

Bottlenecks.

An essay prepared for the Saturday Night Literary Club, Topeka, Kansas, to be presented on Saturday, 11 October 2008.

Submitted by Paul H. Kindling, the Gentleman from Mississippi.

Mr. President, Gentlemen of the Club,

I appreciate the kind introduction by the Gentleman from South Carolina.

The bottleneck represents a paradox. The top of a container narrowed so that it can be closed and spillage prevented. It is descriptive when the cork is also called a “stopper”. The device I used to enhance, by aeration, the taste of the product of fermentation, by the way, a process discovered by the Sumerians about 12,000 years ago, demonstrates the physics of the bottleneck. Where flow through a bottle’s neck is faster the pressure is lower. The Italian physicist Giovanni Batista Venturi (d 1822) described this principle.

Sometime around New Years 1930 two different strands of DNA, the building blocks of our genes met up after passing, inside their respective containers, through the bottleneck of the tubular structure named after the Italian anatomist Gabriel Fallopius, 1523 - 1562. The previous “owners”, if that is the right term, of these DNA strands likely had consumed some sparkly watery substance poured out of a traditional bottle with neck, previously stoppered and with wire secured. At any rate, nine months later, on the fine first day of October 1930, I had the good fortune of seeing, for the first time, the light of day. Now, 78 years later, I am one of around 6.8 billion individual human beings living on this planet. Each of these individuals is different from the others, each the result of the combination of two different sets of DNA strands. Each also has 4, 8, 16, 32 and so on grand and great great etc. parents. Each one of us is the offspring of 1,048,576 individuals who lived 20 generations ago, or at about 1600, assuming about 25 years per generation. With this geometric progression you can see where I might be going. Yet here is the other paradox: all of us, all of the exemplars of the species known as “Homo sapiens” carry some part of the DNA of but a few thousand individuals. We are all related. These few thousands lived about 50,000 to 60,000 years ago.

Why were there so few?

Where did they live?

How were they then able to populate the globe?

How can we be so certain about these matters, the dating, the location?

When one thinks about it, it is rather curious that it is the DNA of our genes which tells the story of the past. The explosion in the study of the genome beginning in the 1990's has brought a large amount of new evidence. Well, when DNA replicates and splits in preparation for the reproductive process mistakes are made. I say "mistakes" because the copying process does not make perfect copies. It is indeed true that we learn from our ancestors' mistakes. The mistakes, or "mutations", may or may not have any effect on the individual, but the mistake, once made, stays there and is passed on, in perpetuity, so to speak. Certain specific mistakes then can become "markers" and indicate that those individuals who carry this mistake must all be the offspring of the individual in whom it first occurred. The converse is true also: individuals, or groups, or populations who do **not** have a specific marker **cannot** be the offspring of the individual or groups or populations in whom the marker first appeared.

Unlike in wars, all of which by definition are uncivilized, though one was called "civil", DNA replication mistakes are made at a stable, generally fixed, rate. This allows the experts to estimate the time when a certain mistake was made. It is this DNA mutation clock which tells us that we are all related to that small group who lived 50,000 or so years ago. From these mistakes we also know that they lived in Africa, and, amazingly, more precisely in East-Central Africa.

Why were there so few? We know from other fossil evidence that humans lived in many parts of the globe. What about the Neanderthals? Peking man? Java man? Homo erectus? Lucy? Our Homo sapiens DNA tells us that all those others ultimately vanished. What happened 50,000 or so years ago? Well, my last paper was about a possible future ice age. This is about one in the past.

Professor Stanley Ambrose of the University of Illinois, Champaign Urbana used the term: "bottleneck" to describe what likely occurred then, and I quote:

"The last glacial period was preceded by 1000 years of the coldest temperatures of the Late Pleistocene, apparently caused by the eruption of the Mount Toba volcano. The six year long volcanic winter and 1000-year-long instant Ice Age that followed Mount Toba's eruption may have decimated Modern Man's entire population. Genetic evidence suggests that Human population size fell to about 10,000 adults between 50 and 100 thousand years

ago. The survivors from this global catastrophe would have found refuge in isolated tropical pockets, mainly in Equatorial Africa. Populations living in Europe and northern China would have been completely eliminated by the reduction of the summer temperatures by as much as 12 degrees Celsius". Mt. Toba, on Sumatra, is near the equator.

