Evoluční medicína

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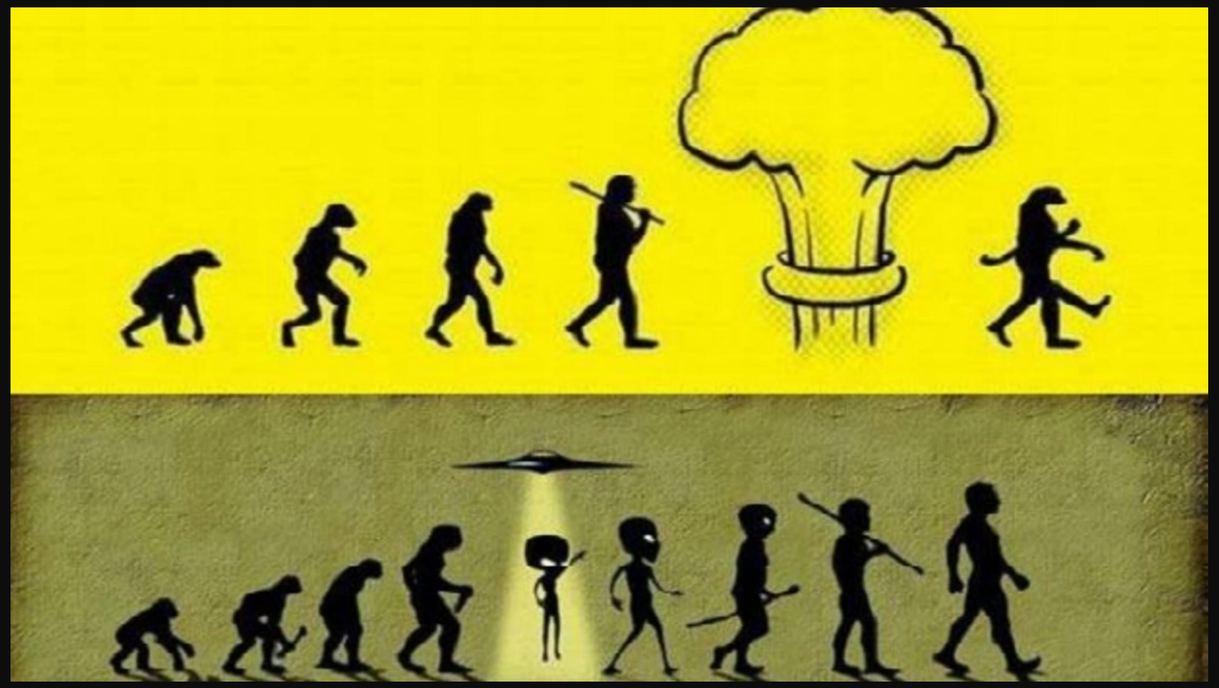
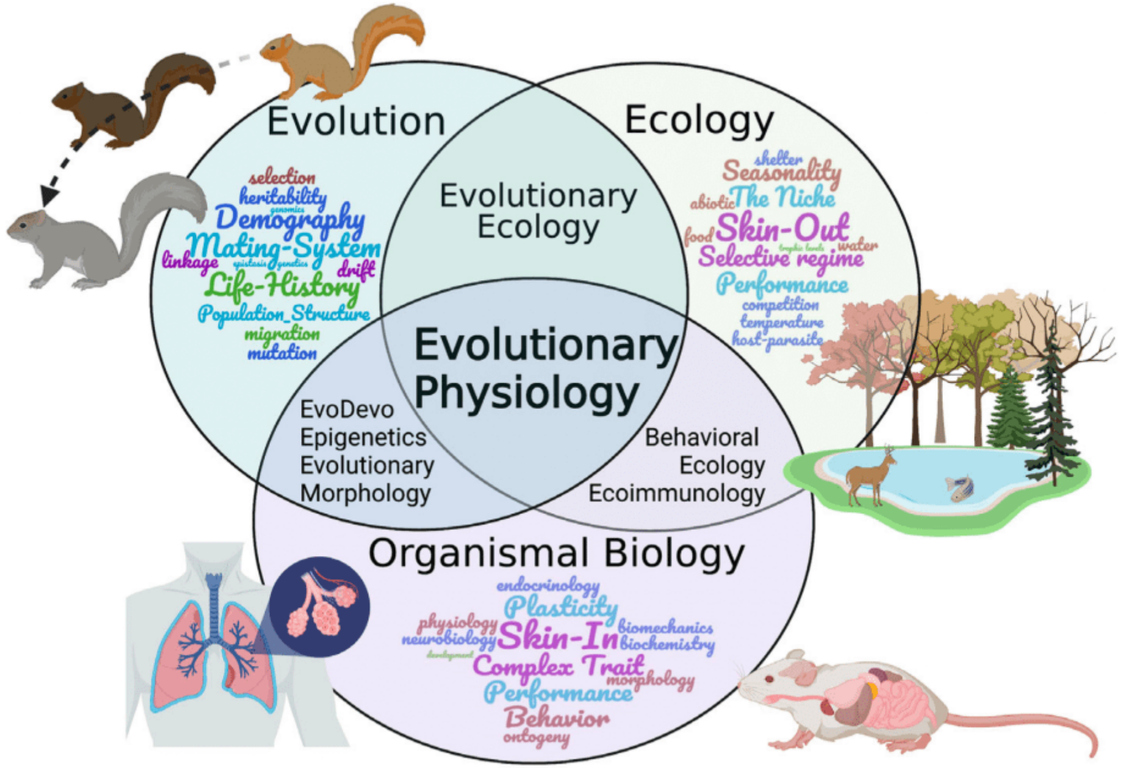
Co je evoluční medicína?

- Evoluční medicína neboli darwinovská medicína je aplikací moderní evoluční teorie k pochopení zdraví a nemoci.
- Moderní biomedicínský výzkum a praxe se soustředily na molekulární a fyziologické mechanismy, které jsou základem zdraví a nemoci,
- zatímco evoluční medicína se zaměřuje na otázku, proč evoluce utvářela tyto mechanismy způsobem, který nás může zanechat náchylný k nemocem.
- Evoluční přístup vedl k důležitým pokrokům v chápání rakoviny,] autoimunitních onemocnění[a anatomie . Mezinárodní společnost pro evoluci, medicínu a veřejné zdraví koordinuje úsilí o rozvoj tohoto oboru.
- Vlastní časopis **Oxford University Press** *Evolution, Medicine* and Public Health a The Evolution and Medicine Review.




Evolution
selection
heritability
Demography
Mating-System
linkage
drift
Life-History
Population_Structure
migration
mutation
Evolutionary Ecology
Ecology
shelter
Seasonality
abiotic
The Niche
food
Skin-Out
water
Selective regime
Performance
competition
temperature
host-parasite
Evolutionary Physiology
EvoDevo
Epigenetics
Evolutionary Morphology
Behavioral Ecology
Ecoimmunology
Organismal Biology
endocrinology
Plasticity
physiology
neurobiology
Skin-In
biomechanics
biochemistry
Complex Trait
morphology
Performance
Behavior
ontogeny

Kdy?

Obor tak měl nejisté rané dětství, ale brzy jej přivedly k omezení dospívání dvě díla: pojednání z roku 1991 „Úsvit darwinovské medicíny“ od George Williamse a Nesse a kniha „Evoluce infekčních chorob“ z roku 1993 od Paula Ewalda.

VOLUME 66, NO. 1 MARCH 1991

THE QUARTERLY REVIEW *of* BIOLOGY

THE DAWN OF DARWINIAN MEDICINE

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ABSTRACT

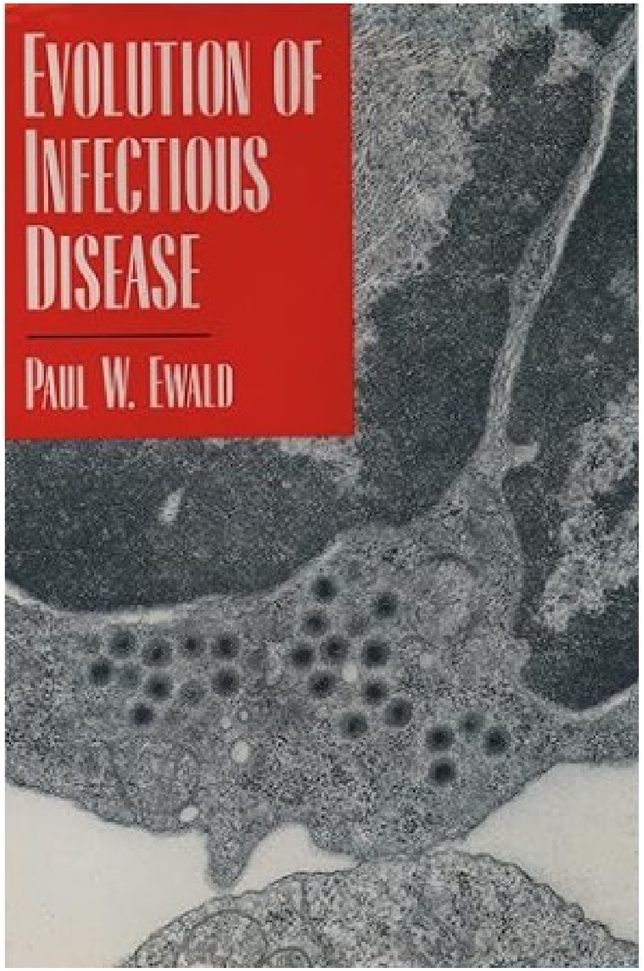
While evolution by natural selection has long been a foundation for biomedical science, it has recently gained new power to explain many aspects of disease. This progress results largely from the disciplined application of what has been called the adaptationist program. We show that this increasingly significant research paradigm can predict otherwise unsuspected facets of human biology, and that it provides new insights into the causes of medical disorders, such as those discussed below:

1. Infection. Signs and symptoms of the host-parasite contest can be categorized according to whether they represent adaptations or costs for host or parasite. Some host adaptations may have contributed to fitness in the Stone Age but are obsolete today. Others, such as fever and iron sequestration, have been incorrectly considered harmful. Pathogens, with their large populations and many generations in a single host, can evolve very rapidly. Acquisition of resistance to antibiotics is one example. Another is the recently demonstrated tendency to change virulence levels in predictable ways in response to changed conditions imposed incidentally by human activities.

