Summary

Genesis, transformation and mutations of landscapes are the subject of this book. A new paradigm is adopted in which the arts, sciences and techniques inter-communicate and interact with each other and with the local actors of a territory. The subject is typically interdisciplinary, involving several sciences, both natural and human, and may even include aesthetic aspects. Its aim is to propose a model that can more rationally harmonize the needs and aspirations of human populations with natural conditions. In addition, an example is given of the process of soil aluminization in humid and sub-humid climates.

The landgenic model is thus proposed and developed. It is a complex evolutionary model, based on a metaphor with evolutionary biology. It's up to the multiple skills and know-how called upon to identify the "genotypic" traits of the territory and establish their modes of expression in "phenotypic" characters.

In the model, landgenic traits and characters are distributed according to four levels of organization: species and instantiation at the two higher composite levels, facet and holon at the two more homogeneous lower levels. The landgenic species is made up of a population of instantiations in the same way as all the individuals of a biological species. Each instantiation is in turn made up of one or more facets divided into seven categories, including those of ancient Rome: Urbs (urbanized land), Hortus (horticultural land), Ager (arable land), Saltus (rangeland for livestock and gathering) and Silva (forest land). They are completed by Desertum (almost no human presence) and Aqua (ocean waters and rivers). Finally, within each facet, several holons can be distinguished, requiring a more sophisticated degree of observation or analysis.

These include, but are not limited to, geographers, urban planners, architects, sociologists, economists, civil engineers and agronomists, as well as local players such as industrialists and craftsmen, shopkeepers, transporters, farmers, livestock breeders, foresters and ordinary residents. From a socio-economic point of view, landgenics engineering enables us to identify the "de facto or potential commons" of each type of local actors.

An illustration of the model is provided by the two landgenic species of the "Moors of Gascogne" natural region: the dune coast and the retro-littoral plateau. The mutation of a true Saltus common into a vast privatized or state-owned Silva and intensive Ager occurred here in the 19th century, and the mutations incurred are explained and illustrated.

Landgenics began in the Pleistocene with the emergence of Homo sapiens. However, it inherited territories shaped by strictly natural processes. Landgenic species have been differentiated since the Holocene, with the sedentarization of agriculture. Landgenic species are differentiated around Urbs, closely associated with Hortus, with a centrifugal distribution towards Ager, then Saltus and finally Silva.

Soil aluminization is a key process in this dynamic. It results from soil acidification induced by root and microbial respiration, as well as by nitrogen nitrification. As soon as the soil pH falls below 5.5, the trivalent cation Al^{3+} gradually replaces the divalent (Ca^{2+} and Mg^{2+}) and monovalent (Na^{+} and K^{+}) basic cations on the adsorbent complex. These cations, displaced in soil solution, are then leached out along with nitrates and bicarbonates. The rate of aluminization of the soil then increases as the pH continues to fall.

From a phytobiological point of view, aluminium interacts with phosphorus. It favors root uptake, with a favorable effect on growth observed in many species in culture solution or in vegetation vases. However, beyond an optimum threshold, which varies widely from species to species, aluminum causes toxic effects by blocking meristematic activity in the root apex. Some species have evolved to resist this stress by exuding aluminum-complexing organic acids from root cells, or by internal complexation with organic compounds. In the latter case, tolerance manifests itself in the ability to accumulate aluminum intracellularly, right down to

the leaf level. The tea plant is an emblematic example.

In the evolution of species, each population tries to find its niche in the face of natural obstacles and environmental stresses. These spatial dynamics generate new ecotypes, which are the precursors of new species. Some evidence from the field confirms this evolution. In ecology, two phenomena are also reported: an increase in woody biodiversity with aluminization, and a retrogression of ecosystems. The latter is characterized by a decline in overall biomass after a period of maximum production.

The overall development of the landgenic facet of Ager (and Hortus) shows an inflection with the industrial revolution, marked by an exponential pace from the 18th and 19th centuries onwards. This is also reflected in the urban development of Urbs, a historical overview of which is provided. This inflection suggests a forthcoming demographic transition and/or landgenic innovations to meet the food challenge.

The agropedological data available are provided by an interdisciplinary team of general agronomists and soil scientists. These data are limited. They do, however, enable us to put forward several coherent hypotheses that are solid enough to enter into a more knowledge-based territorial design. For example, a theory can be sketched out concerning the ancestral practice of shifting cultivation on forest slash-and-burn in a highly aluminized Silva landgenic holon. Annual crop yields decline rapidly from one harvest to the next, due to the subsequent depolymerization of amorphous aluminum, to the point where it is no longer profitable to work in a self-subsistence economy. A long rotation with Silva, at least 15 to 30 years, leads to an accumulation of mineral nutrients in the forest biomass and a decline in the seminal potential of the herbaceous layer. This results in low population densities, with critical thresholds of around 10 inhabitants/km^2 maximum.
Also in Silva, the ambiguous effect of aluminum through interactions with phosphorus in more or less aluminized Eucalyptus holons in Mexico is confirmed.
In Ager and Saltus, the stimulating effects relayed by the toxic effects of aluminum are confirmed by the cassava and sweet potato yield curves obtained from an experiment in Puerto Rico. In addition, experiments in Burundi on unsuccessful attempts to convert highly aluminized Saltus into Ager, at least in a self-subsistence economy. Also discussed are aluminized holons from oil palm plantations in Southeast Asia, and holons from natural pastures in the lower Pyrenees.

Organizing knowledge and know-how into disciplinary silos is a legacy of the Enlightenment. It creates an epistemological deficit for the study and understanding of these complex, evolving landscape systems. It also results in a knowledge deficit.

The proposed landgenic model aims to correct these shortcomings at the territorial level. It proposes outright the institution of interdisciplinary R&D. The latter must take into account the willingness, collaboration and participation of local populations, all too often neglected by top-down development policies. The emergence of local "potential commons" is thus of paramount importance.