# SPECIES & SUBSPECIES

### A film on the classification of the living world



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### THE TREE

Everyone knows the tree of life, or at least thinks that they do: in a corner of our minds, we all have a vague image of a majestic oak in which the human figure presides over a well-ordered natural world, from the simplest bacterium (at the bottom) to the most complex mammal (at the top).

Yet this standard representation is a false one: the true tree isn't as it is usually shown and it tells a much stranger and much more fascinating story. My project is to film the upheaval, the genuine Copernican revolution brought about by the modern concepts of systematics.

In order to do that, we require a striking depiction of the tree of life, something that goes beyond the traditional, basic representations that are limited to a few dozen branches. Ideally, we should be able to descend to an almost infinite degree, creating a tree with millions of branches. That is what I shall aim for.

Something that was impossible on paper can now be done with computer graphics: we can construct a virtual tree around which we can move, switching from the general (the living world) to the specific (Australia's common snake-necked turtle), the desired effect being that of the *fractal image*, in which we are able to discover more and more detail as we approach.

### **HOMO SAPIENS**

The other key image in our story is the human body. Firstly because we use our own body image as a "benchmark" for descriptions of all other organisms and secondly because, let's face it, one particular species interests us more than the others: we cannot really deal with man in the same way as salsify even though, from a taxonomic point of view, we should.

Rather than talk of man from an exterior stance of impossible objectivity, we shall make him part of the story, turning him into a character and getting him to tell the story from his point of view. Therefore, we shall use a Narrator whose task is to embody; on his own, the whole of the human race.

Similarly, just as we shall use both "photographic" images and drawn representations of the different animal species, our narrator will also appear in two different ways: at times "in the flesh" and at others as a drawn, animated version, allowing him to enter the animated sequences and allowing us to subject him to all kinds of graphic manipulation: making his skeleton or nervous system appear superimposed, morph from the human morphology to that of the coelacanth, chop him to bits, etc...

The idea behind all this is to show that our two key images – the human body and the tree of life – are closely linked: man, just like other species, is a puzzle, a patchwork of evolutionary innovations, each one of which corresponds to a branch of the tree. We shall illustrate this idea to the letter by

cutting our narrator into "evolutionary parts" such as the upright position, the thumb, the nose, the mammary gland, the alveolar lungs, the fleshy fin, bilateral symmetry, the nuclear cell, etc.

"I"

Using "I" wasn't an initial choice; it imposed itself in the course of writing to "give body" to the ideas. To show man's place in the world, we needed a totally subjective approach.

As a result, the narration may seem unusual since the narrator is also a protagonist in the film and appears in the footage. At times he means "we" and at others "I". The narrator also speaks *in situ* (among stuffed animals, sharing the screen with the image of a bacterium, etc.) and plays his own part: he is an actor, not a reporter.

### Several graphic worlds

### "Real" footage:

Our approach to the animal world is different from that of the "traditional" nature documentary because it is a taxonomic rather than an ecological approach. We look at things in much more specific detail, close too and out of context: we are interested in morphology rather than lifestyle.

With the exception of a few sequences (such as the introduction), we shall not attempt to show beautiful, National Geographic-style images. No lion pouncing in slow motion on a gazelle (or only to show the morphology of the rear limbs). We shall focus on the chimpanzee's jawbone, the tarsier's nostrils, the marmoset's moustache and the jellyfish's radial symmetry.

However, we shall need close-ups and shots against a neutral background: rather than go to shoot in Kenya, we shall therefore film against a white background in the Vincennes zoo.

### The tree:

This is the central image in the film. We wish to obtain an impression of abundance and complexity, something organic that goes beyond the simple abstract diagram... The way of doing this can probably to be found in 3D graphics (even if we choose, for ease of comprehension, to keep the tree on a single plane). The richness of this image is an important challenge and the graphic design work still remains to be done.

One of the challenges facing the film is to "ground" part of the history of ideas and to find a graphic equivalent for certain concepts. Before reaching the tree, we must first build it up, passing through different systems, each of which must be given a topological equivalent: a straight line for Aristotle's classification, a cutting of the plane for Linné's, a tree for Darwin's and, finally, a "bush" for modern classification, instigated by Hennig.

### Other animation:

The rest of the animation has a white background and a minimalist graphic world, inspired by the zoology plates in the Petit Larousse dictionary.

Unlike the tree, it doesn't need to be "spectacular" and requires simple means. We shall use twodimensional animation, ranging in complexity from a simple virtual caption stand to basic animation using the cutout technique (cf. Terry Gilliam's famous animated sequences for the Monty Python team).

