, already formed**’.

[*Topographia Hibernica* **1188**, Giraldus Cambrensis (Welsh monk)]



Ο Francis **Bacon** (1561 - 1626) πίστευε ότι:

“not only that one species might pass into another, but that it was a matter of **chance** what the **transmutation** would be”

(Poulton 1908: 54).

-Το κλίμα μπορεί να αλλάξει το είδος του φυτού **μόνιμα**:

Ο John **Ray** ισχυρίζεται το **1687** ότι “Wheat . . . degenerates into tares, rape into radish . . . maize into wheat” (quoted in Crombie 1994 v.2: 1270).

"Peter **Crescentius**, the great **14th century agriculturist**, devoted **3 chapters** to **sudden species changes** . . . and for the next 200 years the **sudden mutation** of species was recorded in practically every work on natural history"

(Zirkle 1951: 48)

Erasmus Darwin

Lamarck

Nurs'd by warm sun-beams in primeval caves /
Organic Life began beneath the waves. /
Hence without parent by spontaneous birth /
Rise the first specks of animated earth;