The Record of Human Population History

Andrew Colin Renfrew: Well, good morning, ladies and gentlemen. And first of all I'd like to say what a very great pleasure and privilege it is to be here on this occasion to celebrate your 250th anniversary, and I'm very grateful to the organizers for the organization and for having invited me. It seems to me that I'm probably the first person in this meeting to be concerned with not just the historical dimension but with history, including prehistory. Many of us are interested in asking the question what are we? in the sense of how have we become what we are. And that really is the focus of my talk today, and I want to ask to what extent molecular genetics, genes, understanding of the genome, has clarified for us that process. In some aspects it clearly has, it gives us insights into how we have become *Homo sapiens*, but I want to emphasize that the story
involves more than that, and that there are some aspects which we have not yet addressed very successfully, and I think the question today that's worth asking is whether genes and molecular genetics, as currently deployed, have yet taught us about the most significant transformations in the human story. That is to say, as I shall argue, that as it happened in the past 10 or 15,000 years, and to ask whether we're yet ready to undertake the appropriate analyses.

Well, when in New York, where better to start than with *The New Yorker*, so I give you first of all this slide, that in a rather subtle way, asks us what are the differences between today and cocktails at a private view in Madison Avenue perhaps 15,000 years ago. And I want to move on to a cartoon by Chas Addams from again, *The New Yorker*, which I think poses problems about the nature of mind, which have still not been very effectively addressed. So I think this is a conundrum. As you can see there are some creatures, perhaps ants, who are constructing what looks like a pyramid, while those undertaking the picnic, no doubt cholesterol-rich picnic, are making the comment, "Well at least they're not bothering us." But we're all aware that some ants, termite ants, construct nests, so what is so disquieting—because I hope you find this image disquieting—what is so disquieting about this image? And one element—it may not be easy to analyze completely—one element is that these ants are doing something which is clearly the product of planning, while those undertaking the picnic, no doubt cholesterol-rich picnic, are making the comment, "Well at least they're not bothering us." But we're all aware that some ants, termite ants, construct nests, so what is so disquieting—because I hope you find this image disquieting—what is so disquieting about this image? And one element—it may not be easy to analyze completely—one element is that these ants are doing something which is clearly the product of planning, and planning—I'm not sure about purposive behavior—but planned purposive behavior is surely something that is unique to the human species. So as you'll see, this slide is rather relevant to my talk this morning.

Now, my suspicion is that I was invited to this symposium not to give you the bad news that genes and genomes have as yet made limited contribution to our understanding of human history, as I shall go on to say, but because I have also been involved, to a limited extent, in the new discipline of archaeogenetics, which may be defined as the study of the human past using the techniques of molecular genetics. And archaeogenetics has already been of great value in indicating, mainly through studies of mitochondrial DNA for female lineages, and non-recombining Y-chromosome studies for male lineages, that our species, *Homo sapiens sapiens*, originated in Africa over 100,000 years ago, and came to populate the globe following disbursals out of Africa less than 80,000 years ago. And despite some notable successes with the study of ancient DNA, some of them pioneered by Svante Pääbo, who spoke to us yesterday, despite those successes on DNA recovery from hominid or human remains, it is very fascinating that most of the data in the field of archaeogenetics have come from the comparison of molecular genetic sequences obtained from living individuals in different parts of the world, so that, in that sense, the record of human population history is imminent within us.

And this is a slide from one of the very first papers to make progress in this respect. This is a slide of mitochondrial DNA from the work of Cann, Stoneking, and Wilson, when they were comparing the mitochondrial DNA from living
individuals in many different parts of the world, and they achieved the first divide, as it were, from African individuals versus the rest. And this led them to the conclusion, which has since been supported by other work, that the first divide in the history of the diversity, the dispersal of our species and the diversity which comes with it, is the result of the emergence of our species, *Homo sapiens sapiens* in Africa from our *Homo erectus* ancestors, and that subsequent dispersal process. And there we see the map produced at that time, which although it's been significantly improved on by later studies, shows the history of those dispersals of our species out of Africa 60 or 70,000 years ago, by a slow process of migration or diffusion, and the subsequent peopling of the world by our species, *Homo sapiens sapiens*.

