



Celestial Bodies: Inner and Outer Space

Gísli Pálsson, University of Iceland

Themes

- Out of Earth/ Into the genome
 - Parallels and differences
- The anthropology of outer space
- Two “giant steps for mankind”
 - Evolution/biosociality

A remarkable half-a-century

- 1952: Photograph 51 of DNA
- 1953: The double helix
- 1957: Sputnik
- 1961: Gagarin
- 1969: Humans on the Moon
- 1998: International Space Station
- 2000: Mapping the human genome

Fetus-Womb/Astronaut-Space

**Barbara Duden 1993:
The Nilsson Effect.**

**Meredith W. Michaels 1999:
Fetal Galaxies: Some Questions About
What We See.**

- 1965

QuickTime™ and a
TIFF (Uncompressed) decompressor
are needed to see this picture.

AUGUST 1990 \$2.95

LIFE

THE FIRST PICTURES EVER OF
HOW LIFE
BEGINS

- 1990



Big dipper
Astrophysicist Stephen Hawking, accompanied by his physicians and nurses, floats on a zero gravity jet at 24,000ft above the Florida coastline. The plane made eight parabolic dips, giving Hawking the experience of weightlessness. Photograph: zero Gravity Corp



The Guardian, 25 4 2007

“Astrophysicist Stephen Hawking, accompanied by his physicians and nurses, floats on a zero gravity jet at 24,000ft above the Florida coastline. The plane made eight parabolic dips, giving Hawking the experience of weightlessness”