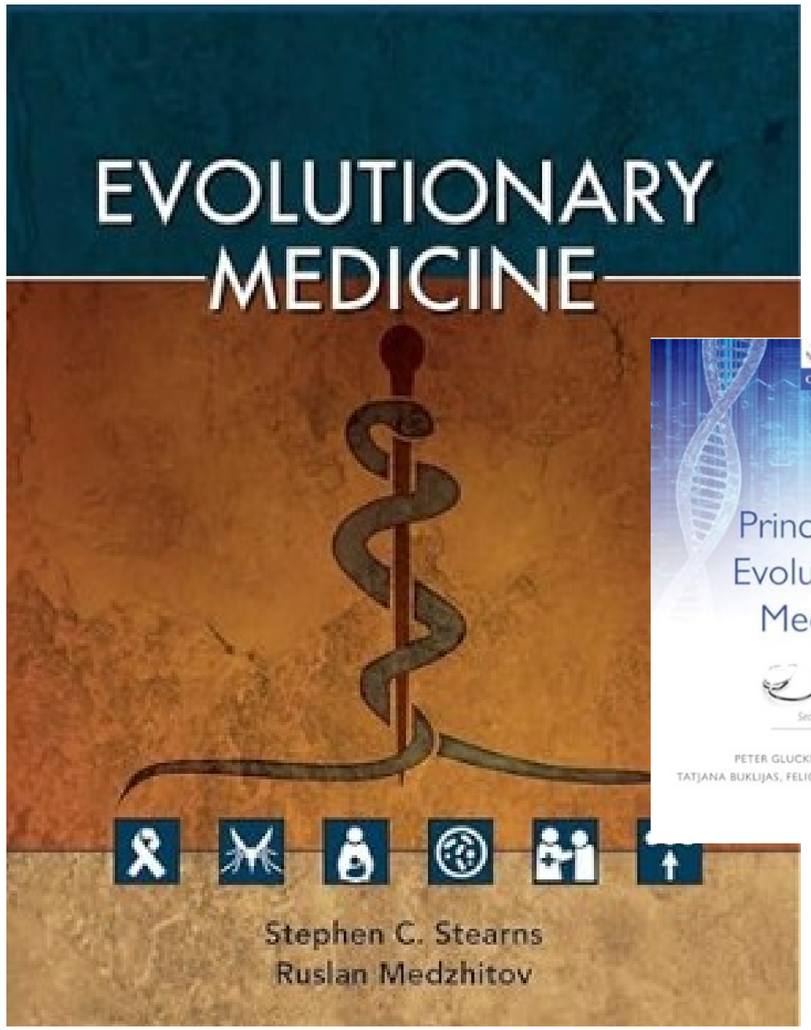
2. Injuries and toxins. Mechanical injuries or stressful wear and tear are conceptually simpler than infectious diseases because they are not contests between conflicting interests. Plant-herbivore contests may often underlie chemical injury from the defensive secondary compounds of plant tissues. Nausea in pregnancy, and allergy, may be adaptations against such toxins.

3. Genetic factors. Common genetic diseases often result from genes maintained by other beneficial effects in historically normal environments. The diseases of aging are especially likely to be associated with early benefits.

4. Abnormal environments. Human biology is designed for Stone Age conditions. Modern en-



56 odborníků z různých oborů, včetně antropologie, medicíny, ošetřovatelství a biologie, se s využitím metody Delphi dohodlo na 14 základních principech, které jsou vlastní vzdělávání a praxi evoluční medicíny.[5] Těchto 14 principů lze dále seskupit do pěti obecných kategorií: rámování otázek, evoluce I a II (s II zahrnuje vyšší úroveň složitosti), evoluční kompromisy, důvody zranitelnosti a kultura. Další informace o těchto zásadách naleznete v tabulce níže.Základní principy evoluční medicíny[5]Základní princip tématuTypy vysvětlení (rámování otázek) K úplnému biologickému pochopení vlastností, včetně těch, které zvyšují zranitelnost vůči nemocem, jsou zapotřebí jak přibližná (mechanistická), tak konečná (evoluční) vysvětlení.Evoluční procesy (evoluce I) Všechny evoluční procesy, včetně přirozeného výběru, genetického driftu, mutace, migrace a nenáhodného páření, jsou důležité pro pochopení vlastností a nemocí.Reprodukční úspěch (evoluce I) Přírodní výběr maximalizuje reprodukční úspěch, někdy na úkor zdraví a dlouhověkosti.Sexuální výběr (evoluce I) Sexuální výběr formuje rysy, které mají za následek různá zdravotní rizika mezi pohlavími.Omezení (evoluce I) Několik omezení brání schopnosti přirozeného výběru utvářet vlastnosti, které jsou hypoteticky optimální pro zdraví.Kompromisy (evoluční kompromisy) Evoluční změny v jedné vlastnosti, které zlepšují kondici, mohou být spojeny se změnami v jiných vlastnostech, které kondici snižují.Teorie životní historie (evoluční kompromisy) Vlastnosti životní historie, jako je věk při prvním rozmnožování, reprodukční délka života a rychlost stárnutí, jsou utvářeny evolucí a mají důsledky pro zdraví a nemoci.Úrovně selekce (evoluce II) Zranitelnost vůči chorobám může nastat, když má selekce protichůdné účinky na různých úrovních (např. genetické prvky, buňky, organismy, příbuzní a další úrovně).Fylogeneze (evoluce II) Sledování fylogenetických vztahů pro druhy, populace, znaky nebo patogeny může poskytnout pohled na zdraví a nemoci.Koevoluce (evoluce II) Koevoluce mezi druhy může ovlivnit zdraví a nemoci (např. evoluční závody ve zbrojení a vzájemné vztahy, jako jsou ty, které lze vidět v mikrobiomu).Plasticita (evoluce II) Faktory prostředí mohou posunout vývojové trajektorie způsoby, které ovlivňují zdraví, a plasticita těchto trajektorií může být produktem vyvinutých adaptivních mechanismů.Obrany (důvody zranitelnosti) Mnoho příznaků a symptomů onemocnění (např. horečka) je užitečným obranným prostředkem, který může být patologický, pokud je dysregulován.Nesoulad (důvody zranitelnosti) Rizika onemocnění mohou být změněna u organismů žijících v prostředí, které se liší od prostředí, ve kterém se vyvinuli jejich předkové.Kulturní praktiky (kultura) Kulturní praktiky mohou ovlivnit evoluci lidí a jiných druhů (včetně patogenů) způsoby, které mohou ovlivnit zdraví a nemoci (např. užívání antibiotik, porodní praktiky, strava atd.).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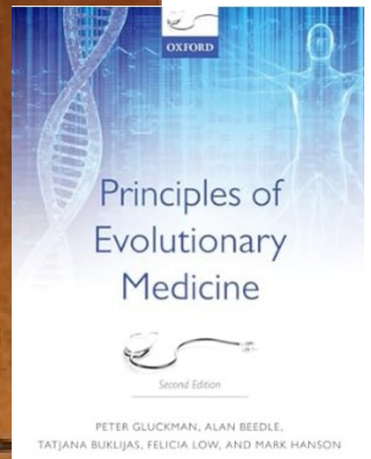
MEDICINE
Stephen C. Stearns
Ruslan Medzhitov