And more recently comparable work has been undertaken using non-recombining Y-chromosome studies, which give you the male lineages and so it gives you a separate insight into these processes, and gives you information about perhaps somewhat different aspects, but the conclusions are substantially the same.

### The Emergence of Homo sapiens sapiens

Well, this brings me to offer you what I consider to be one of the paradoxes, if not exactly in human history, in our understanding of human history, the sapient behavior paradox. Because so far as we understand it from molecular genetic studies, the hardware, the actual physical composition of ourselves as members of the species *Homo sapiens sapiens*, and our brains, is not significantly different, so far as we've been able to determine, from our ancestors, our sapient ancestors, who left Africa 60,000 years ago, or if one were talking about Europe, who arrived in Europe and peopled Europe something like 40,000 years ago. And so that notional confrontation is a very interesting one, because if you were to meet your ancestor of 40,000 years ago, that ancestor in terms of the genetic composition and in terms therefore of the brain at the time of brain would not be very significantly different from ourselves, or at any rate that's what seems to be the case. And we have some clear understanding in outline, through fossil studies and then through archaeogenetic studies, of the history of the evolution of our species.

And so what I want to do now is to give you something of a caricature of the way the human revolution is often portrayed, the human revolution being the emergence of our species, and then its embarking on the course of cultural development which ensues. And it's often suggested, or often implied, that it is the role of the scientist to show how the emergence of *Homo sapiens sapiens* came about, and then that’s the job done, that effectively tells the story. So let me illustrate this account, and this account is one of the triumphs of archaeology, prehistoric archaeology, over the past fifty or so years.
So here we have a slide, which I find a very evocative, a slide of the footprints in volcanic ash of our ancestor *Australopithecus* at Laetoli in Africa, something like 2 million years ago. So here you have footsteps, not yet human footsteps, but hominid footsteps, of this particular creature, where you see the skull, as I say, *Australopithecus*. But by 2 million years ago we have our more immediate ancestor, *Homo habilis*, and the term, the genus *Homo* is ascribed to this hominid, who was capable of using stone tools, what we would see as rather simple stone tools, such as were found by Louis Leakey in Olduvai Gorge. The finds of these tools are so far restricted to Africa; it's not clear that *Homo habilis* ever migrated outside of Africa. But the story continues and something like a million years ago you have again our more proximate ancestor, *Homo erectus*, and *Homo erectus* did indeed diffuse out of Africa and is found in the Orient, in China, in Southeast Asia, and indeed in Europe. And it is with *Homo erectus* that much more sophisticated industries are found. As archaeologists, we have to speak mainly about stone tools at this early period, because we find very few other direct indicators of human behavior than the stone tools which are so effectively preserved.

But one of the characteristic products of *Homo erectus* in many parts of the world, including Africa, was the production of what has often been called the hand ax. And these, as you can see, and as you probably know, really are very sophisticated tools, which were made by chipping, of course, a flint core, but using very controlled techniques, so that for you or me, unless you’re experienced in the matter, trying to produce one or two of these today would be a painful and sometimes rather a bloody business. And if you try it, you’d better wear gloves, though I doubt if *Homo erectus* wore gloves in the production of these tools.

