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MATH EMAT ICS

FROM THE
■ IDEAL TO
THE UN-
■ CERTAIN

Francois Roche

R&Sie(n) is an architectural practice founded in 1989 by François Roche and Stéphanie Lavaux. R&Sie(n) unfold their protocols through the re-staging of different kinds of contemporary relationships: aesthetic, machinist, computational, organics, biological and even artificial. They consider architectural identity as emanating from principles of uncertainty defined through provisional processes and forms in which animism, vitalism and mechanism become vectors of dynamic mutations. François Roche is currently a research professor at Columbia University (since 2005). In 2010, François Roche was a visiting critic at Cornell University and co-taught a studio entitled Mutations, with Caroline O'Donnell.

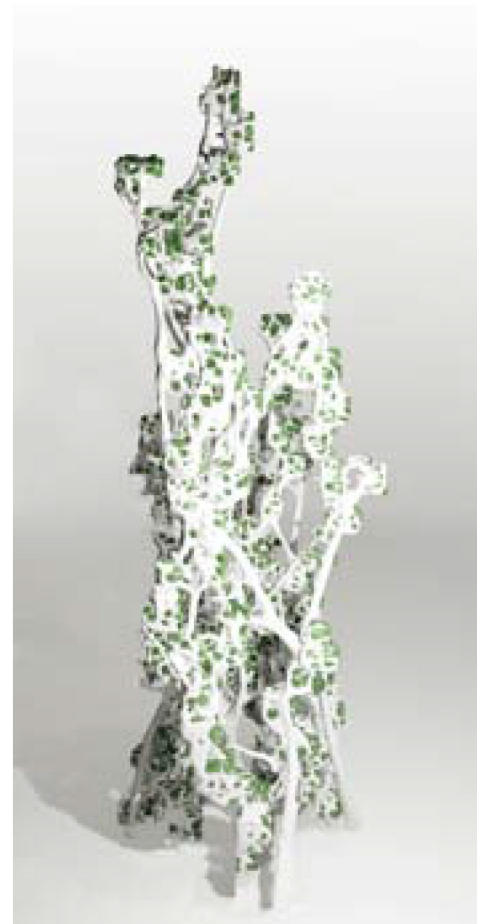
Experimentation on Human Park¹

Looking beyond a strictly scientific and architectural horizon, and reading beyond the usual philosophical benchmarks, it is tempting, and indeed enlightening, to envisage a *modus operandi* from a metaphorical and strategic angle when exploring the ‘chemistry of bodies,’ often envisaged as an element liable to disturb and alter linear, authoritarian logics, to reach what we might call swarm intelligence aggregations. Similarly tempted, we look at the relationship of the body to space, and even more so, of bodies in their social relation: not just their interrelation, within a given cell, but also their intra-relation as part of an osmosis with others. This results in an architecture that plays with conformism and conventions: all bywords of the ‘undisciplined’ conception of production, in its articulation of the collective and the political.

The research *An Architecture des ‘Humeurs’* constitutes the second leg (after *I’ve Heard About*, in 2005) of an architectural voyage (in the spirit of Thomas More’s *Utopia*) federating the skills of scientists from a host of disciplines (mathematics, physics, neurobiology, computations, scripts, nanotechnologies, robotic, etc.). This exploration is an attempt to articulate the real and/or fictional link between geographical situations and the narrative structures capable of transforming them. Specifically, the focus here is on using nanotechnology to collect physiological data of from all

participants to prepare and model, by means of these ‘moods’—a (post)modern translation of Hippocrates’ humors—the foundations of an architecture in permanent mutation, modeled (and modulated) by our unconscious. It is an investigation into an architecture of uncertainty and non-determination.

While this is not a sequel to the *I’ve Heard About* show held by the MAM (Paris Municipal Modern Art Museum) in 2005, that first research did explore the relationship between physiology, computation, and indeterminism, in the sense of its genesis.