Icelandic Settlement on Another Planet, 1929-1930

133.9
Quest

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HÖFUNDUR

GUÐM. DAVÍÐSSON

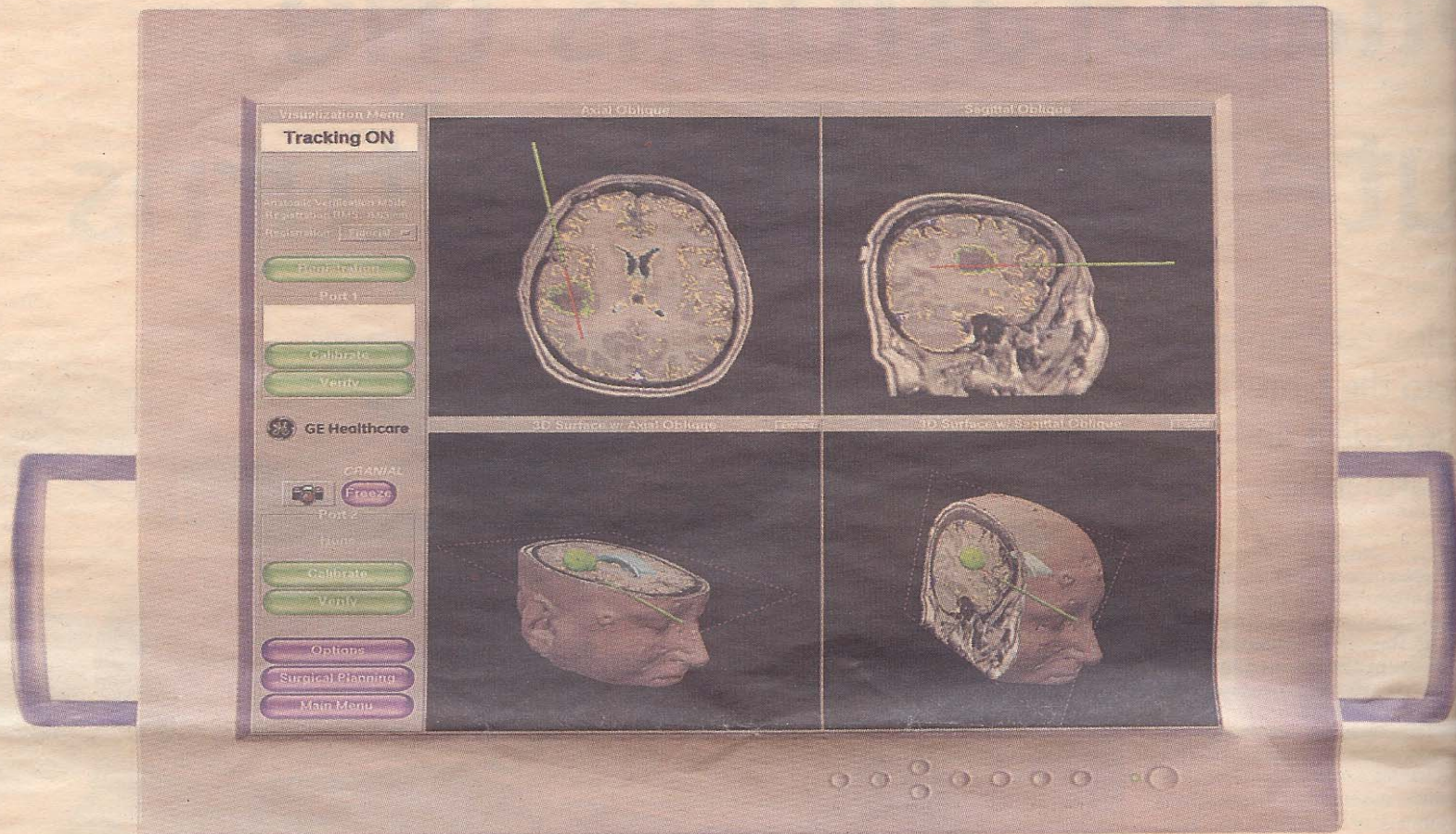
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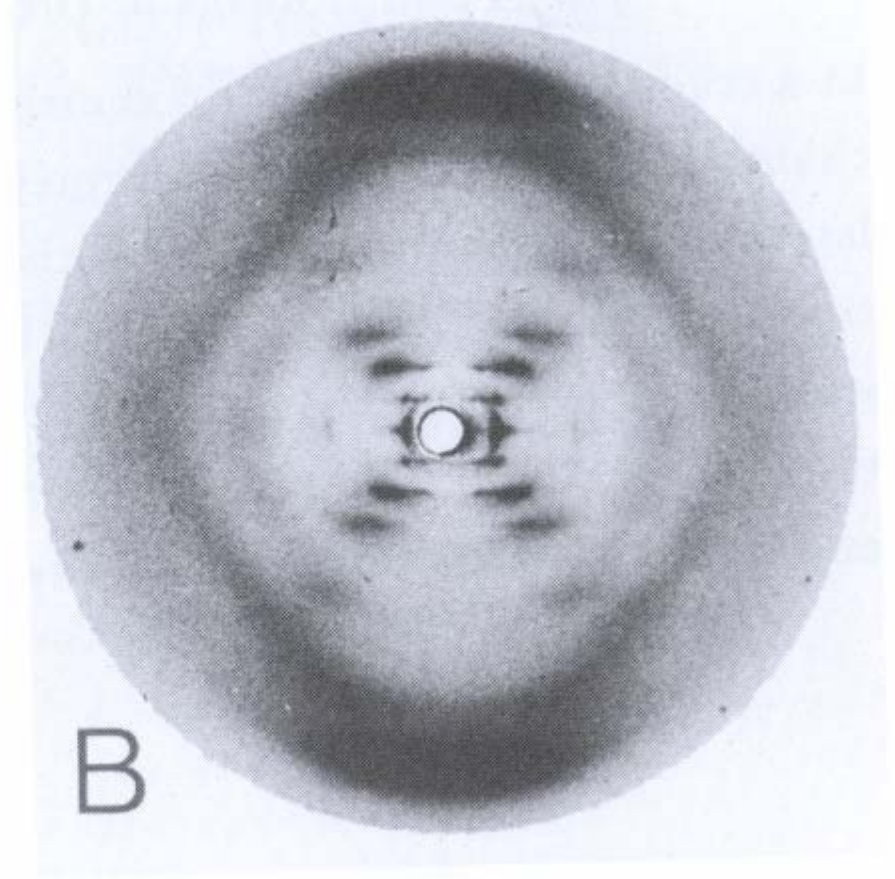
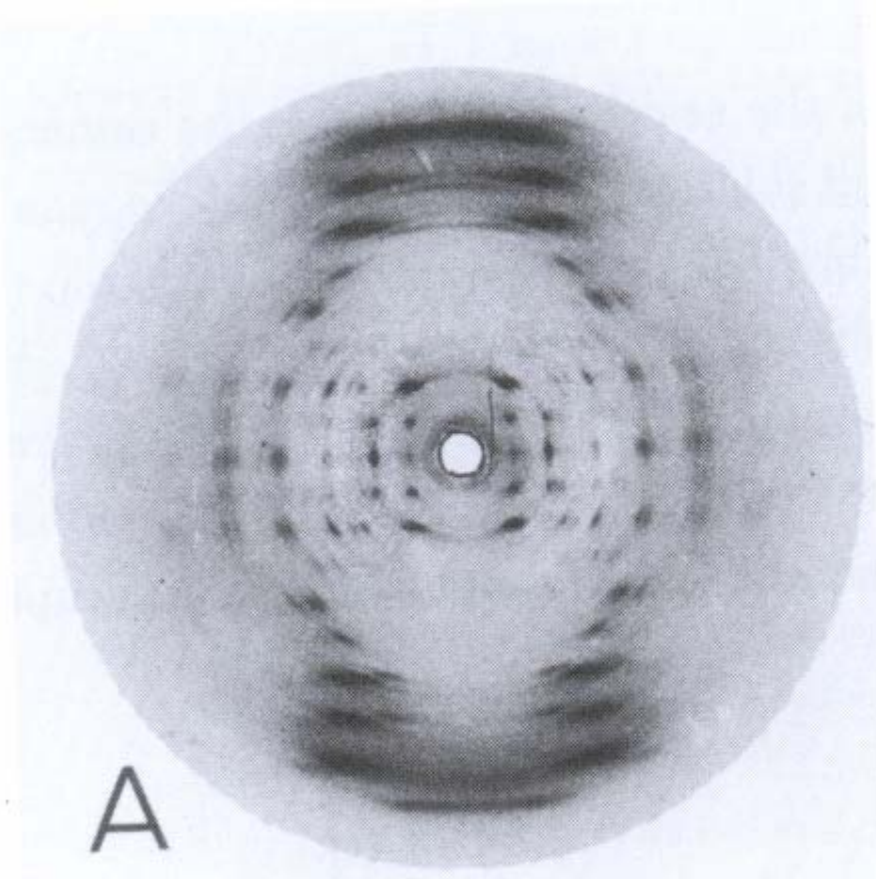


