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Hominid evolution and the emergence of the genus *Homo*

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I am very happy and much honoured to have been invited, for the third time, to this famous Academy, for a new working group.

If I understood well, my duty, here, is to give you the state of art of palaeoanthropology, the current way of understanding, with bones and teeth, the history of Man, of his close relatives and of his closest ancestors. I will try to do that.

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Let us remember, for the pleasure, that Man is a living being, an eucaryot, a metazoaires, a chordate, a vertebrate, a gnathostom, a sarcopterygian, a tetrapod, an amniot, a synapsid, a mammal, a primate, an Haplorhinian, a Simiiform, a Catarrhinian, an Hominoidea, an Hominidae, an Homininae and that life, on earth, is around 4 billion years old, metazoaires, 2 billion years old, vertebrates, 535 million years old, gnathostoms, 420 million years old, mammals, 230 million years old, Primates, 70 million years old, Hominoidea, 50 million years old, Hominidae, 10 million years old.

And let us remember also that Primates, adapted to arboricolism and frugivory, developed three flourishing branches worldwide all over the tropics: the Plesiadapiforms, the Strepsirhinians composed of Adapiforms and Lemuriforms, and the Haplorhinians, composed of Tarsiiforms and Simiiforms, and that the Hominoidea are a superfamily of the Simiiforms, born in Eastern Asia, fifty million years ago, as I mentioned above. The Hominidae are a family of the Hominoidea, born in tropical Africa ten million years ago, and they include the last common ancestors of two subfamilies: the Homininae, us, and the Paninae, the Chimpanzees.

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Ten million years for the Homininae-Paninae divergence may not be the right figure but it is an easy one, probably not too far from the real one. The debate about this date has always existed, especially between palaeontologists and geneticists. The palaeontologists used to prefer long chronologies (the Early Divergence Hypothesis), the geneticists, short ones (the Late Divergence Hypothesis). I remember that it had already been the reason

for the organization in May 1982 of the Pontifical Academy of Sciences' working group called *Recent Advances in the Evolution of Primates* (Chagas, 1983), reason that I suggested to the President Carlos Chagas.

Everybody agrees on the common ancestry of *Homo* and *Pan*; with the discovery of *Sahelanthropus*, 7 million years old, in Chad, palaeontologists are currently thinking of a divergence not too long before this fossil, considered a Homininae. Geneticists were suggesting less first (Scally *et al.*, 2012), and then more, up to 12 million years ago (Langergraber *et al.*, 2012). Svante Pääbo will tell us more about that.

So here let us accept 10 million years as a sort of average.

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The progeny of these common ancestors, as we said, split into two main branches, Homininae and Paninae, probably because of the emergence of two environments, different enough, one more covered with more trees, one less, with less trees. The analysis of the diet (teeth) of several mammals of these upper Miocene levels shows, as a matter of fact, an increase in C4 plants, meaning a development of grasses (Cerling *et al.*, 2010; Uno *et al.*, 2011).

The subpopulation which happened to be in the more covered environment became the Paninae, the prechimpanzees and the chimpanzees – knuckle-walking locomotion and frugivory; the subpopulation which happened to be in the less covered environment became the Homininae, the prehumans and the humans – erect posture, double locomotion, bipedality and arboreality, and diet from trees (fruits) and from the ground (roots).

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I. Early Prehumans

Let us take the "Homininae road". Between 10 and 4 million years ago, 3 genera and 4 species document the first step of this Prehumanity: *Sahelanthropus tchadensis*, 7 million years old, found in Chad, signed by Michel Brunet and 37 authors in 2002; *Orrorin tugenensis*, 6 million years old, found in Kenya, signed by Brigitte Senut and 5 authors in 2001; *Ardipithecus kadabba*, possibly 5.8 to 5.6 million years old, named by Yohannnes Haile Selassie in 2001; and *Ardipithecus ramidus*, 4.4 million years old, named by Tim White and 2 authors in 1994, both found in Ethiopia. Let us call them the early Prehumans.