**The Emergence of Language in Humans**

Now, one of the fascinating themes which we’ve already been discussing at some length is, when in the evolutionary line down to ourselves was language first practiced? Well how would you know? It’s not clear how you would know, that’s why we don’t know the answer to the question. It seems reasonably sure that *Homo sapiens* in general, our own species, was and is capable of sophisticated language involving a wide vocabulary, involving syntax, involving tenses for the past and for the present. And we know that mainly because all living *Homo sapiens* groups have this capacity, although we diverged historically, as we were looking at from the earlier map, some considerable time ago. So we can reasonably confident that our *Homo sapiens* ancestors of 40,000 or 60,000 years ago should have been capable of that, first of all because the descendents in all the diverse areas of the globe have much the same linguistic capacity; despite the diversity of language, there’s about 6,000 different languages spoken in the world today. And secondly, of course, because we have come to the conclusion on the basis of the genetic reconstructions which we were just looking at that the genetic composition of ancestral *Homo sapiens sapiens*, 40,000 years...
ago or 60,000 years ago, was not significantly different from that of ourselves. Although it should be added that we do not yet have ancient DNA successfully recovered for Homo sapiens sapiens of 40,000 years ago. Through the work of Pääbo and his colleagues we do have that for Neanderthal man, Homo sapiens neandertalensis, but for technical reasons the risks of contamination, or problems of contamination, it's probably likely that we will not have that documentation by actual analysis of ancient DNA of humans 40,000 years ago that they were not significantly different genetically from ourselves. But that still seems to be a reasonable assumption.

So when would language emerge? And how would you know when it emerged? Well, there used to be an argument that you couldn't possible learn how to make stone tools of that degree of sophistication without being told how to do so. But many archaeologists now feel that the power of mimicus, of learning through imitation, should not be underestimated, and perhaps therefore it would be possible to learn and to pass on the skill of making stone tools in that way. And we're talking about half a million years ago; these hand axes are up to half a million years old. Perhaps that could be done without the use of a developed language.

Indeed to my mind the best evidence that we have for the use of language, and all of this is inferential, is that around that time our Homo erectus ancestors must presumably have been constructing and using boats or rafts, because in Indonesia the island of Flores was—you find stone tools of Homo erectus there from contact something like 350,000 years old, and the understanding is despite fluctuations in sea level, the island of Flores was an island, in distance some thirty or forty kilometers from the nearest mainland, as it were, throughout that period. And I find it difficult to conceive how an island like that could effectively be populated by a human or Homo erectus population without the use of a boat or a raft, and I don't really see, even if you're a very plausible Homo erectus how you would persuade your lady friend, if you were a Homo erectus man, how you would persuade your lady friend to enter the raft without some pretty plausible story. And I don't see how that would be effected other than linguistically, although that's a matter of inference and perhaps for debate.

Well, here now is a skull, Cro-Magnon, a skull of Cro-Magnon, which was one of the early fossil remains found in France a century ago. This particular skull is some 32,000 years old, and is of our own species, Homo sapiens sapiens. And when you look at the tool kits of Homo sapiens sapiens, they're not so radically different to the casual observer, and since I'm not a specialist in the Paleolithic period I rather think of myself as the casual observer, I don't instantly say, "Good gracious me, that is an Aurignacian tool kit, how much it differs from the Mousterian tool kit which was used in the preceding period."

But there are those enthusiasts for the human revolution who rightly point out that together with the new tool kits, the composite tools which Homo sapiens was
producing, we do have documentations of changes in behavior, and they emphasize above all, and not unreasonably so, the production of cave art. This is one of those early paintings. This is about 30,000 years ago from the Grotte Chauvet in France, and it is still, I think, breathtaking that you can visit the painted caves of France and north Spain and you can see these astonishing animals at Lasko or Altamira or the Grotte Chauvet which were made by *Homo sapiens sapiens* something like 30,000 years ago.

And not very younger than that are the stone figurines, sometimes called Venus figurines, just three or four inches long, and also bone figurines. This is a very famous example found more than a century ago, the Venus of Villendorf, and so these figurines are something of the order of 20, 25,000 years old.

So the conventional view of human origins, which I'm not disputing but I'm suggesting it's insufficient, the conventional view is that there was this great transition and that with the transition from *Homo erectus* to *Homo sapiens*, there emerged our own species, with new behaviors reflected in the tool types, certainly with that advanced linguistic capacity which all *Homo sapiens sapiens* communities share, with the capacity to go out and people the world, as we've been seeing, and also with these extraordinary products of cave art and mobiliary art, the small figurines. The word *art* is perhaps rather a modern one, but these representations of the world in paint and in stone, if we don't like the word *art*.