EVIDENCE-BASED
EVOLUTIONARY
MEDICINE
WILEY Blackwell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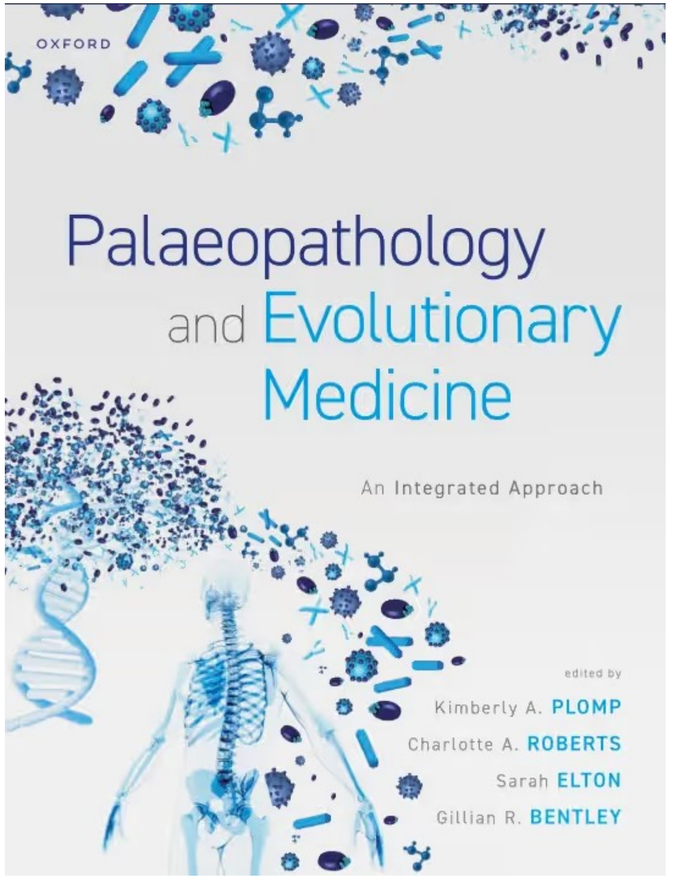
Medicine
Second Edition
PETER GLUCKMAN, ALAN BEEDLE,
TATJANA BUKLIJAS, FELICIA LOW, AND MARK HANSON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An Integrated Approach
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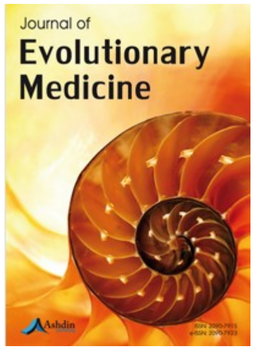
Charlotte A. ROBERTS
Sarah ELTON
Gillian R. BENTLEY



8 New Clinical Briefs in EMPH 2019

EVOLUTION, MEDICINE, & PUBLIC HEALTH

The Oxford Press open access journal *Evolution, Medicine & Public Health* has published eight new Clinical Briefs in 2019. They are lovely one page summaries that are perfect for teaching...or just pleasure reading.

The shapes of virulence to come
Aakash Pandey, Daniel E Dawson*Evol Med Public Health*, Volume 2019, Issue 1, 2019, Page 3, https://doi.org/10.1093/emph/eoy037

Tandem repeat disorders
Calen P Ryan*Evol Med Public Health*, Volume 2019, Issue 1, 2019, Page

About The Evolution & Medicine Review

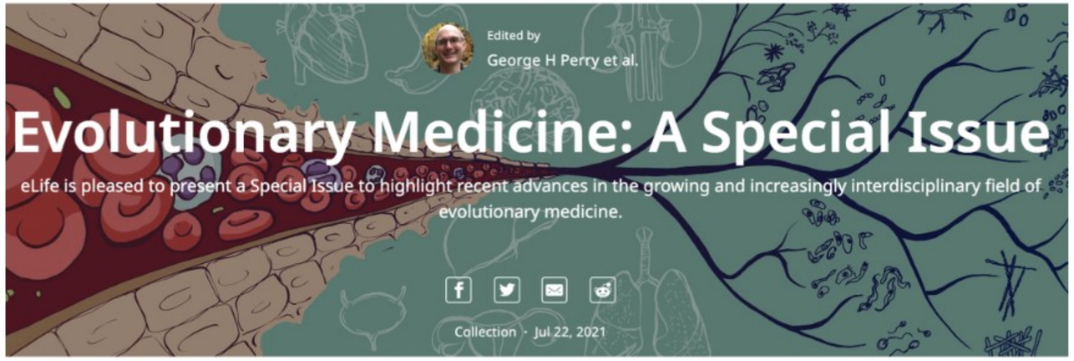
The International Society for Evolution, Medicine, and Public Health

Evolution, Medicine, and Public Health-open-access from Oxford Univ. Press

EvMedEd - Online resources for teaching and learning evolutionary medicine

ClubEvMed - Online journal club/ discussion of current topics

Type your email... Subscribe



Baylor University

LABORATORY OF EVOLUTIONARY MEDICINE & ONE HEALTH

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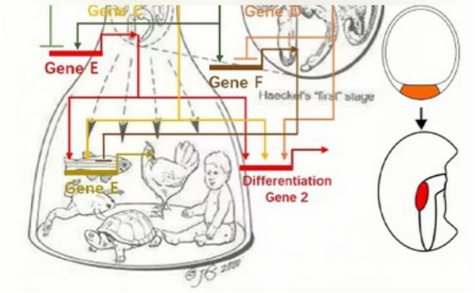
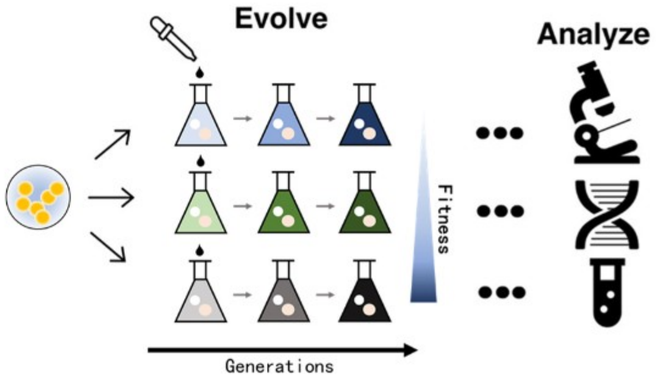
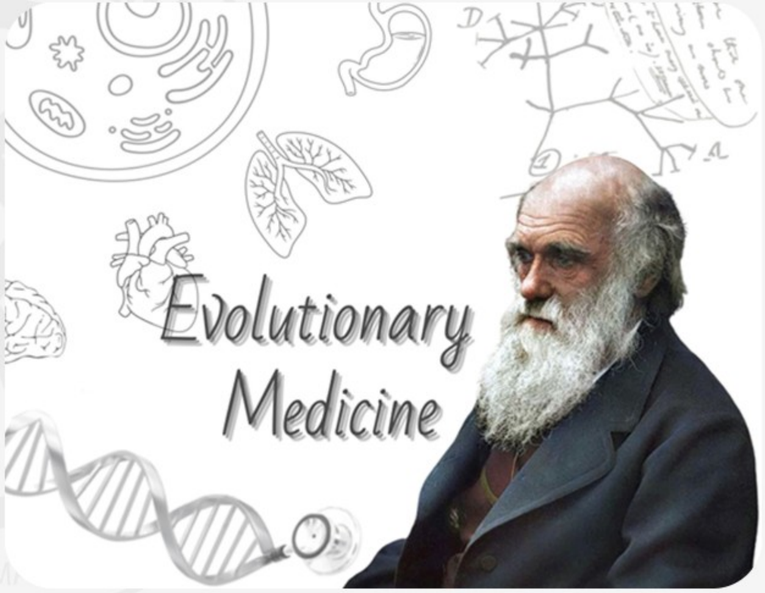


Marcoevolutionary developmental biology



Genomic evolution of major transition



Evolutionary implication on medicine

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Elective: Imaging
Elective: MolOcular - Inflammatory and degenerative diseases of the eye
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Focus area EVOLUTIONARY MEDICINE

Medical Life Sciences is one of the few Master programmes worldwide with a focus on **Evolutionary Medicine**. It has been part of Medical Life Sciences form the start, and for a reason.

Diseases can be puzzling. Why certain conditions occur or how to treat them are often questions for which the answers are still pending. When regarding these questions from an evolutionary perspective, researchers often find answers.

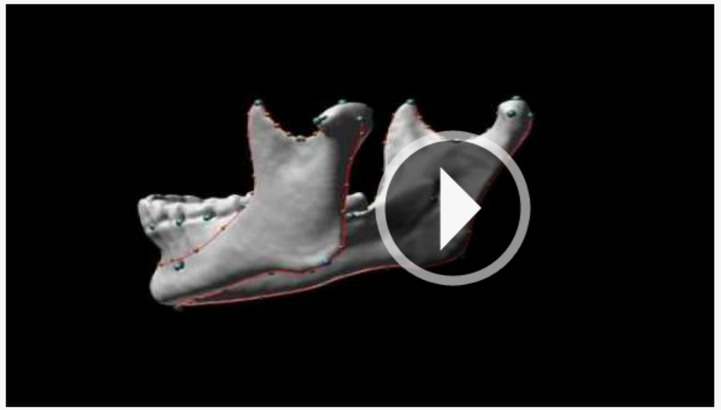
Understanding something that first seemed incomprehensible is a powerful experience. It makes progress possible and leads to new approaches, which is very important in medicine to prevent, diagnose and treat medical conditions. Evolutionary Medicine helps create opportunities to do so.

Bringing together evolution and medicine gets fascinating once you start looking at cancer, allergies, ageing, autoimmune disorders or chronic diseases: Why do we suffer from chronic conditions such as diabetes, heart disease or obesity? Why do pathogens develop drug resistance? Can we do something against it? How do our gut bacteria and diet influence our health? The more questions you try to answer, the more intriguing it gets.
You study the connections between evolution and medicine - developing hypotheses, connecting the dots and getting ready to conduct research yourself in your thesis and beyond: Evolutionary Medicine is one of the biggest drivers in today's biomedicine.