They all share an erect posture; two of them, *Orrorin tugenensis* and *Ardipithecus ramidus* elegantly demonstrate, through their anatomy, the double locomotion, bipedality and arboreality, we previously mentioned.

The femora of *Orrorin* (3 have been found) show, for instance, apomorphic features with humans, elongated antero-posteriorly compressed

femoral neck with asymmetric distribution of cortex, spherical, anteriorly twisted head, shallow superior notch and developed gluteal tuberosity, precursor of the *linea aspera*. And in contrast, the humeral shaft (one has been found) shows an insertion of the *brachioradialis* muscle as a strong vertical crest characteristic of arboreal habits.

Demonstrating the same double locomotion, the pelvis of *Ardipithecus ramidus* is modified in its upper part to walk and run in odd contrast with its lower part still adapted to climb – powerful hip and thigh musculature; his foot still possesses an "os peroneum", known in monkeys but lost in Paninae, amazingly used here to help it walk in increasing its rigidity – a typical exaptation – in contrast with an abducted (grasping) big toe; its hand still looks very strong, able to support the weight of the body – palmigrady – but shows at the same time a good grip.

"*Ardipithecus* was at home both moving along trees on its palms and walking upright on the ground" wrote Brooks Hanson in the 2009 *Science* issue dedicated to the description of *Ardipithecus ramidus* (White *et al.*, 2009). It is obvious that this new environment and the adaptative answers in diet, posture and locomotion that the Homininae found to survive, had consequences in the organization of their brains and of course in their behaviour: regular food carrying, pair-bonding and reproductive crypsis (females did not advertise ovulation), suggests Owen Lovejoy in the same *Science* issue.

According to the very low degree of sexual dimorphism, readable in *Ardipithecus ramidus*, it is clear that these early Prehumans were still living in quite a covered environment, synonymous of protection.

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II. Classic Prehumans

Around 4 million years ago, the climate seems to change again, in the same dryer direction. It looks more like an increase in the same change, having happened around 10 million years ago. The landscape is opening: its covered part, which still existed, is diminishing and its opened part is obviously increasing.

I suggested the existence of that change many years ago because, having studied the Proboscidians, I was surprised by the fact that in Kanapoi, in Kenya, 4 million years ago, *Elephas ekorensis* and *Mammuthus subplanifrons*, the Elephantidae eating grasses, were appearing whereas *Anancus kenyensis, Stegotetralodon orbus* and *Primelephas gomphotheroides* eating leaves (and existing in Lukeino, 6 million years ago for instance) had disappeared. And there are now some beautiful confirmations of these observations with the demonstration of the strong development of C4 plants at these geological

times (Lee-Thorp *et al.*, 2012) (Lukeino is one of the sites of *Orrorin tugenensis*, Kanapoi is one of the sites of *Australopithecus anamensis*).

So this new period, between 4 and 3 million years ago, is the time of the Australopithecines sensu lato, as well as the Kenyanthropines, who were more aggressive, walked better, and had started eating meat.

We know 2 genera and five or six species of these Prehumans that we could call classic Prehumans to differentiate them from the early Prehumans. They come from Chad, Ethiopia, Kenya, Tanzania and South Africa, a sort of concentric tropical circle around the equatorial forest.

In chronological order, they are:

- *Australopithecus anamensis* from Kenya and Ethiopia, starting around 4 million years ago, signed by Meave Leakey and three coauthors in 1995;
- *Australopithecus bahrelghazi*, from Chad, 3.5 million years old, signed by Michel Brunet and five other authors in 1996;
- *Australopithecus afarensis*, starting around 3.9 million years ago from Tanzania and Ethiopia and signed by Donald Johanson and two authors in 1978 (which can now be reduced to its Tanzanian part, because the type chosen was a mandible from Laetoli in Tanzania, the Ethiopian part having recently become *Australopithecus chamensis* (not yet completely accepted);
- *Australopithecus prometheus*, from South Africa (previously known by the nickname of Little Foot) around 3 million years old; this old name, given by Raymond Dart (Dart, 1948) to some South African specimens, has been recently proposed by Ronald Clarke, to name it Little Foot (Clarke, 1995, 2012);
- *Kenyanthropus playtops*, 3.5 million years old from Kenya, described by Meave Leakey and six coauthors in 2001, which could be synonymous of *Australopithecus bahrelghazi* and which is modern looking thanks to its orthognathic flat midface.