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R. Franklin's images of DNA (1952)



the **universe** within us has only very recently been the subject of serious study. ... Now, as we enter the next millennium, we are on the threshold of a truly momentous achievement that will have enormous implications for the future. For the first time, we will know our genetic endowment -- the sequence of our DNA. Then our **voyage** into the universe within really will have begun. (Textbook)

Since ancient times we have drawn charts of the sky, of the world, and of our anatomy. Today, a new chart is added to the collection: The **map of our genome**. ... We invite you on a tour of the **geography of the genome**, exploring the chromosomes, the sequence, and the differences between individuals and populations. (*Nature*, 2000)

MAPPING THE HUMAN GENOME

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At New England Biolabs, we are dedicated to producing highly-pure restriction enzymes for the manipulation and analysis of genomic DNA. Our diverse range of 8-base cutters includes recombinant Not I, Asc I and Sfi I. And now, NEB introduces recombinant Fse I which offers both the exceptional purity and unmatched value essential for success in your genomic research.

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3'...C C G G C C G G...5'		3'...C A A A T T T G...5'			
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20 years and beyond...

The Geography of our Genome

Since ancient times we have drawn charts of the sky, of the world, and of our anatomy. Today, a new chart is added to the collection: the map of our genome. Its purpose is to synthesize the insights and meaning gained from the sequence of the human genome. We invite you on a tour of the geography of the genome, exploring the chromosomes, the sequence, and the differences between individuals and populations. The integration of these exciting new findings ushers in a new era of scientific and medical progress.

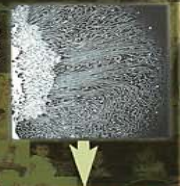
The cell nucleus

The nucleus of a single cell (left) contains all the genetic information required to make the human body. This genetic information is packaged as chromosomes (right).



DNA fibres

All the genetic information is stored along the fibres of DNA (two metres in every cell). The linear continuity of DNA is responsible for many of its genetic and physical properties.