In Kiel, you are extremely well positioned for plunging into Evolutionary Medicine - or EvoMed for short:

- Medical Life Sciences has been teaching EvoMed since the programme started, with professors hosting seminars for students, running international research projects and supervising students in their thesis work. As an EvoMed student, you will be involved in research from the start.
- EvoMed lecturers are investigators in the ROOTS Cluster of Excellence. This huge interdisciplinary research project at Kiel University revolves around human societies through history. One big aspect is health. EvoMed researchers investigate how humans adapted to

Biohistory & Evolutionary Medicine Laboratory



Dr. Hila May

Our biohistory and evolutionary medicine laboratory focuses on several fields of interest:

- **Evolutionary medicine:** The impact of the "trade off" mechanism on present human health. Many parts of our body had to accommodate themselves in order to facilitate the development of our large brain and erect posture.
- **Biohistory:** Much of our history is recorded in our bones. Advanced methodologies allow us to reconstruct important events on the individual level as well as on the population level. This includes daily lifestyles, health, nutrition, inter or intra-personal violence, labor intensity, demographical structure, etc.
- **Ancient DNA:** The reconstruction of past population structure and migration. The Levant witnessed dramatic population movements and replacements during the last 15,000 years, which shaped the region's history.

Related Links

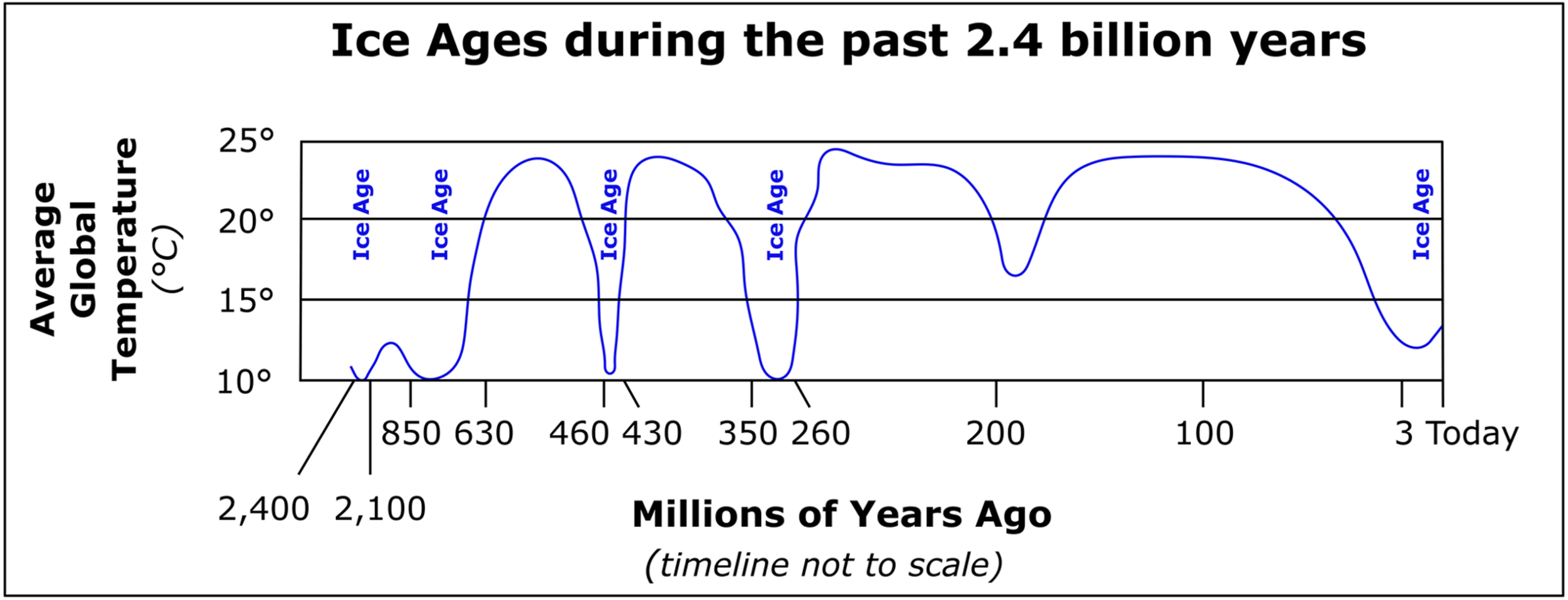
- Dan David Center for Human Evolution and Biohistory Research
- Shmunis Family Anthropology Institute
- Faculty of Medicine
- Department of Anatomy & Anthropology
- School of Dental Medicine
- Steinhardt Museum of Natural History
- Gitter-Smolarz Library of Life Sciences and Medicine

Svante Pääbo

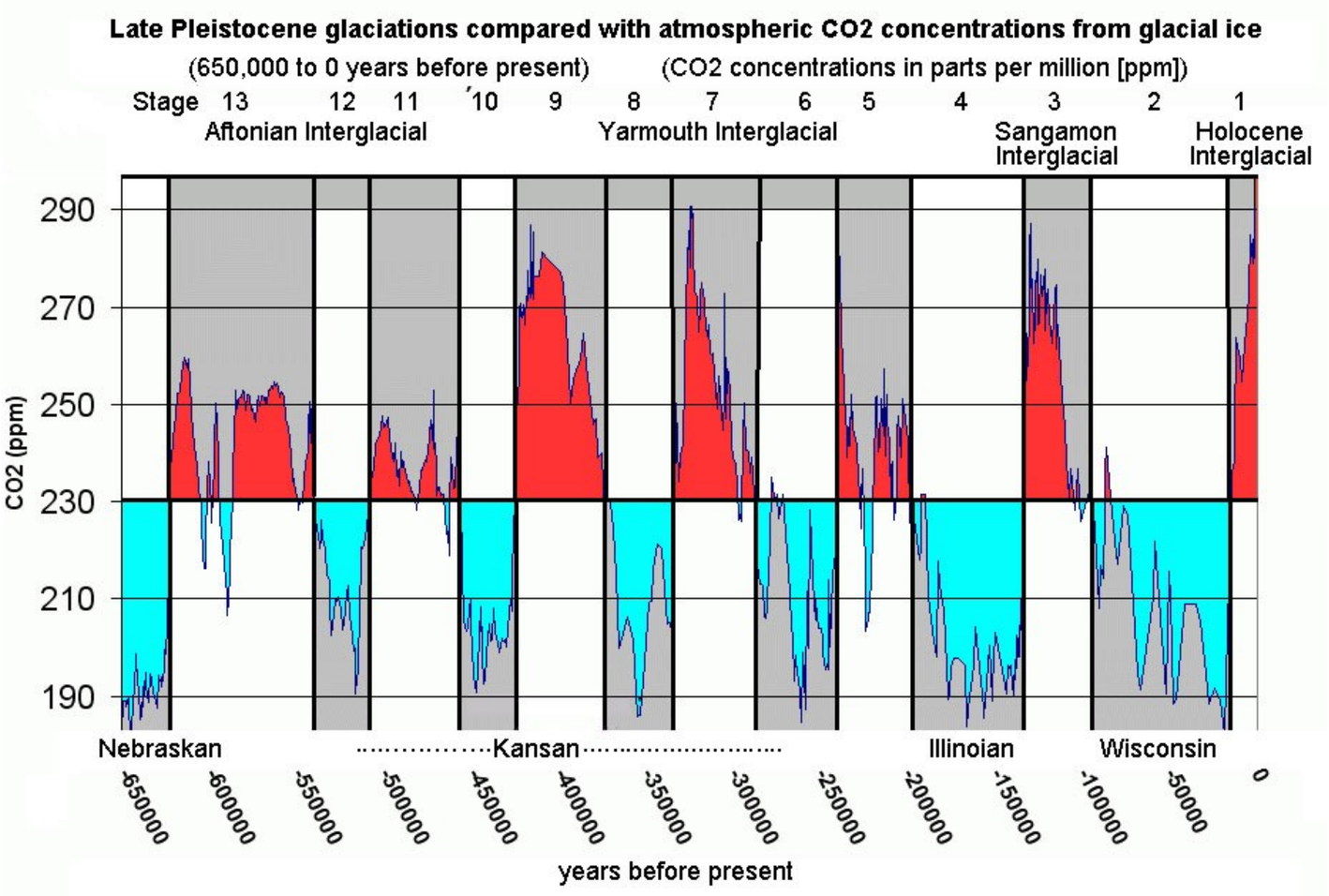
Things to know about the geneticist who won this year's Nobel Prize in Physiology or Medicine