Well, that's all right so far as it goes, but I'd like first of all to point out that the notion that cave art and figurine art, mobiliary art, are universal features of early *Homo sapiens sapiens* in the Upper Paleolithic period, that is to say, prior to 10,000 B.C., is an erroneous one. If you look at the distribution of cave art, that Franco-Cantabrian cave art, it's shown there on the map in that shaded area of north Spain and southern France, and the dots on the map show you the finds of the figurines we've been speaking of, which are mainly in Central and Western Europe with a few further east in Siberia. And although it's certainly the case that in the Upper Paleolithic period in Australia you do have some designs on rock walls, they are not at all in the style of the Franco-Cantabrian cave art, nor do you find carvings of the kind that we've just been looking at. So it's a mistake to think of those products as a general feature of our species in the period between 40,000 years ago and 10,000 years ago.

**Homo sapiens sapiens** Lifestyle

And now I want to go on to show you what I think were some of the most astonishing transformations in human existence, whereas what we've been looking at up to now, the lifestyle of *Homo sapiens sapiens* in the period between 40,000 years ago and 10,000 years ago, to my way of thinking wasn't overwhelmingly different from the lifestyle of their *Homo erectus* ancestors. They were, of course, hunter-gatherers, they were living in small mobile groups or bands, perhaps groups of twenty people, and they had all kinds of wonderfully
ingenious strategies for extracting food from the world. They had had the use of
fire for a considerable length of time. They were indeed in the Upper Paleolithic
period using bows and arrows. Certainly by then they had learned to construct
boats or rafts. So there are lots of quite sophisticated elements of behavior, but
they were still leading a hunter-gatherer life.

And now I want to take you to the time period around 10,000 years ago in the
Near East and in Anatolia, and this is a slide from the site of Çatal Hüyük, which
is one of the earliest towns, one of the earliest settled communities in human
experience, around 7,000 B.C. And there you have a large town, and I could
show you many slides to document that, a settled life. It’s a town of many acres
or hectares in area, and it, too, produced paintings, this time on plaster. There
was burial, although burial was something—deliberate burial, sometimes with
grave goods—was also a feature of our Homo sapiens ancestors, as much as
20,000 years ago, and the creation of effigies of terra-cotta, which in some cases
it may not be extravagant to claim as deities. This lady from Çatal Hüyük—the
original head is not preserved, but she’s seated on a chair or throne which is
supported by two feline animals, two sort of tiger- or lion-looking animals, and
this is a rather strange procedure, unless this is a woman with rather particular
and special powers. And elsewhere in the Near East at this time or a little earlier,
around 8,000 B.C., you find new practices, new practices of burial, you find skulls
with plaster faces which are difficult for us to understand, but beautifully made
plastered faces, such as you find at the site of Jericho, for instance, around 8,000
B.C. And above all the settlements, some of them, there are many permanent
settlements, the settlements are large-scale. At Jericho there was what appears
to be a defensive wall.

In other words, you find categories of behavior that are now completely different,
represent very marked developments in comparison to those of our hunter-
gatherer sapiens ancestors of the Upper Paleolithic period. And it’s clear that a
very significant transformation has occurred, and it’s not just in the Near East that
you find this transformation. Accompanying the transformation, I should
emphasize, is the development of food production, is the development of
domesticated plants and domesticated animals. You find similar developments a
little later in India and in China, in Egypt of course also, and you find analogous
developments, again some millennia later, in Central America, in Mexico, and
also in southern America. And so far as we can tell, these developments in those
different areas, the move towards permanent settlement in village communities
and the exploitation of domesticated plants, these are developments which occur
independently one from another.

And then we have a whole series of remarkable and very different trajectories of
development which lead on in each of these areas to what can be described as
state societies, or as urbanization. Here from Mesopotamia is the Lady of Warka
from the Sumerian civilization, what is now Iraq, somewhere around 3,000 B.C.,
and it was that civilization, of course, which around that time produced the first
literacy, as also did the contemporary early civilization of Egypt. And here is one of the first emblems of kingship in Egypt, the so-called Narmer palette, from around 3,000 B.C., which also has some of the earliest Egyptian hieroglyphic symbols, indicating the development there of writing.

