Sources of the following article:
http://creation.com/content/view/732
http://creation.com/what-about-the-big-bang-creation-magazine
First published: *Creation* **20**(1):6, December 1997

Dazzling design in miniature: DNA information storage

by Werner Gitt

The cells of the human body can produce at least 100,000 different types of proteins, all with a unique function. The information to make each of these complicated molecular machines is stored on the well-known molecule, DNA.

We think that we have done very well with human technology, packing information very densely on to computer hard drives, chips and CD-ROM disks. However, these all store information on the surface, whereas DNA stores it in three dimensions. It is by far the densest information storage mechanism known in the universe.

Let's look at the amount of information that could be contained in a pinhead volume of DNA. If all this information were written into paperback books, it would make a pile of such books 500 times higher than from here to the moon! The design of such an incredible system of information storage indicates a vastly intelligent Designer.

In addition, there is the information itself, which is stored on DNA, and transmitted from generation to generation of living things. There are no laws of science that support the idea that life, with all its information, could have come from non-living chemicals. On the contrary, we know from the laws of science, particularly in my own area of expertise, that messages (such as those that we find in all living things) always point back to an intelligent message sender. When we look at living things in the light of DNA, Genesis creation makes real sense of the scientific evidence.

Addendum to *Creation* magazine article: calculations by Dr Gitt

The greatest known density of information is that in the DNA of living cells. The diameter of this chemical storage medium is d = 2 nm, and the spiral increment of the helix is 3.4 nm (1 nm = 10^{-9} m = 10^{-6} mm). The volume of this cylinder is $V = h \cdot d^2 \cdot \pi /4$:

$V = 3.4 \cdot 10^{-6}$ mm $\cdot (2 \cdot 10^{-6}$ mm$)^2 \cdot \pi /4 = 10.68 \cdot 10^{-18}$ mm^3 per winding.

There are 10 chemical letters (nucleotides) in each winding of the double spiral (= $0.34 \cdot 10^{-9}$ m/letter), giving a statistical information density of:

r = 10 letters/($10.68 \cdot 10^{-18}$ mm^3) = $0.94 \cdot 10^{18}$ letters per mm^3.

This packing density is so inconceivably great that we need illustrative comparisons.

First: What is the amount of information contained in a pinhead of DNA? How many paperback books can be stored in this volume?

Example: The paperback *Did God Use Evolution?* has the following dates:

Thickness = 12 mm, 160 pages, L_B = 250,000 letters/book

Volume of a pinhead of 2 mm diameter (r = 1 mm):

$V_P = 4/3\ \pi\ r^3 = 4.19$ mm^3

How many letters can be stored in the volume of 1 pinhead?

$L_P = V_P \cdot r = 4.19$ mm$^3 \cdot (0.94 \cdot 10^{18}$ letters/mm$^3) = 3.94 \cdot 10^{18}$ letters

How many books can be stored in the volume of 1 pinhead?

$n = L_P/L_B = 3.94 \cdot 10^{18}$ letters /(250,000 letters/book) = $15.76 \cdot 10^{12}$ books

What is the height of the pile of books?

$h = 15.76 \cdot 10^{12}$ books $\cdot$ 12 mm/book = $189.1 \cdot 10^{12}$ mm = $189.1 \cdot 10^6$ km

Distance to the moon M = 384,000 km

How many times the distance to the moon is this?

$m = h/M = 189.1 \cdot 10^6$ km /384,000 km = 492.5 times

Secondly: The human genome has $3 \cdot 10^9$ letters (nucleotides). In body cells there are $6 \cdot 10^9$ letters.

The length of the genome L_G is given by

$L_G = (0.34 \cdot 10^{-9}$ m/letter$) \cdot 3 \cdot 10^9$ letters $= 1.02$ m

The volume of the human genome V_G is

$V_G = L_G/r = 3 \cdot 10^9$ letters$/(0.94 \cdot 10^{18}$ letters/mm$^3) = 3.19 \cdot 10^{-9}$ mm^3

Volume of a pinhead of 2 mm diameter: $V = 4/3\ \pi\ r^3 = 4.19$ mm^3

How many human genomes could be contained in 1 pinhead?

$k = 4.19$ mm^3 / $(3.19 \cdot 10^{-9}$ mm$^3) = 1.313 \cdot 10^9$ times

These are the genomes of more than thousand million people or one fifth of the population of the world.

Thirdly: A huge storage density is achieved, manifold greater than can be attained by the modern computers. To grasp the storage density of this material, we can imagine taking the material from the head of a pin with a diameter of 2 mm and stretching it out into a wire, which has the same diameter as a DNA molecule. How long would this wire be?

Diameter of the DNA molecule d = 2 nm $= 2 \cdot 10^{-6}$ mm (radius r $= 10^{-6}$ mm)

Cross-section A of the DNA molecule:

$A = r^2\ \pi = (1$ nm$)^2\ \pi = (10^{-6}$ mm$)^2\ \pi = 3.14 \cdot 10^{-12}$ mm^2

Length of the wire LW = Volume of the pinhead VP / Cross-section A

LW = VP/A = 4.19 mm^3 / $(3.14 \cdot 10^{-12}$ mm$^2) = 1.33 \cdot 10^{12}$ mm $= 1.33 \cdot 10^6$ km

Length of the equator = 40,000 km

k = $1.334 \cdot 10^6$ km/ 40,000 km = 33.3 times

If we are stretching out the material of a pinhead into a wire with the same thin diameter as a DNA molecule it would have a length more than 30 times around the equator.

These comparisons illustrate in a breath-taking way the brilliant storage concepts we are dealing with here, as well as the economic use of material and miniaturisation. The highest known (statistical) information density is obtained in living cells, exceeding by far the best achievements of highly integrated storage densities in computer systems.