The double helix

The molecular structure of DNA was described by James Watson and Francis Crick in 1953. It shows that genetic information is stored digitally, as defined by the order of the nucleotide bases, A, C, G and T.



Visualizing contigs

Individual fragments of cloned DNA are fluorescently labelled (red or green) and hybridized to stretched DNA fibres. The order of the signals corresponds to their physical locations in the genome. Overlaps between clones can be seen as the mixed fluorescent light (yellow) of two clones.



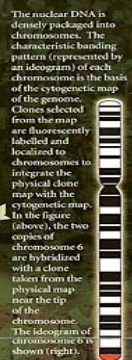
The physical clone map

Individual clones are assembled into contigs, and a representative overlapping set (the tiling path) is selected for sequencing and further studies.



The cytogenetic map

The nuclear DNA is densely packaged into chromosomes. The characteristic banding pattern (represented by the ideogram) of each chromosome is the basis of the cytogenetic map of the genome. Clones selected from the map are fluorescently labelled and localized to chromosomes to integrate the physical clone map with the cytogenetic map in the figure (above); the two copies of chromosome 6 are hybridized with a clone taken from the physical map near the tip of the chromosome. The ideogram of chromosomes is shown (right).



The human karyotype

The normal human chromosome complement, or karyotype, contains two copies of the 3,000,000,000-base human genome, packaged into 22 pairs of autosomes plus the X and Y sex chromosomes. Here the human karyotype has been stained using different coloured chromosome-specific probes.



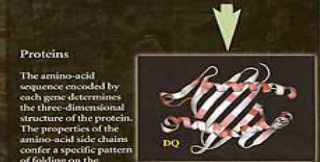
Chromosome aberration and disease

Sometimes chromosomes become rearranged, causing disruption of their genetic material. Many such chromosomal rearrangements, including loss, gain or breakage of chromosomes, are often seen in diseased tissues; as shown, for example, in the karyotype of cells from a lung tumour.



Genes

Annotation of the genome sequence has identified over 30,000 genes, plus many other features such as repeat sequences and CpG islands.



Proteins

The amino-acid sequence encoded by each gene determines the three-dimensional structure of the protein. The properties of the amino-acid side chains confer a specific pattern of folding on the polypeptide chain. Variants can be viewed in the structure of each protein, such as the HLA class II protein domain shown here.



Access to data

A central web page provides access to all the internet sites containing the data sets:
www.ncbi.nlm.nih.gov/genome/central
www.ensembl.org/genome/central
www.nhgri.nih.gov/genome_hub

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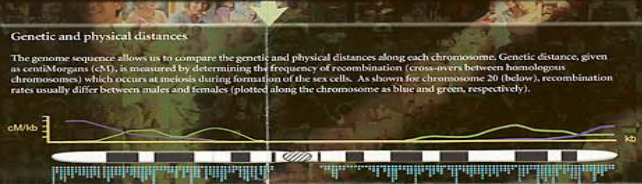
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The DNA sequence

The sequencing method developed by Fred Sanger and colleagues in 1977 provides a digital readout of the order of bases in the DNA. Overlapping sequences are then assembled to form a consensus sequence. As of January 2001, over 2,700,000,000 bases of draft human genome sequence are available in public databases, of which nearly a billion bases are finished reference sequence (with an accuracy of greater than 99.99%).



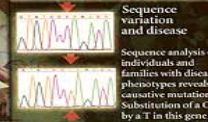
The SNP map of the genome

There are about three million differences between the DNA sequences of any two copies of the human genome. Over one million SNPs have been placed along the sequence to create a SNP map of the human genome. The distribution of SNPs on chromosome 20, obtained by random sampling, is shown above — each spot represents 25 SNPs.



Sequence variation and disease

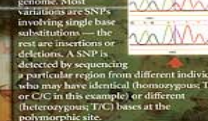
Sequence analysis of individuals and families with disease phenotypes reveals causative mutations. Substitution of a C by a T in this gene



sequence (the *SH2D4* gene on the X chromosome) causes uncontrolled proliferation of immune B and T cells in response to an Epstein-Barr virus infection. Variations in genes can also cause individuals to respond differently to the environment, medicines, allergens, chemicals and toxins.