Australopithecus afarensis and *Australopithecus chamensis* from East Africa as well as *Australopithecus prometheus* from South Africa show the double locomotion that we described in *Orrorin tugenensis* and *Ardipithecus ramidus*, but a double locomotion not completely similar to the one of the early Prehumans. The orientation of the lesser trochanter of the femora is more posterior in *Australopithecus*, for instance, than in *Orrorin*, where it is medially projected; the head of the femora has the same diameter as its neck in *Australopithecus*, but is much larger in *Orrorin*, the head is twisted *posteriorly* in *Australopithecus*, but anteriorly in *Orrorin* and so on. The interpretation of

their differences is that Australopithecines walk and run more efficiently.

And for the first time, one species, *Australopithecus anamensis,* showed, through a particularly stable hind limb (knee joint) and a quite instable forelimb (elbow joint), exclusive bipedality. I wonder whether this specificity so important in anatomy and its consequent behaviour would not necessitate a different generic name.

In comparison with the early Prehumans, the size of these classic Prehumans is about the same or slightly increasing, but their sexual dimorphism is completely different; it is very important indeed, reflecting a much more open environment, consistent with what we said about the fauna, the flora, and the anatomy of these Homininae.

As far as the teeth are concerned, these classic Prehumans seem to have chosen two diets, two adaptations, both then possible, in showing an increasing or decreasing size of the post canine teeth. *Australopithecus afarensis* and *Australopithecus chamensis*, for instance, have chosen to increase the size of these teeth; *Kenyanthropus playtops*, to decrease it.

Furthermore, after the description of cut marks on a few bones, in a site, Dikika, 3.4 million years old, where only one species of Homininae has been discovered so far, *Australopithecus afarensis* (*chamensis*?), the idea that some of these classic Prehumans were already partly carnivores, which means more omnivorous, has been claimed and more or less accepted (McPherron *et al.*, 2010).

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In summary, between 10 and 3 million years ago (chapter I and chapter II) a subfamily, the Homininae, was born in central and east Africa, and evolved in central, east and south Africa, because of climate changes. It is currently documented by 5 genera, *Sahelanthropus, Orrorin, Ardipithecus, Australopithecus, Kenyanthropus* and 10 species. All these Homininae were, as we said, tropical and African without any exception, permanently upright, walking and climbing first before becoming exclusively biped, with a slowly increasing endocranial capacity, 300 to 350cc in *Ardipithecus ramidus*, 400cc in *Australopithecus chamensis*, and complexity (more convolutions and better irrigation), a slow reduction of their prognathism at different speeds and with a trend to reduce or to increase the size of their cheek teeth. The diversity of these Prehumans, as far as locomotion, dentition, consequent behaviour and diets are concerned, is important and fascinating; it is obvious that we will find more fossils and greater diversity.

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III. Late Prehumans and Early Humans

Around 3 million years ago, probably a bit less, climate changed again in the dryer direction, having started 10 million years ago and having increased 4 million years ago; but this time global cooling and tropical drought were severe: less and less trees, more and more grasses and the need for everyone to find solutions to adapt to these new conditions to survive.

Global cooling appeared in the study of oxygen isotope ratios O^{18}/O^{16}, in the tests of microorganisms collected in deep-sea cores in the Atlantic and in the Indian oceans. Tropical drought, now very well-known and studied, appeared first in the sediments of the lower Omo river basin in Ethiopia (Coppens, 1975, 1978 a and b, 1983a, b and c, 1985; Boisserie *et al.*, 2008), because these sediments are the only ones in tropical Africa to offer a clear continuous, very fossiliferous and thick enough (more than one kilometre) deposit of these geological times, between a little more than 3 million years at the bottom to a little less than l million years at the top. Among many examples of the Omo sequence documenting this climate change, let us take only two of them, one from the fauna, and one from the flora.