A few examples:

- The notion of "character" illustrated by an imaginary "hair sorting machine".
- Homology explained by morphing from the dolphin's fin to the bat's wing
- The edifying story of the duck-billed platypus told in a short animated sequence, etc.

This documentary will have a creative approach, showing a serious and scientific subject in a playful and innovative manner. All animation techniques (cutouts, incrustation, shot-by-shot animation, 2D, 3D, morphing, etc.) will be used but they must allow room for more traditional elements (the intervention of the narrator played in the footage by an actor, the reconstitution of a movement, a face-to-face encounter between two species, etc.)

Denis Van Wearebeke Writer-director

# Synopsis

The Earth is inhabited by a colossal variety of creatures. Life has seeped in everywhere. Estimates put the number of species on Earth at between 5 and 100 million living species!

One of these species, homo sapiens – which the narrator belongs to – has invented *taxinomy*: the art of classifying living forms.

Among these countless possible classifications, there is one that corresponds to a natural order. It is a "genealogical" classification that places species on a tree: the tree of life. There is "kinship" between all the creatures living on Earth. This is why taxinomy concerns us all personally.

### I – From scale to tree, a little scientific history

We focus on the problem of classifying a very reduced sample of living things, made up of only 7 species (Scottish salmon, the orangutan, the canary, the snail, the crocodile, the bat and homo sapiens). We realize it is not so easy.

Wit the help of Hervé Le Guyader, who is a "systematician" and science historian, we go over the steps that led from classification according to Aristotle to classification according to Darwin.

This passage through time reveals several conceptual leaps, from a purely linear diagram (the scale of Beings) to a three-dimensional tree, which becomes our central figure.

### 2 – Users' guide to the classification of species today

Now we know what the result should look like but we do not know how to get there: how do we draw the tree of life? How do we reveal hidden kinship among species?

In using the example of primates' "opposable thumb", we end up with the famous notion of "shared innovative character".

Hervé Lecointre, systematician at the Museum, explains the scope of this concept invented in the 1950s by Willi Hennig, and tells us of some of the surprising consequences of its application: reptiles – as a category – no longer exist, the crocodile and the canary are close cousins.

Our initial problem is finally resolved: our 7 species are now impeccably classified.

### 3 – Man's place

Another consequence of modern classification is that it changes the shape of the tree of life. It does not grow upwards but in all directions! And instead of the majestic oak tree of yesteryear, it now looks like a vulgar bush...

As a result, homo sapiens, who had given himself the place of honor at the top of the tree, finds himself (oh cruel disappointment) at the tip of a very ordinary branch.

Yet the tree has many other revelations in store, particularly this one: we are puzzles, or patchworks of innovations that have occurred over millions of years of evolution and each of our physical characteristics, each detail of our body, results from a particular cross-over of the branches of the tree of life...

We then undertake an exploration of the tree in search of pieces of the puzzle. Starting with man's position on the tree, we move toward the center – which also implies going back in time – and watch the birth of more and more primitive characteristics: standing upright, the thumb, mammary glands, the 4 members, alveolar lungs, the fleshy fin, bilateral symmetry, the nucleus cell, etc.

This voyage through time and body ends in a meeting with LUCA, the mysterious ancestor of all living creatures. With Patrick Forterre, we try to compose its picture.

### Conclusion

This attempt leads us to question our usual conception of evolution and conclude that it is wrong: no, evolution does not start with a simple worm and more toward more complex beings; no, man does not descend from apes, any more than fish descend from bacteria.

If man is not the outcome of evolution, what makes him unique? From a biological perspective, not much. For a naturalist, man is "*a tall primate whose sparse body hair is dense on the head*."

For some, he is a thinking reed, for others a *dancing oyster-plant*. We will have to admit that the question remains open...

**Narrator (V.O.):** The Earth is inhabited by a vast range of creatures. Life can be found everywhere: in the meadows of Normandy, tropical forests and coral reefs. But not only: life has moved into every environment, even the apparently most hostile. The scalding-hot springs in the ocean depths, the sand of the deserts, the icy wastes of Antarctica and our own stomachs also shelter living creatures.

We have only a faint idea of the diversity of life: how many species could you name, off the top of your head? 50? 100? 200? According to the estimates, there are between 5 and 100 million. The sheer scope of this range is already a good indication of our ignorance. 10,000 new species are discovered each year. As I speak, 1,747,851 have been identified!