Single nucleotide polymorphisms (SNPs)

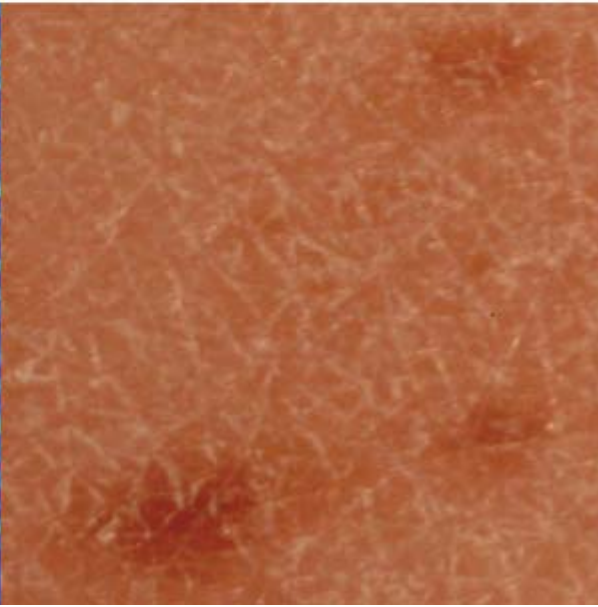
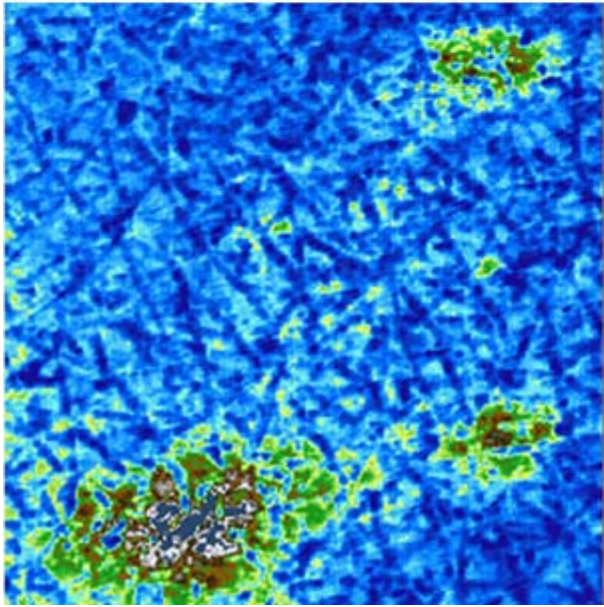
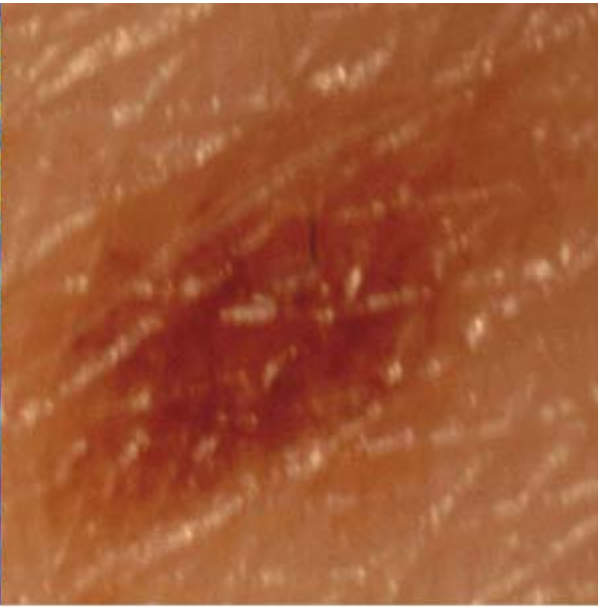
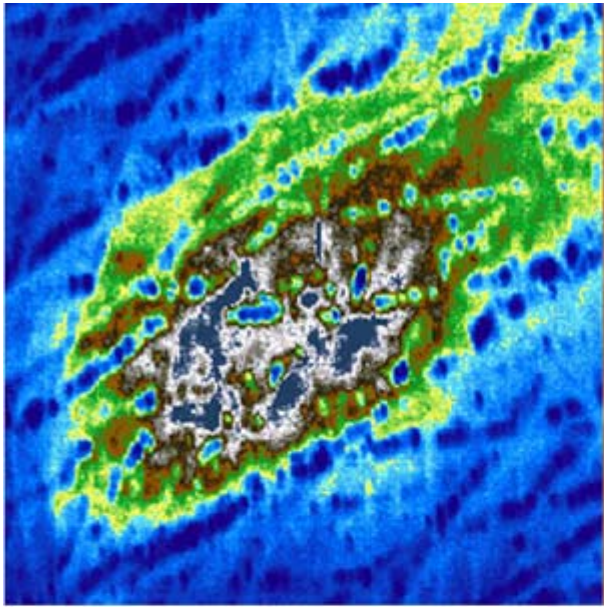
Natural sequence variation occurs between any two copies of the human genome. Most variations are SNPs, involving single base substitutions — the rest are insertions or deletions. A SNP is detected by sequencing a particular region from different individuals, who may have identical thymosin α 1 or C/C in this example) or different (heterozygous T/C) bases at the polymorphic site.