As far as the faunal example is concerned, I have chosen to give you the quantification of two tribes of Antelopes, the Tragelaphini, living in open forests, covered areas and more or less thick bush, and the Alcelaphini, adapted to run in open countries, without too much water. In the lower levels, Tragelaphini represented 33% of the Antelopes, Alcelaphini 9%; in the upper levels, Tragelaphini are 3% of the Antelopes, Alcelaphini, 29%.

Let us now mention the figures obtained by palynology; an index of a number of pollens of trees on a number of pollens of grasses has been done in lower and upper levels; for the earliest levels, this index reached the figure of 0.4; for the upper levels, the same index got the figure of 0.01.

I hope that this demonstration of climate change, through these two examples, has been convincing.

The Homininae have been giving three brilliant answers to this crisis. Let us call these answers a robust one and two gracile ones.

The robust one can be schematically called a physical answer: bigger body size, more massively built, impressive new masticatory equipment for chewing vegetarian fibrous diet, but only small, allometric, development of the brain; we know 2 or 3 genera and 4 species to document this answer.

The gracile ones can be very schematically called an intellectual answer in East Africa: much bigger brain and omnivorous diet but small body, and a more mobile answer in South Africa, better pelvis for better bipedality but small brain; we know 2 genera and 4 species to document these second and third answers.

This pack of 4 or 5 genera and 8 species can be called late Prehumans and early (or first) Humans, the Person.

The robust answer looks particularly interesting at the same time because of its homogeneity, its diversity and the limits of this diversity. By homogeneity, I mean that the three answers we will describe have found the same strategy: robust body, robust cheek teeth and small brain. By geographical and ecological diversity, I mean that in three biogeographical and ecological niches, the answers are, as a matter of fact, comparable but not similar.

In the Afar area (east Africa) the robust form is *Australopithecus garhi* (2.5 million years old), long hind limbs but long forelimbs as well, very big teeth (canine but anterior also), prognathic face and small brain (450cc), discovered and published by Berhane Asfaw and five other authors in 1999.

In eastern Africa sensu lato, south of Ethiopia, Kenya, Tanzania, Malawi, we are dealing with a robust lineage, *Paranthropus* or *Zinjanthropus aethiopicus* – that Arambourg and myself discovered and described in 1967 – and *Paranthropus* or *Zinjanthropus boisei* – that Louis Leakey described in 1959 – the first 2.7 to 2.3, the second 2.3 to 1.2 million years old. Both are very robust forms, with a prognathic dish midface in *Paranthropus aethiopicus*, much less in *Paranthropus boisei*, a shallow palate in *P. aethiopicus*, much deeper in *P. boisei*, a small cranial capacity (400 cc) in *P. aethiopicus*, larger (530cc) in *P. boisei*, and a very specialized dentition, very small anterior cutting teeth in a straight line and very large post canine grinding cheek in two almost straight rows, with very thick enamel.

In South Africa, a similar form of specialized Prehuman, *Paranthropus robustus* was described by Robert Broom as soon as 1938; its characteristics are about the same as for the east African robust parade: strongly built body, skull with robust superstructures, like a sagittal crest, wide dish face, deep postorbital constriction, small anterior, strong posterior teeth, deep palate, small brain (around 500cc).

This diversity is a beautiful example of adaptation but also a beautiful example of parallel adaptation as well; it seems that these solutions were found independently by very close but different lineages. I would not be surprised if the origin of *Paranthropus* (or *Zinjanthropus) aethiopicus-boisei* were *Australopithecus afarensis* (*chamensis*?), and the origin of *Paranthropus robustus* were *Australopithecus prometheus* (Little Foot).