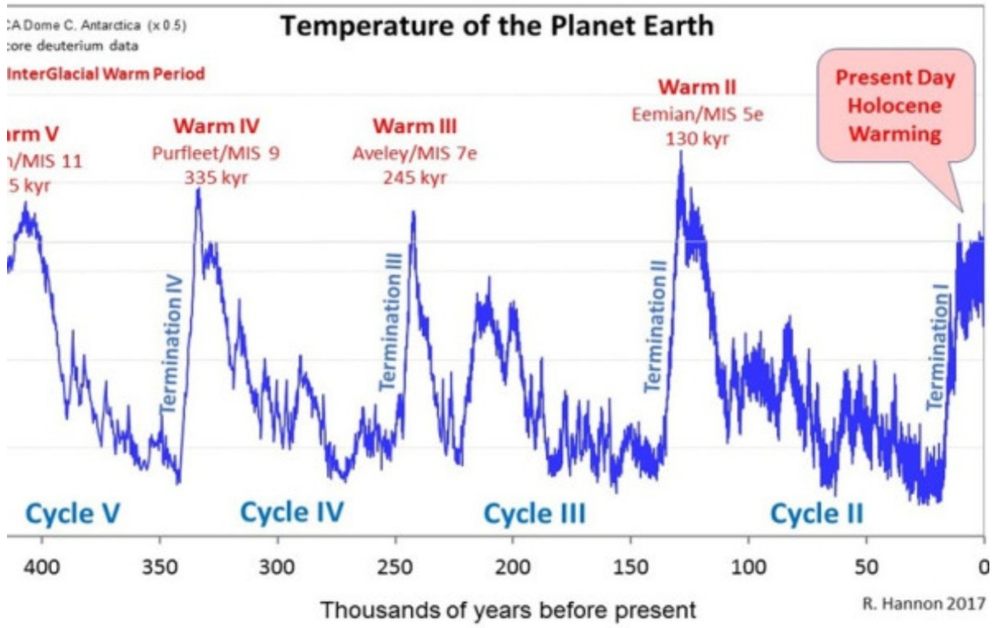
NEWS18 creative

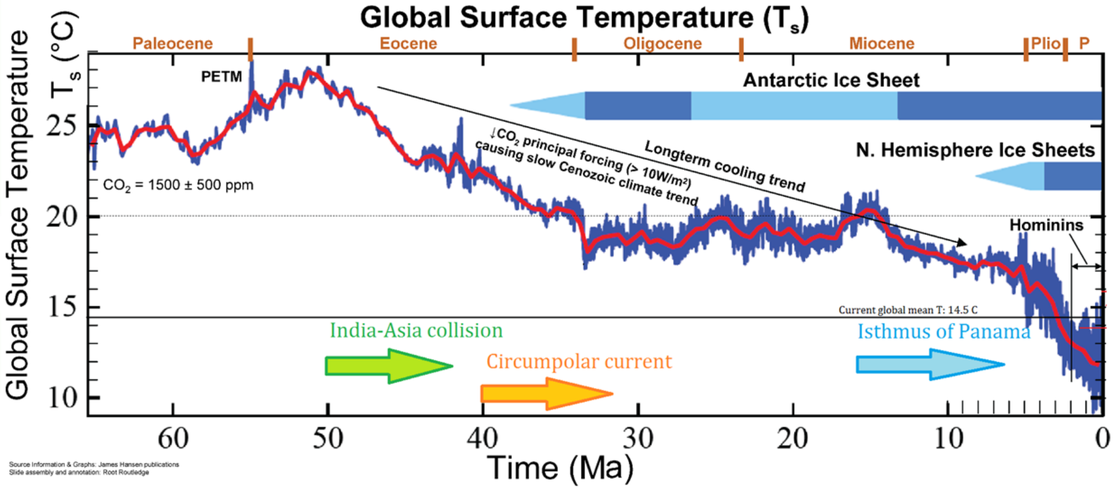
Doby ledové


Ice Ages during the past 2.4 billion years
Average Global Temperature (°C)
25°
20°
15°
10°
Ice Age
Ice Age
Ice Age
Ice Age
Ice Age
850 630
460 430
350 260
200
100
3 Today
2,400
2,100
Millions of Years Ago
(timeline not to scale)

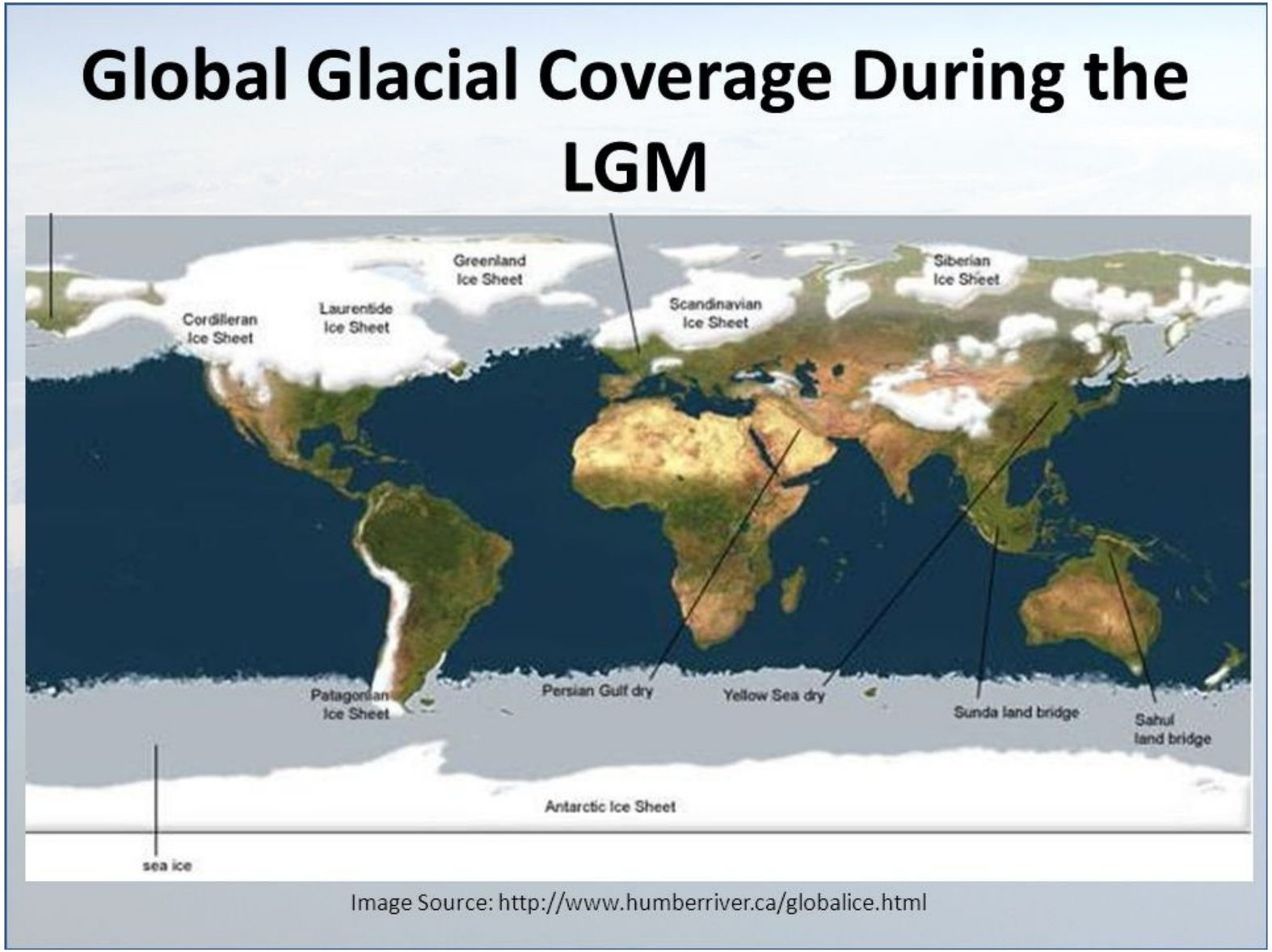
Doby ledové


Late Pleistocene glaciations compared with atmospheric CO2 concentrations from glacial ice
(650,000 to 0 years before present)
(CO2 concentrations in parts per million [ppm])
Stage 13 12 11 10 9 8 7 6 5 4 3 2 1
Aftonian Interglacial
Yarmouth Interglacial
Sangamon Interglacial
Holocene Interglacial
CO2 (ppm)
290
270
250
230
210
190
Nebraskan
Kansan
Illinoian
Wisconsin
650000 600000 550000 500000 450000 400000 350000 300000 250000 200000 150000 100000 50000 0
years before present

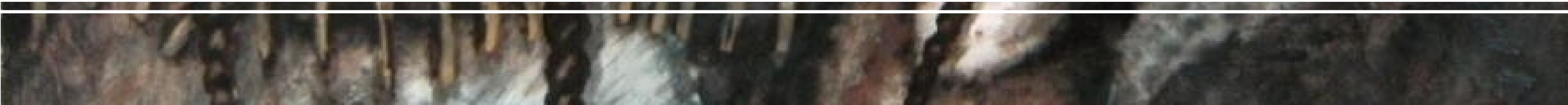

A Dome C. Antarctica (x 0.5)
ore deuterium data
InterGlacial Warm Period
Temperature of the Planet Earth
rm V
/MIS 11
5 kyr
Warm IV
Purfleet/MIS 9
335 kyr
Warm III
Aveley/MIS 7e
245 kyr
Warm II
Eemian/MIS 5e
130 kyr
Present Day
Holocene
Warming
Termination IV
Termination III
Termination II
Termination I
Cycle V
Cycle IV
Cycle III
Cycle II
400 350 300 250 200 150 100 50 0
Thousands of years before present
R. Hannon 2017


