books & ideas.net

Will We Soon Be Extinct?

by Matthieu Calame

Paleontologists distinguish five periods of mass disappearance of animal species. Are we now entering the sixth period—that of human extinction? Either way, the question brings us back to the fragility of our life conditions. So just a word to the wise!

Reviewed: Charles Frankel, *Extinctions. Du dinosaure à l'homme*, Paris, Seuil, 2016.

Here it comes again: the sixth extinction! That which a number of biologists have feared and even predicted in light of the impact of human activity—with the alternate possibility whereby, following the scenario immortalized in the Lumière brothers' short film *The Waterer Watered*, man himself may end up on the tumbrel. This is an unusual scenario in the field of evolutionary biology, where one has yet to identify a species that through its specific activity and superior intelligence might bring about, simultaneously, the collapse of biodiversity and its own disappearance.

Diversifications and extinctions

Let us briefly recall the general thread of this earthly if not cosmic drama.

Life "appeared" on Earth about 4 billion years ago in the form of simple unicellular organisms, which were nevertheless quite complicated when compared with the most sophisticated mineral formations. Propelled by a sort of drive for complexity, it gradually developed into ever more elaborate formations and branched out into an increasing number of

species. Attempts to picture this process by starting from the original cells take the form of a "phylogenetic tree," on the model of the genealogical tree. This tree of life is composed of large main branches that sprout into smaller and smaller branches: These correspond, in descending order, to kingdom, phylum, class, order, family, genus, and, finally, species, which differentiates into subspecies to eventually form new species.

If the friendly seal-eating orca were placed on that tree, it could be called *Animalia Chordata Mammalia Cetacea Delphinidae Orcinus Orca Bob* (Bob because it lives in the Miami Dolphinarium), which gives an idea of this diversification process. In practice, biologists have settled for the nickname *Orcinus orca*.

This compulsion to diversify, still largely underestimated when Linnaeus (1707-1778) and Buffon (1707-1788) laid the groundwork for the classification, has produced a prodigious number of species. According to current estimates, this number rises to 10,000 for birds, 6,000 for mammals, a little more than 100,000 for reptiles, 100,000 for arachnids, and 250,000 for marine animals (all classes included). As for fungi, bacteria and archaea, they seem innumerable, in the primary sense of the term. This is, in short, an inventory *à la* Prévert.

But the tree of life, like every tree, has had a hectic history, with its share of dried-out, storm-torn, and lightening-struck branches, and with its new lateral shoots. While there exists a natural rate of extinction, paleontologists have identified five clearly abnormal periods in which species disappearances were substantial, far exceeding species appearances and drastically impoverishing species diversity. These five "mass extinctions" usually bear the name of the period they brought to a close: Ordovician (445 million years ago), Devonian (372 Ma), Permian (252 Ma), Triassic (200 Ma), and Cretaceous (66 Ma).

For various reasons, scientists initially had difficulty accepting the notion of mass extinction. Later, on the contrary, they saw extinctions everywhere, before ultimately converging on the current scenario in which extinctions appear as events that are certainly not unique, but nevertheless quite rare. How might one explain these extinctions? It would seem that their origins are different, yet all boil down to changes in the geochemical environment (heat, pH, composition of the atmosphere) that were too rapid for species.

This point reminds us, in passing, of the potentially fragile and unstable character of our life conditions. So just a word to the wise! What seems surprising, in fact, is not so much that crises have occurred, but that life has overcome them, recreating abundant biodiversity in a "rapid" time frame—of the order of a million years.

The Cretaceous: The Star of Extinctions

The Cretaceous is by far the star of extinctions, because it is the one that put an end to the reign of the dinosaurs. Charles Frankel therefore gives it a special place.

Of course, this is also the nearest extinction. In its aftermath, mammals—which had been confined by dinosaurs to the subordinate roles of town mice and country mice not even worthy of a fable—were able at last to seize their chance and to realize their potential, from the blue whale to the bat, so as to achieve that exceptional evolutionary success known as man.