The gracile solutions, contrasting with the robust one, are heterogeneous according to the ecogeographical niches where they had to express themselves.

One of these solutions, "found" by South African Prehumans, was a strategy of more efficient mobility; it has been documented by a lineage of *Australopithecus africanus*, *Australopithecus sediba*. *Australopithecus africanus* is famous

because it was the very first species of Prehuman ever recognized, described and named by Raymond Dart in 1925. *Australopithecus africanus*, which could well be around 2.4-2.5 million years old (at Sterkfontein), seemed to have fore limbs still adapted to climb but hind limb already fully adapted to walk; it has a globular skull with a moderate to marked alveolar prognathism, small endocranial capacity (440cc) and a dentition with relatively small incisors and canines and relatively large premolars and molars.

Australopithecus sediba recently found and published by Lee Burger and six authors in 2010 is 1.9 to 2 million years old – it still possessed long and powerful forelimbs to climb but a derived hand with a long thumb to grip, a primitive foot but a derived wider pelvis, a human-like sacrum and strong femora, synonymous of a good bipedality associated with a more evolved face but a still very small cranial capacity (420cc).

And the second solution, "found" by the east African Prehumans, was a strategy to survive in an environment probably dryer than the South African one, an obvious bigger reorganized brain and a new dentition for a clear omnivorous diet, where meat had become a part of new feeding habits. This solution is documented by a new genus, *Homo*, and two possible species, *Homo habilis* and *Homo rudolfensis*, (Leakey *et al.*, 1964, Groves *et al.*, 1975).

The consequences of this natural event and natural adaptation to this event by natural selection, have been fantastic; more meat, more animal protein, means better brain; more brain means a new level of thought, curiosity, new approaches of life, cognitive, intellectual, spiritual, ethic, aesthetic, new behaviours.

I am conscious that the words that I am employing are philosophically and scientifically too provocative, too strong and at last inappropriate, even wrong. But for a palaeontologist, a field palaeontologist, after years of surveys and excavations, discovering in the middle of an obvious dramatic climate crisis the very first stone-made tools and their makers, is just fantastic. Suddenly you are in front of the first Human, the true Human being, in front of a Person, capable of anticipating enough to create a shape for his own future use or pleasure.

It is to recall the pioneer role of the lower Omo river sequence in Ethiopia in the discovery of the correlation between the 2.7 climate change and the emergence of the genus *Homo* that many years ago I proposed the name of (H)Omo event, with an H in brackets to link *Homo* and Omo (in a very bad pun).

And scientifically speaking 2.6 or 2.7 is the date of the discovery by one, or by several Homininae. It is, as a matter of fact, not currently possible to claim for sure who is, or who are, the makers of second-degree stone tools.

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In summary, between 3 and 2 million years ago, because of a change in climate, classic Prehumans invented three brilliant solutions to survive: the robust one (late Prehumans) which would last almost 2 million years and the gracile ones, one of them being more mobile and the other being Man, still alive almost 3 million years later (first Humans). With the first Humans (at least) emerges a new level of consciousness, probably never reached before, giving rise to the very first manmade artefacts planned according to their projected function.

It is the emergence of the Person. As soon as the genus *Homo*, the human genus, was born, Man was there, complete, even if he has been evolving during the 2 and a half million years after his birth and even if he is still expected to evolve in the future.

The answers to the questions of where, when, how and why did a Prehuman become a Man, could be:

In tropical Africa (may be only East Africa);

Between 3 and 2 million years ago, around 2.7;

In developing his brain and changing his diet and his dentition and, of course, his behaviour to try to adapt to the dramatic climate change he had to cope with.

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IV. Classic and late Humans

The genus *Homo*, being omnivorous, which means carnivorous pro parte, enlarged his territory; a carnivore always has a larger ecological niche than any herbivore.

But being carnivorous, the genus *Homo* had to hunt and consequently became more mobile.