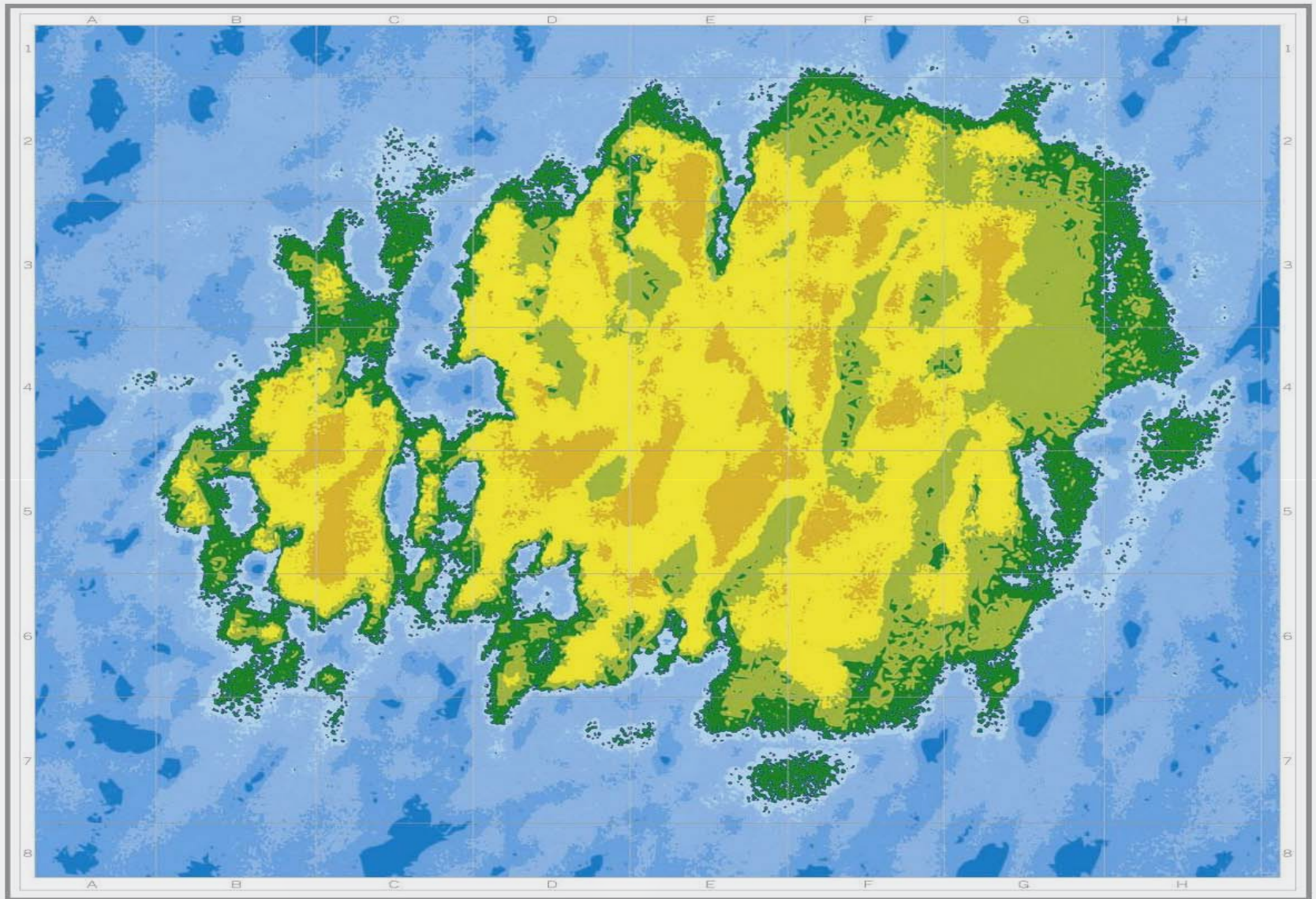


Human populations

All individuals share genome sequences that are 99.9% the same. Nonetheless, the remaining 0.1% is responsible for all of the genetic diversity between individuals. Typing SNPs allows us to chart the evolution of the human race and its migration across the globe.