Global Surface Temperature (T$_s$)
Paleocene
Eocene
Oligocene
Miocene
Plio
P
PETM
Antarctic Ice Sheet
N. Hemisphere Ice Sheets
↓CO$_2$ principal forcing (> 10W/m^2) causing slow Cenozoic climate trend
Longterm cooling trend
CO$_2$ = 1500 ± 500 ppm
Hominins
Current global mean T: 14.5 C
India-Asia collision
Circumpolar current
Isthmus of Panama
Global Surface Temperature T$_s$ (°C)
25
20
15
10
60 50 40 30 20 10 0
Time (Ma)
Source information & Graphs: James Hansen publications
Slide assembly and annotation: Rodd Routledge

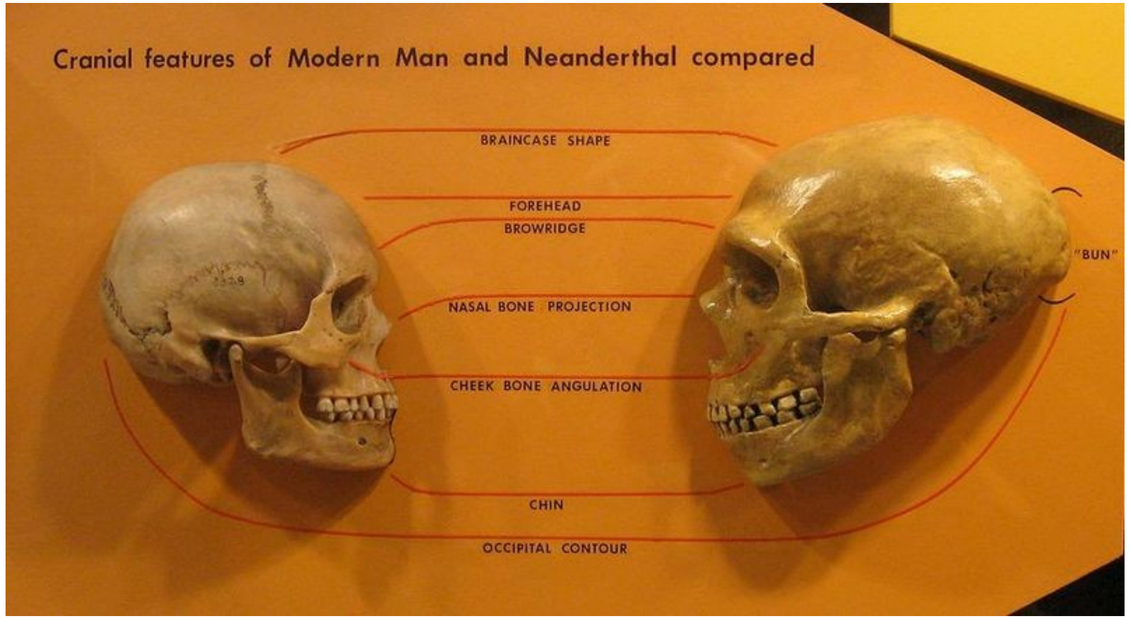
Doby ledové

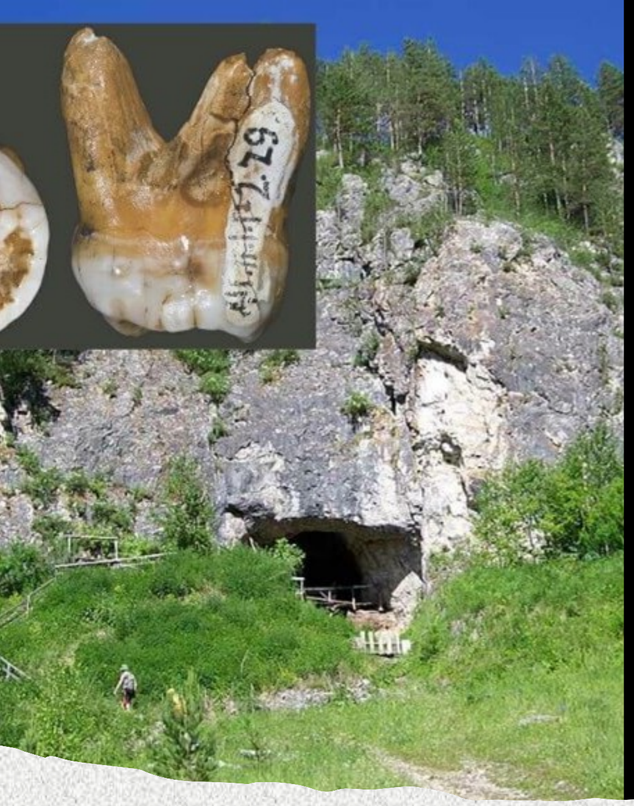

Global Glacial Coverage During the LGM
Greenland Ice Sheet
Siberian Ice Sheet
Cordilleran Ice Sheet
Laurentide Ice Sheet
Scandinavian Ice Sheet
Patagonian Ice Sheet
Persian Gulf dry
Yellow Sea dry
Sunda land bridge
Sahul land bridge
Antarctic Ice Sheet
sea ice
Image Source: http://www.humberriver.ca/globalice.html

Člověk neandertálský – *Homo neanderthalesis*



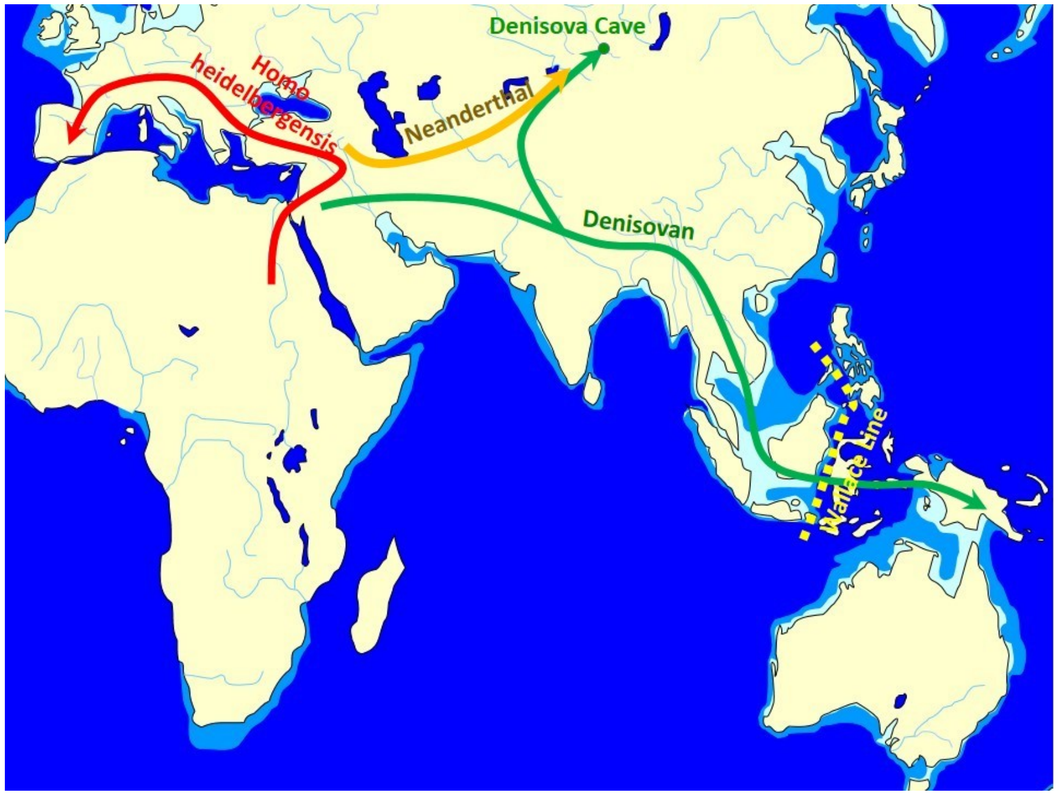

Neanderthal
Modern human
Lower cranium
Larger bowridge
Larger nose
Larger, broader rib cage
Shorter forearm
Broader hips
Shorter tibia

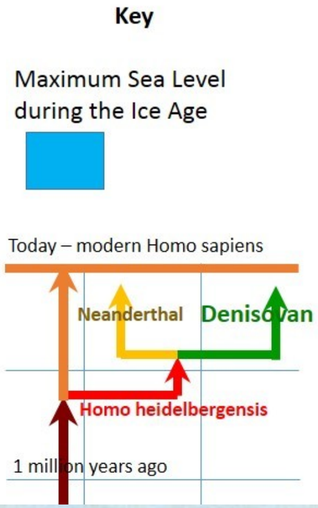

Cranial features of Modern Man and Neanderthal compared
BRAINCASE SHAPE
FOREHEAD
BROWRIDGE
NASAL BONE PROJECTION
CHEEK BONE ANGULATION
CHIN
OCCIPITAL CONTOUR
"BUN"