Having a bigger brain, more plicated, with a better irrigation, the genus *Homo* became consciously organized to explore more territories for hunting and gathering and maybe also for curiosity.

As we said before, the genus *Homo* made tools, invented shapes for functions or not, and as soon as he had done that, kept doing it forever. Man and tools became a couple, no tools without Man, no Man without tools. And since making a tool, as soon as the first one, is a symbolic gesture, I would say "no symbol without Man and no Man without symbol".

As *Homo*'s adaptation to climate change was a success, his population probably increased demographically, very slowly, of course, but at a speed fast enough to be obliged to move, to extend his territory.

In summary, being more mobile because of his new diet, more curious because of his new brain, better equipped because of the tools he made,

more numerous because of his adaptative success, Man, the first Man, the first species of the genus *Homo*, moved.

And some environmental reasons could probably be added to these previously mentioned ones – a natural extension of his ecological niche – to support the idea of a very early movement of the genus *Homo*.

For environmental, biological and cultural reasons it was the very first species of the genus *Homo* who moved, extending his territory, as soon as 2 to 2.5 million years ago, almost anywhere and everywhere (with a latitudinal climatic limit) in the Old World, Africa, Europe and Asia.

And since, with *Homo*, there are stone tools, it becomes easier to trace his movements.

I would briefly like to list some data to support the idea of a very early in and out of Africa n°1 movement of *Homo* as soon as *Homo habilis*.

Africa:	more than 2 million years, in Algeria, Aïn Boucherit (tools);
Middle East:	more than 2 million years in Israel, Yiron (tools); 1.8 million years in Georgia, Dmanissi (bones and tools);
Europe	:1.6 in Italy, Pirro Nord (tools); 1.6 in France, Lezignan (tools); 1.2 in Spain, Sima del Elefante (bones and tools), Barranco León, Fuente Nueva 3 (tools).
Asia:	1.9 in Pakistan, Riwat (tools); more than 2 million years in India, Masol (tools); 1.8 in Malaysia, Lunggong (tools); 1.6 in Indonesia, Sangiran, Modjokerto (bones and tools); 1.7 to 2 in China, Majuangou, Yuanmou, Longuppo, Renzidong, Longuddong (tools).

Then, it seems that there is:

1) A *Homo habilis, Homo ergaster, Homo erectus* lineage, all over this huge area. But as *Homo* was not demographically numerous enough to exchange genes everywhere all the time, the very first species of the genus *Homo* could have become the second and the third, but not the fourth because new subspecies or species of *Homo* emerged by isolation (by sea or by ice);

2) A probable *Homo antecessor, Homo heidelbergensis, Homo neandertalensis* lineage in Europe and then, later, in the Middle East and Central Asia;

3) A population of Siberia, the Denisovians, derived from the *Homo neandertalensis* lineage, discovered by geneticists (Sante Pääbo and his staff), remaining a Siberian spot from a much larger territory (Asia);

4) A probable endemic lineage of *Homo erectus* in the Indonesian islands, *Homo erectus* and *Homo soloensis* in Java, *Homo floresiensis* in Flores;

5) A probable *Homo erectus*, *Homo rhodesiensis, Homo sapiens* lineage in Africa and the Middle East (Morocco, Israel);

6) Another probable *Homo erectus* lineage "evolved *Homo erectus*" in the Far East (*Homo sapiens* like) (China);

7) And then a possible emergence of Homo *sapiens sapiens* in Africa around 200,000 years ago and a possible movement, for environmental reasons, of this subspecies out of Africa again (n°2), through the Bab el Mandeb and the Sinai around 100,000 years ago (Eriksson *et al.*, 2012), interbreeding with the populations previously established in Asia.

Homo sapiens sapiens has been found in:

Middle East:	100,000 years in Israel, El Zuttiyeh (bones);
Asia:	100,000 years in China, Zhirendong (bones) (Liu *et al.*, 2010);
	75,000 years old in India, Narmada valley (bone) (Sankhyan *et al.*, 2012);
	74,000 years old in Malaysia, Lenggong (tools) (Zuraina Majid, personal communication, 2012);
	60,000 years old in Laos, Tam Pa Ling (bones) (Demeter *et al.*, 2012).