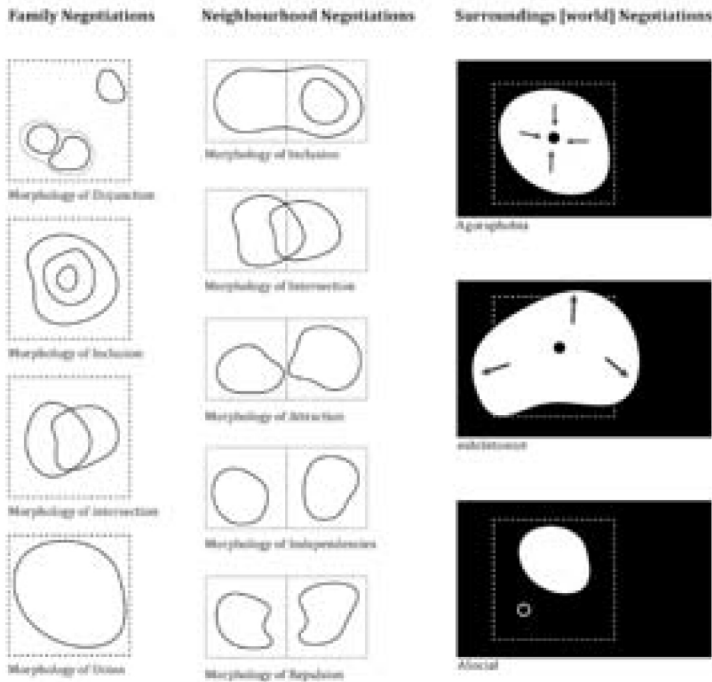
I’ve Heard About sought to understand and write (in the sense of writing code) biological geometries that mimic natural ones. The predominant figure was that of coral and its growth. This second piece goes beyond that representation, since we have already studied the factors that condition the emergence of such a geometry. These factors are the principles of exchange—dynamic principles based on a system’s immanent forces, to capture the chemistry of the body as an element that can disturb and alter linear logics. Thus, the logics of authorities replace a top-down approach with a bottom-up one.

The *Architecture of Humors*—a double-entendre, meaning both mood and fluid—is an interrogation of the confused region of the psyche that lies between pleasure/desire and need/want, by detecting physiological signals based on neurobiological secretions and thus realize a ‘chemistry of humors,’ treating future property buyers as inputs, who generate a range of diverse, inhabitable morphologies and the relationships between them. The groundwork comes from a rereading of the “*Malentendus*” inherent in the expression of human desire. Those that traverse public space through the ability to express a choice by means of language, on the surface of things, and those that are underlying and perhaps more disturbing, but just as valid. By means of the latter, we can

taking into consideration that the latter is not reducible to the sum of its parts (or even to the ensemble of relationships between the parts). It allows for the definition of all the properties of a given situation in relational modes, both the relationships between the elements themselves (residential areas) and those between these elements and the ensemble or ensembles they fit into.

$$\begin{cases} \frac{\partial \psi}{\partial t} + V|\nabla \psi| = 0 \\ \frac{\partial J}{\partial \omega}(\omega) \cdot \theta = - \int_{\partial \omega} (Ac(u) \cdot e(u)) \theta \cdot n \, ds \longrightarrow V(x) = Ac(u) \cdot e(u)(x) \quad \forall \end{cases}$$

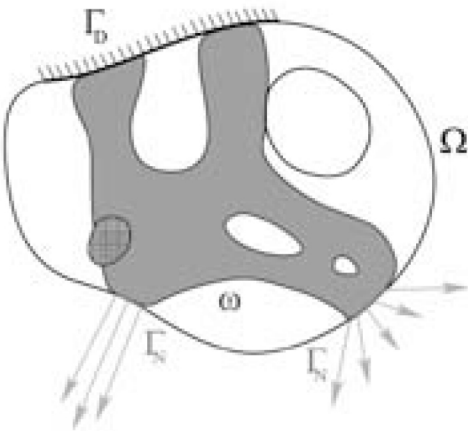
The operators of belonging, union, inclusion, intersection, and disjunction describe morphologies characterized by their dimensions and position and above all, by the negotiations of distance they carry out with the other parts. This produces relational protocols: protocols of attraction, repulsion, contiguity, dependence, sharing, indifference, exclusion, etc. Thus, before the morphology of a habitat is reduced to a functional typology, it is first structured as an area of exchange.



Mathematical formulae aid the development of these combinations and thus become the matrix for the relational structure on which an inhabitable space is based.

In contrast to the standardized-model formatting of habitats, this tool offers the potential to negotiate with the ambiguities of one’s own humors and desires. It enables the mixing of contradictory compulsions (appearances) and even some ‘malentendus’, which could be translated both as misunderstandings and mishearings: “I’d like that but at the same time / maybe / not / and the opposite.” These malentendus are directly influenced by the pathologies generated by collective living oscillating between -phobia and -philia.