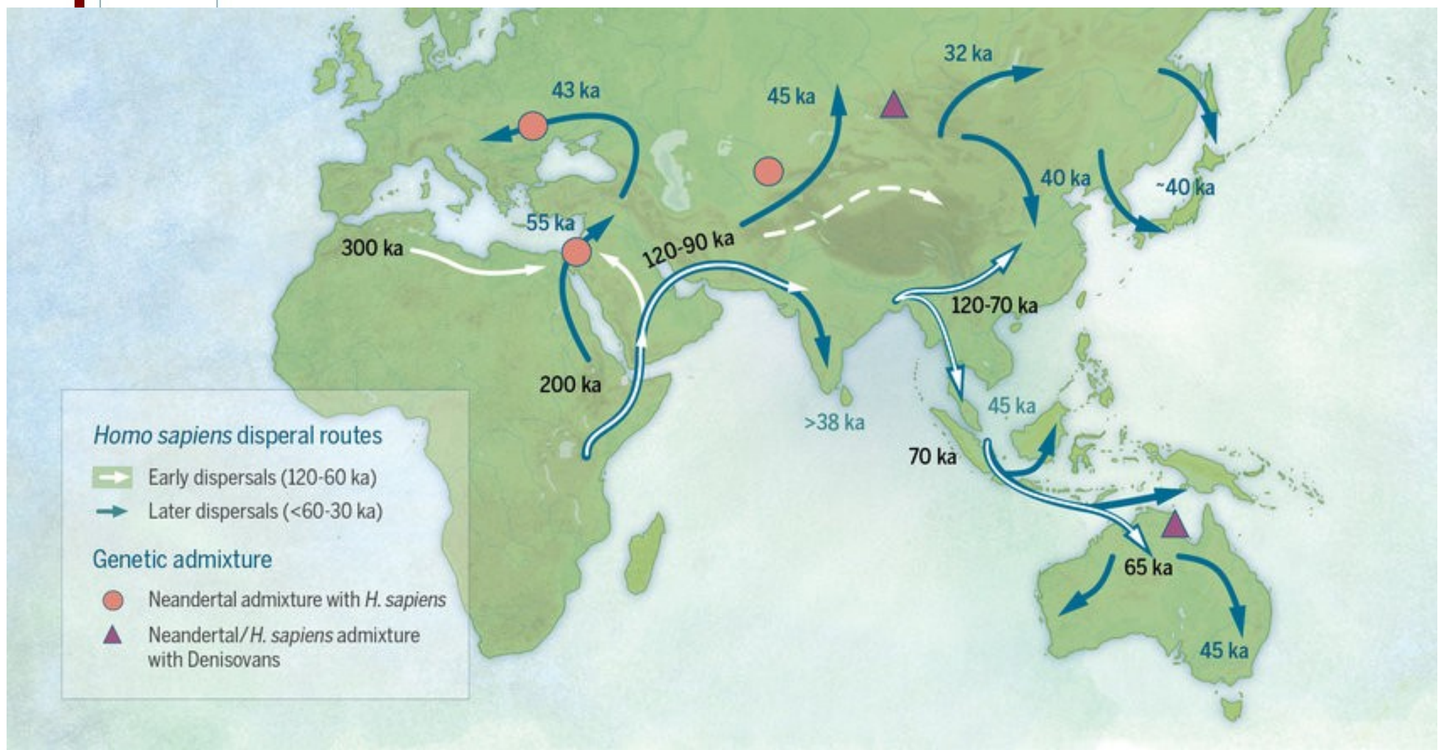


Homo denisoviensis

Migrace moderního člověka







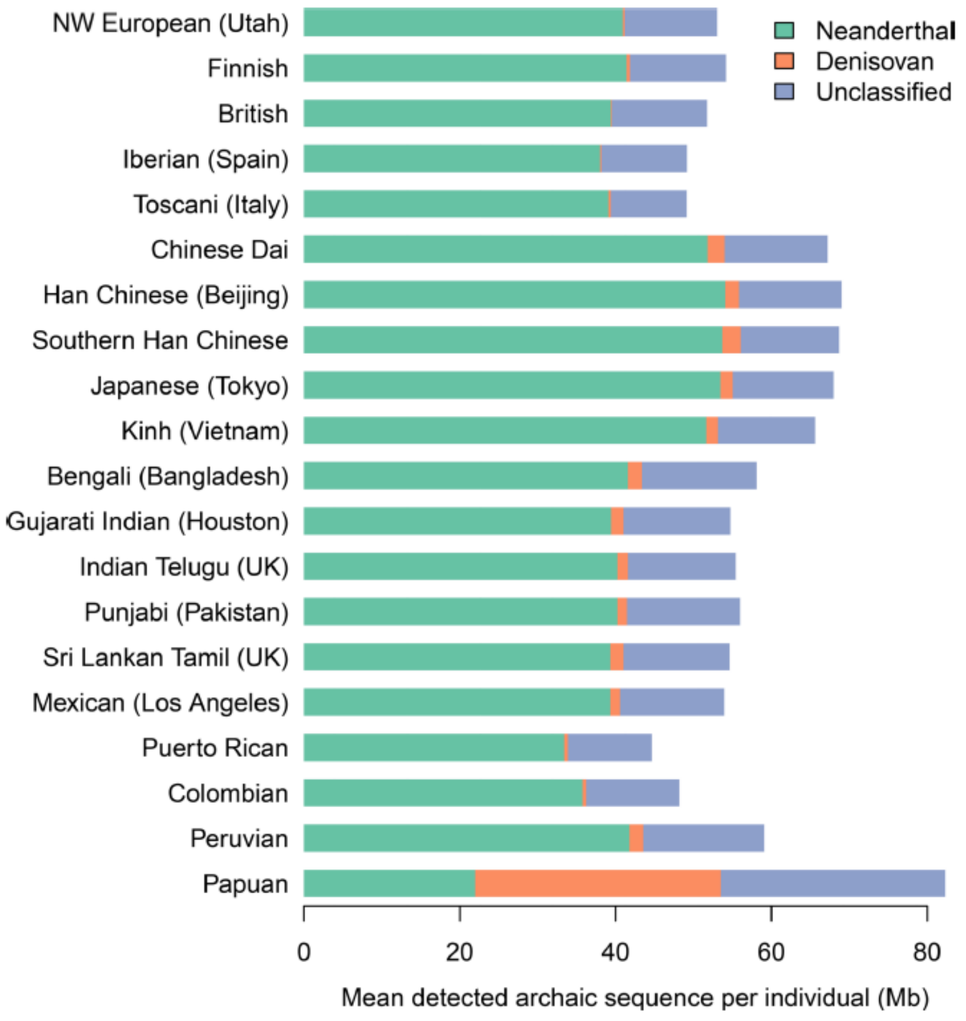
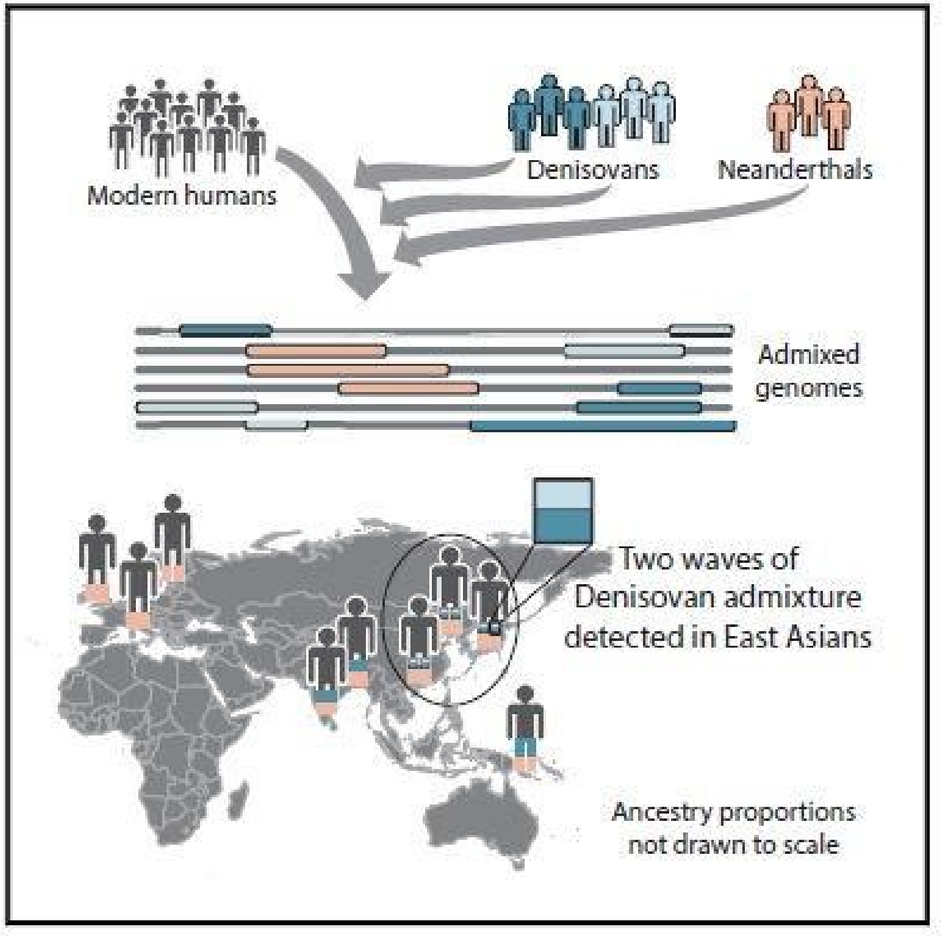
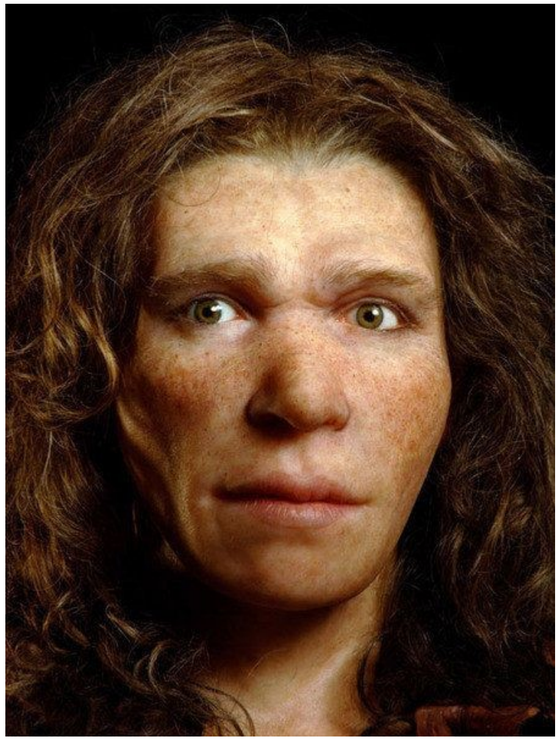