And there we move onto further developments, Egyptian pharaohs, the pharaoh Tutankamen, and so on. And I've just chosen rather casually a few slides to emphasize the very differing trajectories which are being followed in different parts of the world as social complexity develops. So here is a great temple at Ushmal in Mexico, and with the developments of the Mayan civilization and the other contemporary civilizations, again come remarkable works of figuration. This is one of the wonderful stalea from the Maya site of Yashjilan [phonetic], and as you know comes a different kind of literacy. One of the great developments in archaeology of the past twenty years has been the effective decipherment of the Maya script.

But in Europe also, in northwestern Europe, around the same time as the Pyramids were developing and the first ziggurats of Mesopotamia, we had developments of their own monumentality. This is the Ring of Brodgar in Orkney, which is about the same time as the Pyramids. And certainly if you look at some of the extraordinary built stone tombs, this is the huge site, the megalithic site of New Grange in Ireland, built before 3,000 B.C., something like 3,500 B.C., and therefore before the pyramids of Egypt, you have sophisticated accomplishments, although not accompanied by literacy.

And there is one of these very early Mesopotamian tablets, Sumerian tablets, from around 3,000 B.C., one of the first sophisticated recording systems. And then I'd like to highlight in the Indus Valley civilization, we have systems of weights, and although it's very different for the archaeologist to reconstruct the thought processes of people in prehistoric times, you can certainly see how their thought processes were working. And if you as an archaeologist, or as a student today, weigh those cubes of stone, weigh in the modern sense, you find that in a modern sense they're multiples of unit of weight. And it's difficult to conceive how that could be so unless the people in question had a system very closely analogous to our own system of weighing, and were probably using these cubes in order to weigh one commodity against another.

And very appropriate to pay respect to the Acropolis at Athens, and to Greek achievements in the fifth century B.C., the statue of Apollo from the Temple of Zeus at Olympia.

**The Sapient Behavior Paradox**

Now the sapient paradox is this: if we are seeking to ascribe or to explain the human achievement which I've been summarizing in this rather superficial way by referring to these trajectories of development, by the genetic transformation...
which accompanied the emergence of our species in Africa something like 100,000 years ago, or the appearance of our species around the globe, and I've chosen the date of its appearance in Europe as 40,000 years ago as a convenient time point, in what sense is the emergence of the modern brain—and I've said I don't think we doubt that the modern brain emerged 40,000 years ago and earlier—the sapient paradox is if that's the explanation what took so long? Why did it take another 30,000 years before you get the settled communities such as we see at Çatal Hüyük or the earlier settled communities in Mexico or in China, and before these differing trajectories of development got underway?

And that is the central question which I do not believe that molecular genetics has begun to answer for us, and I doubt if molecular genetics will indeed give us the answer. Now I'd like to summarize a few conclusions in the form of questions, and then I'll just give you an inkling of how I think the discussion may need to continue, but the discussion will need to continue of course using our understanding of the capacities of the human brain, which of course are genetically determined, those capacities which were already present 40,000 years ago. But what kind of explanation is that if you've, as I say, got to wait 30,000 years after that for the effects to be made manifest? It simply is not an adequate explanation. So I'd like to ask a few questions and give what would be the current answer.

Was the genetic transformation by which our species, *Homo sapiens sapiens*, emerged largely or entirely accomplished by 80,000 years ago, that would be in Africa, or by 40,000 years ago for instance in Europe? And I assume the answer is yes, I've not heard that disputed.

Secondly, is the study of human demographic history after this time, after 60,000 years ago, by the techniques of archaeogenetics, notably lineage studies by non-recombinant Y chromosome and mitochondrial DNA data, mainly the investigation of diversity among phenotypically neutral markers, while the operational genetic unity of the species is not effectively called into question? And I think in current understanding the answer to that question is also yes. We do understand human diversity better through mitochondrial DNA and Y-chromosome markers, and that allows us to say what were the demographic processes, where were the population movements, where were the striking increases in population, when did one population replace another population? And we have all these episodes being elucidated for us by archaeogenetics. But in terms of the human genome in a general sense, did that make very much difference? To which the answer is probably no.