Thinking about these matters taxes our minds. Our imagination may be superb about many aspects of this life. We know about deception, in ourselves and that which is provided for us under many guises by others, see David Beal's paper September 2008. For access to our imagination, this election season is literally a gold mine not only for the owners of media outlets but also for those who can spin the best hyperbole. Our situation is dire, we are at the verge of collapse, the precipice of a market meltdown, the implosion of candidates and what have you. But nothing, absolutely nothing, can match the stretching our imagination must do to grasp what life must have been like 50,000 to 60,000 years ago. What a tough life it must have been. As it was, an ice age, as we now call those climate conditions, had been in progress for longer than their ancestors could remember. It was made worse when all that lava and ash was forced through the bottleneck of the Mount Toba volcano 71,000 years ago. More sulfur was pushed into the atmosphere during that eruption than in the last 200,000 years. How do we know that?. From ice cores in Greenland and Antarctica.

Genetic evidence shows our ancestors lived in Africa. Bottlenecks of dwindling resources pushed some of them "Out of Africa". The journey these early ancestors made is described by Spencer Wells in the PBS/National Geographic Special documentary and book "The Journey of Man". One of the earliest, but permanent, mistakes their DNA made is the marker now identified as M168. Except for the descendants of our relatives who stayed in Africa at that time every other human being alive on the globe today, yes, every one carries this M168 marker. What is surely amazing is that very early during the ensuing journey Homo sapiens reached Australia. Read the book or view the DVD for a superb account of this captivating story.

The population groups which are considered indigenous to the Americas also carry the M168 marker. This is proof that they too are descendants of the same out-of-Africa group. It is thought that their migration via a land bridge where now the Bering Strait is located occurred about 10,000 to 12,000 years ago.

Perhaps some of you have participated in the national Geographic / IBM Genographic Project. I did. A swab of the inside of my cheek collected enough cells from which DNA was

extracted. My Y-chromosome carries these markers: M168> M89> M9> M45> M207> M173> M343. These identify the path my ancestors had taken. Out of Africa to the northeast, then to mid-central Asia, north and then west to northern Europe.

The stories our DNA has been telling have answered many questions. And, though they are fascinating from many perspectives, many questions are unanswered. As well, many new questions are raised. What DNA has not told us is the story of why our ancestors were more successful than all those others who had lived in those lands, Yes, most likely perished in the brutal conditions. But there is evidence that at least in some areas both Homo sapiens and Homo neanderthalis coexisted. No genetic connection or evidence of interbreeding has yet been found.

It has been proposed that at about the time those few thousands ancestors lived in Africa, a “Great Leap Forward” occurred. The tools they made and used are different, more refined than those of the “others”. It is postulated that this indicated better communication, better language skill, capacity for more abstract thinking. Let us talk about language. Unless nearly totally isolated, by the age of two years all humans know how to speak. We speak the language which is spoken by those around us. Generally, by the age of two years a child will also have developed the capacity for abstract thinking. It has developed the concept of self, in fact will usually use the pronoun “I”. It is interesting that long before we had the genetic evidence of our relatedness, linguists knew that groups of languages were related. The indo-european languages had to have a common ancestor language. We do not know how it may have sounded. Early written language is found in cuneiform writing and dates to about five thousand years ago. My esteemed critic, the Gentleman from New York, may enlighten us on this subject, as his son is a scholar of ancient languages.

This story is but a small part of the diaspora of Homo sapiens out of Africa started with the great bottleneck of the Mount Toba volcanic eruption. During the 30 or so minutes of this presentation the world’s population has increased by about 4,500 individuals. Resources are again dwindling. In spite of efforts, the rate of population growth has not decreased and is not likely to decrease in the near future. We are beginning to experience the pressures of the next bottleneck. Will there be another catastrophe? Man-made perhaps? Might it be Yellowstone?

I conclude with the quotation with which Spencer Wells begins his book:
“The aim of science is not to open the door to infinite wisdom, but to set a limit to infinite error”.

Berthold Brecht, *Life of Galileo*

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