Figure 5. Mean amounts of detected introgressed material per individual, classified by affinity to the Altai Neanderthal and Altai Denisovan genomes

Definitions of the affinity groups are given in Methods. Unclassified material includes segments that are too short to be confidently classified into an affinity group, as well as longer segments that have low levels of affinity to the archaic genomes.



Adaptace neandertálců na klima v Evropě a co jsme po nich zdědili



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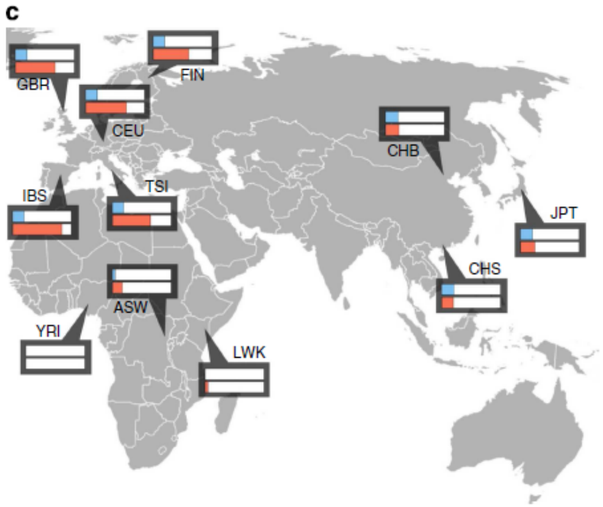
The phenotypic legacy of admixture between modern humans and Neanderthals

Corinne N. Simonti[1], Benjamin Vernot[2], Lisa Bastarache[3], Erwin Bottinger[4], David S. Carrell[5], Rex L. Chisholm[6], David R. Crosslin[2,5], Scott J. Hebbring[7], Gail P. Jarvik[2,5], Iftikhar J. Kullo[8], Rongling Li[9], Jyotishman Pathak[10], Marylyn D. Ritchie[11,12], Dan M. Roden[13,14], Shefali S. Verma[11], Gerard Tromp[15,16], Jeffrey D. Prato[3], William S. Bush[17], Joshua M. Akey[†,2], Joshua C. Denny[†,1,3,13], and John A. Capra[1,3,18,19,*]



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ARTICLE

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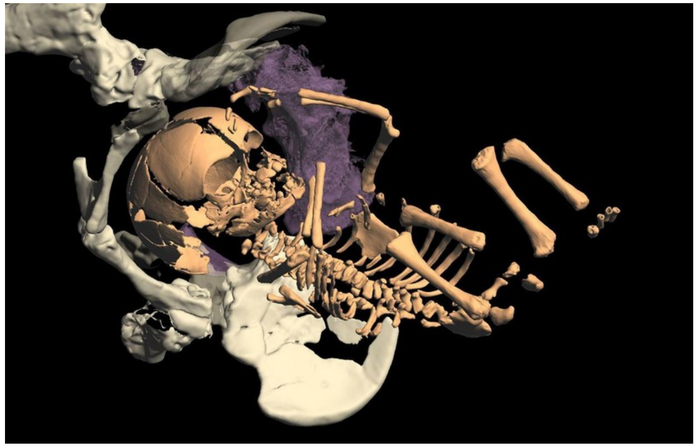
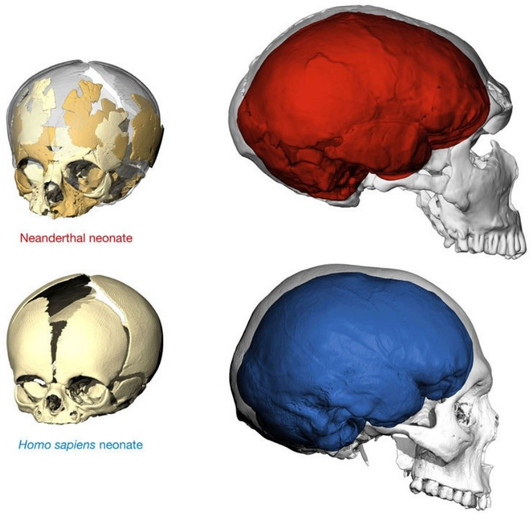
Neanderthal ancestry drives evolution of lipid catabolism in contemporary Europeans

Ekaterina E. Khrameeva[1,2], Katarzyna Bozek[1,3], Liu He[1], Zheng Yan[1], Xi Jiang[1], Yuning Wei[1], Kun Tang[1], Mikhail S. Gelfand[2,4], Kay Prufer[3], Janet Kelso[3], Svante Paabo[3], Patrick Giavalisco[5], Michael Lachmann[3] & Philipp Khaitovich[1,3]

Tuková tkáň

Víc dětí a méně potratů





The Neandertal Progesterone Receptor

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Report

A Neanderthal Sodium Channel Increases Pain Sensitivity in Present-Day Humans

Hugo Zeberg,[1,2,6,*] Michael Dannemann,[1] Kristoffer Sahlholm,[2,3] Kristin Tsuo,[1] Tomislav Maricic,[1] Victor Wiebe,[1] Wulf Hevers,[1] Hugh P.C. Robinson,[2,4] Janet Kelso,[1] and Svante Pääbo[1,5,*]

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Evidence that RNA viruses drove of adaptive introgression between Neanderthals and modern humans

David Enard[1,2,*] and Dmitri A Petrov[3]

- **Odolnost či náchylnost k virovým infekcím**

Article

The major genetic risk factor for severe COVID-19 is inherited from Neanderthals

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Published online: 30 September 2020
Check for updates

Hugo Zeberg[1,2]✉ & Svante Pääbo[1,3]✉

A recent genetic association study[1] identified a gene cluster on chromosome 3 as a risk locus for respiratory failure after infection with severe acute respiratory syndrome coronavirus 2 (SARS-CoV-2). A separate study (COVID-19 Host Genetics Initiative)[2] comprising 3,199 hospitalized patients with coronavirus disease 2019 (COVID-19) and control individuals showed that this cluster is the major genetic risk factor for severe symptoms after SARS-CoV-2 infection and hospitalization. Here we show that the risk is conferred by a genomic segment of around 50 kilobases in size that is inherited from Neanderthals and is carried by around 50% of people in south Asia and around 16% of people in Europe.

Check for updates

A genomic region associated with protection against severe COVID-19 is inherited from Neandertals

Hugo Zeberg[a,b,1] and Svante Pääbo[a,c,1]

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Contributed by Svante Pääbo, January 22, 2021 (sent for review December 21, 2020; reviewed by Tobias L. Lenz and Lluis Quintana-Murci)

LETTER

Altitude adaptation in Tibetans caused by introgression of Denisovan-like DNA

Emilia Huerta-Sánchez[1,2,3]*, Xin Jin[1,4]*, Asan[1,5,6]*, Zhuoma Bianba[7]*, Benjamin M. Peter[2], Nicolas Vin
Xin Yi[1,5,6], Mingze He[1,8], Mehmet Somel[9], Peixiang Ni[1], Bo Wang[1], Xiaohua Ou[1], Huasang[1], Jiangbai Luo
Kui Li[11], Guoyi Gao[12], Ye Yin[1], Wei Wang[1], Xiuqing Zhang[1,13,14], Xun Xu[1], Huanming Yang[1,15,16], Yingrui Li[1], Ju
Jun Wang[1,15,17,18,19] & Rasmus Nielsen[1,2,20,21]

Přizpůsobení vysokohorským podmínkám Tibeťanů získaných od *Homo denisoviensis*

Děkuji za pozornost!