GEFID ÚT 1998 - ÖLL RETTINDI ÁSKILIN

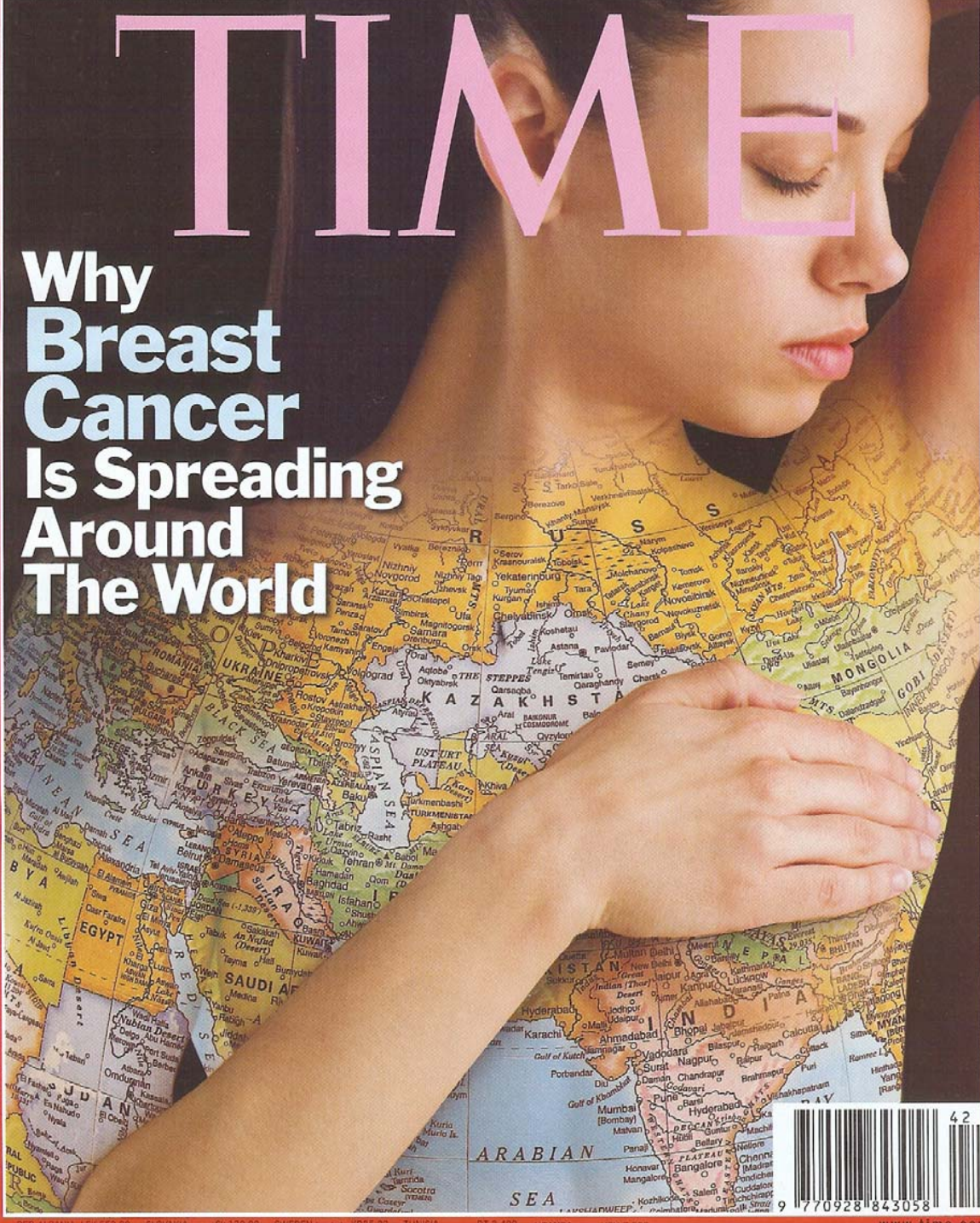


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Why Breast Cancer Is Spreading Around The World

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OMAN 100.00
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KUWAIT 100.00
INDIA 100.00
PAKISTAN 100.00
AFGHANISTAN 100.00
CHINA 100.00
KOREA 100.00
JAPAN 100.00
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The anthropology of outer space

Two key books:

- Ben R. Finney and Eric M. Jones (eds.) 1985:
 - *Interstellar Migration and the Human Experience*
- Debbona Battaglia (ed.) 2005:
 - *E.T. Culture: Anthropology in Outerspaces*

"Galaxies of discourse"

Finney and Jones, 1985

- *Barring nuclear war ..., a good chance Humanity is learning to live in space*
- *Colonizing interstellar comets*
- *The threshold to quantum biological evolution*
- *New species, genetic engineering, cyborgs*

“If our descendants do settle throughout the Solar System, humanity will never be the same again. The course of human evolution will change utterly and inalterably. This is because, by scattering through the vastness of space, our descendants will be setting up the conditions necessary for the rapid speciation of *Homo sapiens*. The threshold of space is also the threshold of quantum biological evolution”.



Lucy
(Many, many years Before Us)



1. One of four life-size dioramas in the American Museum of Natural History's new *Hall of Human Biology and Evolution*. It depicts the creation of 3.5 million-year-old bipedal footprints discovered in Laetoli, Tanzania. These footprints are believed to have been made by *Australopithecus afarensis*, best known from the skeleton popularly called "Lucy." The tracks provide crucial evidence that our prehuman ancestors walked upright. (Photo: American Museum of Natural History).

The earliest humans outside Africa

- D. Lordkipanidze: Postcranial evidence from early *Homo* from Dmanisi, Georgia
 - *Nature*, September 2007
- Variations in body and brain size
- A parallel development in space?



Lucy in the Sky ...: Out of
Africa, Out of Earth

“Picture yourself on a
spacecraft in orbit ...”

The Sample of the Human Genome Diversity Project



Africans

- 1 Bantu
- 2 Mandenka
- 3 Yoruba
- 4 San
- 5 Mbuti pygmy
- 6 Biaka
- 7 Mozabite

Europeans

- 8 Orcadian
- 9 Adygei
- 10 Russian
- 11 Basque
- 12 French
- 13 North Italian
- 14 Sardinian
- 15 Tuscan

Western Asians

- 16 Bedouin
- 17 Druze
- 18 Palestinian

Central and Southern Asians

- 19 Balochi
- 20 Brahui
- 21 Makrani
- 22 Sindhi
- 23 Pathan
- 24 Burusho
- 25 Hazara
- 26 Uygur
- 27 Kalash

Eastern Asians

- 28 Han (S. China)
- 29 Han (N. China)
- 30 Dai
- 31 Daur
- 32 Hezhen
- 33 Lahu
- 34 Miao
- 35 Croqen
- 36 She
- 37 Tuja
- 38 Tu
- 39 Xibo
- 40 Yi
- 41 Mongola
- 42 Naxi
- 43 Cambodian
- 44 Japanese
- 45 Yakut

Oceanians

- 46 Melanesian
- 47 Papuan

Native Americans

- 48 Karitiana
- 49 Surui
- 50 Colombian
- 51 Maya
- 52 Pima

To conclude

1. Outer and inner space: Overlapping galaxies of discourse
2. Climate change and resource depletion are likely to escalate experimenting with human settlement in space.
3. This is likely to fuel research on the human genome and the post-human.
4. 4. New forms of biosocialities