<u>Narrator in</u>: I myself belong to a living species! You have probably heard of it: its scientific name is *homo sapiens*, family of the hominids, order of the primates, class of the mammals... This species may seem uninteresting at first sight but it has at least one remarkable specificity: it is the only one – as far as we know –

...that has undertaken to identify, order and classify the millions of other living species. *Naturalists* – that's what we call *homo sapiens* who study the natural world – even have a name for this work: taxonomy. The goal of this strange science is to classify all living forms within clearly defined categories. Let's take an example:

**Voice 2:** "Animals are classified as: a) belonging to the Emperor, b) embalmed, c) tame, d) sucking pigs, e) sirens, f) fabulous, g) stray dogs, h) included in the present classification, i) frenzied, j) innumerable, k) drawn with a very fine camelhair brush, l) et cetera, m) having just broken the water pitcher, n) that from a long way off look like flies."

What is wrong with this classification that, according to Jorge Luis Borgès, comes from an "ancient Chinese encyclopaedia"? Its lack of coherence? Probably. Its arbitrary and artificial nature? Probably. But, in fact, are there any categories that aren't arbitrary? What exactly would a "natural" classification look like?

Like this: a tree or rather a bush. A gigantic bush. We all know this figure in one shape or another: it's the tree of

A rapid series of scenes of animal (and vegetal?) life

The incessant and frantic seething of life. We blend kingdoms, sizes, rhythms...

Zoological collection or the Gallery of Evolution at the Natural History Museum in Paris.

As the camera pulls back, we discover the narrator standing among hundreds of stuffed animals

Close-ups of stuffed animals, skeletons, lines of formalin jars, rows of boxes and drawers...

#### ANIMATED CAPTION STAND

Each category is illustrated: a swift succession of images of different kinds (drawings, photos, videos) presented like a slide show

**TREE ANIMATION** 

Computer graphic tree of life. View of the whole

life, a sort of family tree in which species replace individuals.

The end of each branch represents a specific living species that has dwelled on Earth at some time. Here, the langoustine. There, the elephant. Over there, the diplodocus, extinct for 65 million years now. And here, me. Yes! *Homo sapiens* is also an animal species: therefore, it is only logical that I should be included in my own classification!

Drawing this tree means asserting that there is always a link between two living creatures, a link through a common past and ancestor. The racoon and the rhinoceros have a common ancestor. The elephant and the langoustine have another. The same goes for the wels catfish and the common slug. Man and, say, salsify are cousins: they share the same ancestor and common characteristics, something that salsify doesn't know and that men... tend to forget!

<u>Narrator in</u>: Therefore, this classification business concerns the elephant, the slug, the wels catfish and the salsify but also concerns me personally! To understand this, let's start with something simple... Zoom to the position on the tree of each species referred to. "Fractal" effect: new details appear as we zoom in

Appearance of the narrator, in his drawn version, at the end of his branch.

We mark out the path in the tree that links, two by two, the species referred to, travelling up to the closest common fork.

## characteristics

**Narrator (V.O.)**: Let's take a small sample of animal life: for instance, the Scottish salmon, the orang-utan, the canary, the snail, the crocodile, the bat and... me, *homo sapiens*. Then let's try to classify all that in a logical manner!

All right, the canary goes... Next to the bat... Because of the wings! The salmon, let's see, the salmon... What if we put all those who live in water together? I'll put the crocodile and he salmon in the same box...

Then we could try... I know, feet! The salmon doesn't have any. The canary, the bat and I have two each. The others have four. That makes three different boxes! Yes, but then the salmon and the crocodile aren't together anymore... That's a nuisance.

If it's the feathers that matter, we can put the canary in one box and all the others in another. Not very interesting...

Instead, let's try a category based on hair: those with it are me, the orang-utan and the bat. Those without are the salmon, the canary, the croc and the snail. Drat, the canary and the bat are no longer together...

It's not that easy finding a single, coherent system. The trouble is that for each characteristic that matters, you can make a different classification! And the least organism has thousands of observable characteristics:

There's the exterior morphology but also the shape and position of the organs and bones, the data linked to behaviour such as the characteristics of a bird's song, the number of chromosomes and all the molecular data of our bodies, in particular that contained in DNA... That makes a whole load of characteristics!

And if we can't manage to classify seven species, wha will we do with 1,747,851?

The narrator sets out animal figurines, one by one, on top of a table.

He handles the figurines to group them, tries different selections according to the different criteria.

### ANIMATED CAPTION STAND

d	A series of shots like a slide show
0	Silhouette of a camel
g, a at	Skeletons
	Partition
	Chemical formulae
at	Chromosomes
	DNA sequence