While this extinction was preceded and succeeded by the worlds we know most about, there is another reason for dwelling on it: The Cretaceous is likely the extinction that followed the most suspenseful and apocalyptic scenario, one that would make a Hollywood screenwriter green with envy. Initially, it was believed that the excellence of placental mammals—our glorious ancestors—was what had brought about their final victory through the mere struggle for life. The old dinosaurs had been surpassed by vigorous mammals.

But one eventually had to face the facts: The dinosaurs had disappeared in full glory and, it seemed, very rapidly. What first alerted researchers was a very thin layer of clay, which geologists systematically encountered at the juncture of the Cretaceous (last part of the Secondary) and the Tertiary. While correlating this layer with the small number of dinosaur fossils proved difficult, the nature of the planktonic skeletons found in the sediments above and below it left no doubt: Between 75 and 80 % of the biodiversity (at least that measured on the plankton) had disappeared in the upper strata. Exceptional volcanic phenomena were posited at first, but it is ultimately the thesis of a gargantuan meteorite—equivalent to the Mont-Blanc—that came to prevail.

It is to Walter and Luis Alvarez that we owe this hypothesis, which subsequent discoveries all confirmed, until researchers managed to identify the impact crater—i.e., the Chicxulub crater in north Yucatan. Based on the gathered evidence (impact width, nature of the rocks, degree of rock melting, height of the layer of clay), the force of the impact was estimated at 100 million megatons of TNT, that is, 10,000 times the nuclear arsenal of humanity and 6 billion times Hiroshima.

In addition to causing immediate and total devastation within a radius of 1,500 km (winds presumably reached 1,000 km/h), the impact raised a storm of shattered rocks whose mass was about 300 times that of the asteroid. According to Frankel:

> These projectiles known as "ejecta" shot out in every direction at speeds of several kilometers per second, because the explosion had blown away any atmosphere that could have slowed them down (p. 67).

To this was added the emission of 500 gigatons of sulfur in just a few seconds, which caused acid rain and the acidification of the ocean's upper layer, and which doomed plankton with calcareous skeletons.

In no time, the entire atmosphere was obscured, and this for several months. The average temperature dropped by 10 degrees. Deprived of heat and light, the plants died out, causing a collapse of the food chain and the disappearance of all animals over 25 kilos. Soon there remained of the masters of the world, which had been struck by Uranian power, only a few skeletons and their memory buried for millions of years. This defeats the hitherto widespread idea whereby "disasters pertain to biblical stories and dinosaurs died a natural death."

The Disappearance of Mammoths and Other Megafauna

Ecce homo, one might say, because 65 million years have passed since then, with their share of glaciations, warmings, and species that came and went, though at a reasonable rate. In the *Homo* category, the gifted member of the family—*Sapiens*—eventually outshined his cousins. He was a rather voracious, clever one, whom protein-rich animals had to learn to guard themselves against. While the megafauna of Africa, where *Sapiens* had spent his youth, had apparently learned to be wary of him, things changed as soon as he left his region of origin.

Homo Sapiens had all the characteristics of an invasive species. He was free from environmental pressures and enjoyed a genuine windfall: a megafauna that did not quite understand the challenge posed to it by the naked ape. While the process remained slow in Eurasia, where he spread 40,000 years ago, it was swift in America, where he arrived barely 12,000 years ago. There, in less than 1,000 years, *Homo Sapiens* eliminated all the megafauna.

We know that the last mammoths lived, albeit in dwarf form, on the isolated Wrangel Island, in the Chukchi sea, 140 km from the Siberian coast. They disappeared shortly after the locals discovered the island. When Polynesians reached New Zealand in the 13th century AD, they had the sad privilege of accomplishing the last destruction of megafauna—in this case that of birds—because the island, which was very isolated, was difficult to access by mammals and hence presented a world dominated by birds. The largest of these, the Moa, consisted of nine different species, two of which exceeded three meters in height and 200 kilos in weight.