And it was apparently this population of *Homo sapiens sapiens* who moved again to Europe 50,000 years ago, to Siberia 30 to 40,000 years ago, to Java 50 to 60,000 years ago and then to Flores 10,000 years ago.

And *Homo neandertalensis*, Java Man, Denisovian and Flores Man became extinct, from 30,000 years ago to 10,000 years ago, but not without leaving some "souvenirs" that the geneticists are trying, more and more successfully, to recognize and identify.

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I must say that I am feeling less comfortable in the systematic world of the genus *Homo*. I am not sure that all these species – *Homo ergaster, Homo antecessor, Homo heidelbergensis, Homo rhodesiensis* etc. – that we mentioned and *Homo cepranensis, Homo georgicus* etc. that we did not mentioned, really exist, or at least exist in the same way as *Sahelanthropus tchadensis, Australopithecus anamensis* or *Paranthropus boisei*. It is not impossible that culture has had a retroaction on biology and that the numerous human species of the same genus *Homo* are only grades with permanent interbreeding potentialities except, maybe, for isolated and specialized forms like *Homo neandertalensis* (the later one) or the tiny *Homo floresiensis*.

I must say as well that, if I am absolutely convinced by the first "out of Africa" n°1 and by its antiquity – 2.5 to 2 million years ago – I am not completely convinced by the second, 100,000 years ago. I think that, if the second does exist, it would not be the second but maybe the tenth or the hundredth; as soon as the movements of people from north-eastern Africa to the Middle East became climatically and environmentally possible, I can-

not understand why the human population would have stopped passing, in both directions, after moving once.

The closing of Europe because of glaciation is understandable; the existence of hand-axes in the tool kit, 1.7 million years ago in Africa, and only 700,000 years ago in Europe, for instance, is important data for sure. The existence of an upper Pleistocene climate change pushing *Homo sapiens sapiens* out of Africa 100,000 years ago is also a good datum. But between "out of Africa" n°1 and "out of Africa" n°2, I guess there were several "out of Africas" as well as "out of Asias".

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Homo sapiens sapiens got to Australia by boat around 40,000 years ago, to America through the almost empty Behring straight, by foot or by boat, around 30,000 years ago (at least) and to Greenland, by foot, 5,000 years ago, and then, obviously by boat to Melanesia, Micronesia, Polynesia, some thousands of years ago.

So since 10,000 years ago there is only one species and one subspecies of Homininae on the Earth, *Homo sapiens sapiens*.

We will have to wait for the peopling of other planets to be able to get, by long enough isolation and genetic drift, new human subspecies or species and new bunches of Homininae…

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In summary, Humans extended their territory very early beyond Africa through the Sinai and the Bab el Mandeb roads to the whole Eurasia; but the peopling was too small for too large an area to stay genetically stable and started to create a generous specific diversity. But a new subspecies, probably born in Africa, extended its territory through the same roads to Eurasia and then to the whole world; this subspecies, *Homo sapiens sapiens*, being obviously dominant everywhere, all the previous human species became extinct.

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This conclusion deals with the history in time and space of the subfamily Homininae, the subfamily, zoologically speaking, we belong to. It is a long history ten million years old, starting in tropical Africa by an odd adaptation to a new behaviour because of climate change, upright posture, and continuing, still in tropical Africa, by another adaptation to another behaviour because of another climate change: a "better" brain.

This succession of natural events and of adaptations has been the natural reason for the emergence of a new being, the human genus, developing in

natural environments a new environment, the cultural one, and bringing with it a new consideration of the individual, the Person.

I would like to conclude with a reaction by one of my own grandmothers, who told me, without any possible discussion, "If you, my grandson, descend from the Apes, I, your grandmother, do not".

She was wrong, as far as the natural history of man was concerned but she was right in defending the dignity of the Person.

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