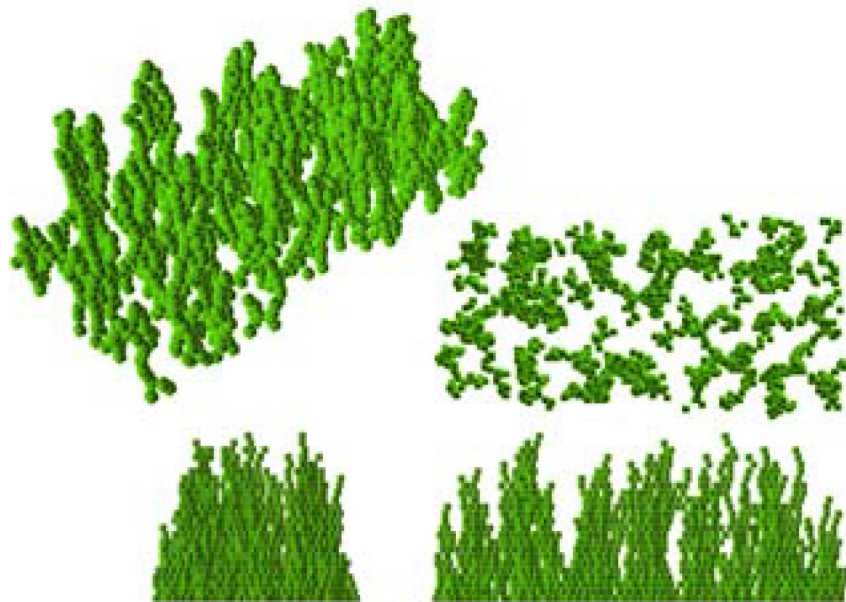
The secondary goal of the research, in terms of mathematical development, is about structural optimization: about defining the structural sustainability of the system as a postproduction.



Not so far away from the mimesis (not mimicry) of nature which is made up of indetermination protocols, algorithms can simulate the growth of a tree in terms of understanding the vitalism of its geometry. Its intrinsic life forces articulate its geometry-photosynthesis-equilibrium-entropy, calculating through iterations. Simultaneously, its incremental generational branches grow and its tendency for recursive re-adaptation (volume and orientation of the trunk) strives for permanent global re-equilibrium, though the generative branching and forking entropy, re-adaptation, and the re-calculation of the previous morphologies to be loaded by the evolution.

The possibility of structure as a postproduction element, emerging a posteriori to become inhabitable morphologies, calls into question the traditional client-relationship and offers an alternative way of generating form. Emancipated from the conceptual logic where the structure is the starting point, the spatial contract takes the place of the social contract. Since it is conceived a posteriori, the structure is reactive, adaptive to multiplicity, as the permanent discovery of new agencies, of entities, and of singularities.

François Jouve developed in the format of this research a mathematical process for “empirically” seeking optimization, by creating forms out of constraints and not vice-versa. The structural optimization algorithm differs from directly calculated structural methods such as calculating the load-bearing structure of a building after it has been designed. In contrast, the algorithm allows the architectural form to emerge from the trajectories of the transmission of forces simultaneously with the calculation that generates them. The algorithm is based on (amongst other things) two mathematical strategies, one taken from the derivative initiated by the research of Jacques Hadamard (to modify a shape by successive infinitesimal step, to improve the criteria we want to optimize, as a permanent variation of frontier) and the other from the protocol of the representation of complex shapes by Cartesian meshing through level set (to understand locally what could be the line of the highest or lowest resulting point, if we project the local incremental iterative calculus onto a 2D diagram, to extract the X,Y



position in the space as data to reinject in the next step of the calculation.)

This secondary goal of these mathematical processes is achieved by an incremental and recursive optimization (ex-local, local and hyper-local) that simultaneously calculates and design's support structures for the physio-morphologies. Following the non-deterministic aggregation of the unpredictable overstacking of desires, the structural branching and coagulating are generated by successive iterations of calculations that physically link the interstices between morphologies so that they can support each other locally and globally. The calculations satisfy precise inputs, including the constraints and characteristics of the materials used, initial conditions, dead load, and transfer of forces, intensity, and vectorization of these forces, etc.

The mathematical process of empirical optimization makes it possible for the architectural design to react and adapt to previously established constraints, instead of the opposite.

Through the use of these computational, mathematical, and mechanization procedures, the urban structure engenders successive, improbable, and uncertain aggregations that constantly rearticulate the relationship between the individual and the collective, between top-down and bottom-up, to and that reactivate the potential of for self-organization, of and for the creativity of the Multitude, in the pursuit of the Metabolism developed by Constant and Debord.

Through the technologies and procedures from now that exist at present, we can “unachieve” what we could tittle call computed-slums: we can re-question and refresh the democratic delegation of power and its collateral effect: the obligation of resistance against to the way of how in which architects are abused or self-abused to pretend to have any expertise on master city planning.