Was this an abuse on the part of backward hunters merely capable of blind and reckless predation? Alas! When, starting in the 16th century, Westerners reached the last preserved islets with their technology, the phenomenon was repeated. To be sure, the Mauritius dodo, a large turkey of 20 kilos, did not seem to require a very challenging hunt. The first dodo was described in 1598 by Dutch navigators; the last known specimen was killed in 1688. The same fate befell the Tasmanian tiger, but also the North American passenger pigeon, which still had billions of individuals in 1866. The last of the passenger pigeons died in captivity on September 1, 1914.

A Sixth Extinction?

Impressive as they are in terms of numbers of species, the extinctions of the last 12,000 years—a few hundred—have little to do with a "mass extinction," which amounts to thousands of annihilated species. So, why panic?

In fact, even today, figures are very far from a loss of 75 to 80%. Species loss adds up to 2% for mammals and birds, to less than 1% for reptiles and amphibians, and to far less for others. Nothing to get worked up about. However, naturalists do not merely write obituary notices for species; they also measure their vitality and their trajectories. From this, they derive much more troubling observations, which suggest that recently extinct species may be a mere foretaste of the abyss to come. The number of threatened species—that is of "critically endangered," "endangered," and "vulnerable" species, as per the International Union for the Conservation of Nature (IUCN) nomenclature—is growing significantly. And we are witnessing an irresistible drift, as "vulnerable" species move to the "endangered" category and "endangered" species become "critically endangered."

The process seems to be accelerating. As shown by the case of the passenger pigeon or that of the codfish (though the latter has not disappeared, in spite of its being overfished), populations can always collapse, sometimes irreversibly. The evolution of a population is not continuous, nor even linear; when it declines, it is at the mercy of fatal events, just as a weakened immune system is susceptible to the opportune illnesses that kill it.

From this perspective, ongoing climate change and its many side effects—like the acidification of the oceans—constitute a serious event that recalls some unpleasant precedents in matters of mass extinction. Climate change is perfectly capable of causing a collapse of large ecosystems. While it is premature to proclaim that the sixth extinction has arrived, we will very likely take that path if nothing is done.

Primarily at issue, of course, is the increasingly heavy human footprint on Earth, with a level of harvesting that is either direct—via hunting, fishing, or deforestation—or indirect—via cultures and infrastructures that parcel out space, such as irrigation, pollution, or accelerated trade in invasive species. Indeed, the entire living world does not necessarily suffer from the expansion of man; a small number of species have managed to adapt and proliferate in his shade, or without him knowing it.

What of the fate of man in all this? It is unsure whether the characteristics—aggressiveness, technical skills, symbolic thought—that constituted an astonishing evolutionary asset in terms of domination are also an asset in terms of duration. Nor is it certain that man can avoid the collapse of the biodiversity whose bases he has readily undermined. And he himself is not safe from asteroids. Small ones regularly land on Earth, and very large ones do so about once every 100 million years. That said, the risk is minimal compared to that of a nuclear war, the probability of which is said to be around 2% each year. The Doctors Strangelove of the world are faring well.

What Is To Be Done?

Frankel ends his book, with considerable audacity, by reviewing the available solutions. For menacing asteroids: A few well-placed nuclear warheads can dissuade them from crashing on the Yucatan. For extinct species: A little genetic engineering *à la* Jurassic Park, and the problem is solved! We will have beautiful passenger pigeons and brand new Tasmanian tigers. If the system collapses, we can send a Noah's Ark to the planet Mars (but with 1,500 humans, because since the Flood we've learned a little more about the minimal genetic base necessary to avoid degeneration).

This chapter is perhaps the least convincing, because Frankel himself does not seem very convinced. He is more persuasive when he speaks of restraining consumption, refusing superfluous comfort, and embracing inevitable degrowth with a view to limiting our ecological footprint. And the author concludes as Candide does in Voltaire's eponymous novel: "Let us therefore be more precautious and vigilant, and let us cultivate our garden."

First published in *laviedesidees.net*, 20 March 2017. Translated from the French by Arianne Dorval with the support of the Florence Gould Foundation.

Published in *Books&Ideas*, 29 May 2017