Thirdly, was the practice of carving small three-dimensional representations of the human form during the Upper Paleolithic period largely restricted to a tract of Eurasia from Franco-Cantabria to Siberia, while the practice of wall painting of animals at that time in the Franco-Cantabrian style was restricted to the western part of that tract, with simpler and rather different representations in Australia?
The answer I think is yes. And do we know why the distribution was so geographically restricted over that time period? I think the answer is no, not a clue. I've never heard anybody give the faintest indication of why that should be.

Is there any suggestion that this behavior had specific genetic determinants in the sense that the humans in the areas where these representations were produced were significantly different in genotype or in phenotype from their contemporaries elsewhere? I think the answer is no, not so far. It could be argued that the ancestors of the Basques had some genetic endowment that allowed us to do these things, but I've never heard that seriously argued.

After 10,000 years ago, we see different trajectories of rapid development in different regions of the world. Is there any suggestion that these had specific genetic determinants, that is, specific to that region, or more precisely were the local genetic features specific local polymorphisms which made possible or facilitated or enhanced the innovations in each developmental trajectory, and which were specific to some of the participants in that trajectory, and which were not present in the participants in other trajectories? Just a long way of asking the same question. And I think the answer is no.

**Human Behavior in Settled Communities**

So genetic variability, genetic homogeneity, are not giving us the handle we need upon these processes. Well now, that is my main point. I'll just take two minutes longer before I conclude to tell you where I think the answer may lie, and I'm sure we shall need more insights into human behavior and how human behavior in general is genetically governed, genetically facilitated, and genetically determined. But I suggest that the crucial transformation in human experience was the development of settled, permanent communities in different parts of the world. How the conditions came about for those communities to develop is a further question, but it comes about partly from demography, partly certainly from climate change, and partly from no doubt other factors. But I suggest that once human communities were able to live permanently together, completely new forms of human interaction, social interaction, were able to develop. Indeed I think of it in terms of property, power and piety, the three *Ps*. And I suggest that it was not until you had settled life that it was possible to have heritable property. And I suggest that until you have heritable property and transferable property some forms of economics are not possible. There were always subsistence economics with any living species, but until you had exchange and property of the kind that I'm speaking of, further economic developments were not possible. And you can see how that would be. If your family now lives in a house, that is your house, and you're going to dispute the right of another group to have access to that house. If you are now sowing fields of wheat and barley, you expect to reap where you have sown, and you do not expect other people to step in and do so. If you are looking after herds of sheep and goats and cattle, or your family are...
doing so, you don't expect somebody else to go and slaughter and eat one of those sheep on a suitable occasion.

Now these, the notion of heritable property is a new relationship. I could—I won't go on to talk about power relationships. I will just point out to you that some of the earliest images that we have in any trajectory are related to things that appear or may appear to relate to superhuman powers. In other words, the development of religious concepts and ultimately the formulation of deities—we've still got a deity on the screen—may have been an important part of that story at very early development of settled communities.

Now I've no doubt that when we have learnt to analyze these procedures more effectively, and we're talking about the formation of mind, we have the brain, the hardware, determined by that human revolution of 60, 70, 80,000 years ago, but the mind, the software, comes about in those conditions that were created in those earliest settled communities.

So what I'm saying to you is, I think this is a point that's not sufficiently appreciated, it's a point that merits much further investigation, and I've no doubt that that will lead us back to ask what are the properties in the human genome, the general human genome, not talking about diverse elements in different parts of the world, what are the properties of the human genome that make it feasible for us to conceptualize? Of course, the existence of language is essential, you must have language before you can have a shared understanding of what is property that is hereditable and so on.

Well I can't go on to develop that theme, but I just put it to you as a question mark, because so far the molecular genetics takes us to that tantalizing spot, but hasn't really crossed the threshold yet, and I think there is a threshold there that we have to cross.

So I'll leave you with a final image: "A word of advice, Dirk. It's the Mesolithic. We've domesticated the dog, we're using stone tools, and no one's naked anymore." Thank you very much.