INSTITUTIONS AND INSTITUTIONAL DESIGN

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Part IX: Evolution of institutions

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Landa, Manuel de 1997 “A Thousand Years of Non-linear History”, Swerve, New York,

Also

Gintis, Herbert 2000 “Game Theory Evolving”, Princeton, Princeton University Press

Non-Linear History?
Manuel de Landa 1997

Looking for generative macro-models

- In the dynamic of urban societies
  - Hierarchies and meshworks
- In the dynamic of the biosphere
  - Evolution, the probe head, the selector
- In the dynamic of languages
  - Constructing social institutions

Basic references: Gilels Deleuze and Félix Guattari “A Thousand Plateaus”, Minneapolis, University of Minnesota Press, 1987, others are works of Ferdinand Braudel, William McNeil, and Michael Foucault

The book is by its own declaration a book of philosophy, albeit a deeply historical philosophy. The basic assumptions are that both “brutal” reality and socially constructed reality around us is a coherent system far from equilibrium driven by a non-linear dynamics. The book explores the possibilities offered by new insight into the dynamics of non-linear non-equilibrium systems to understand reality by investigating the evolution of the urban system of the west, the biological foundations of the agriculture of the west, and the dynamic history of the languages of Europe.

De Landa (1997:18) “I attempt a philosophical approach to history which is as bottom-up as possible.” … “Methodologically, this implies a rejection of the philosophical foundations of orthodox economics as well as orthodox sociology.” (on p19) “Fortunately, the last few decades have witnessed the birth and growth of a synthesis of economic and sociological ideas (under the banner of “neo-institutional economics”), as exemplified by the works of such authors as Douglas North, Victor Vanberg, and Oliver Williamson.” (nb.: the name of North is spelled Douglass)

Model I: Hierarchy

- Examples of it’s simplest structure
  - Geology: rivers as sorting machines and sedimentation as consolidation (sedimentary rock)
  - Biology: genetic accumulation as sorting machine and reproductive isolation as consolidation (species)
  - Society: role differentiation as sorting machine and power institutionalisation as consolidation (classes)
- Basic processes: Sorting and Consolidation makes up the generative model diagram of hierarchy

De Landa (1997:57-58) “The concepts of “meshwork” and “Hierarchy” have figured so prominently in our discussion up to this point that it is necessary to pause for a moment and reflect on some of the questions they raise. Specifically, I have applied these terms in such a wide variety of contexts that we may very well ask ourselves whether some (or most) of these applications have been purely metaphorical. There is, no doubt, some element of metaphor in my use of the terms, but there are, I believe, common physical processes behind the formation of meshworks and hierarchies which make each different usage of the term quite literal. These common processes cannot be fully captured through linguistic representations alone; we need to employ something along the lines of engineering diagrams to specify them.”

Basic process I
(A machine diagram)

Hierarchy: a structure-generating process

1. Sorting of dissimilar elements into homogeneous groups
2. Cementing or consolidating the homogenous elements into a coherent entity with emergent properties

- The same basic process can be seen in the generation of rock, species, social classes, and languages

De Landa (1997:60) "Thus, a double operation, a "double articulation" transforms structures on one scale into structures on another scale. In the model proposed by Deleuze and Guattari, these two operations constitute an engineering diagram and so we can expect to find isomorphic processes (that is, this same "abstract machine of stratification") not only in the world of geology but in organic and human worlds as well."

Process element: Feedback - negative or positive

- Negative: deviation counteracting
- Positive: deviation amplifying

Affecting

- Heterogeneity
  - Localisation – different but homogeneous localities
  - Interweaving – similar but heterogeneous localities

Landa (1997:68) Maruyana writes, “There are two ways that heterogeneity may proceed: through localization and through interweaving. In localization the heterogeneity between localities increases, while each locality remain or may become homogeneous. In interweaving, heterogeneity in each locality increases, while the differences between localities decreases.”

Process element: Phase transitions - Bifurcations

- Slow accumulation of some substance may at some threshold trigger a radical reorganization of processes, changing the direction and/ or character of the processes radically rather than incrementally

Hierarchies vs. meshworks

- Urban development
  - Self-grown by decentralized decision making
  - Planned by centralized decision making
- Bureaucracy (hierarchy) vs. market (meshwork)
  - Markets imply bureaucracies (property rights)
  - Bureaucracies imply a political market where a stable sets of contracts are negotiated
- Explanations by means of "abstract machines"

The word **meshwork** is taken from Stuart Kauffman (1990) "Lectures in Complex Systems" eds. Lynn Nadel and Daniel Stein, Redwood City, CA, Addison-Wesley, 1991

Landa(1997:69) "If this book displays a clear bias against large, centralized hierarchies, it is only because the last three hundred years have witnessed an excessive accumulation of stratified systems at the expense of meshworks. The degree of homogeneity in the world has greatly increased, while heterogeneity has come to be seen as almost pathological, or at least as a problem that must be eliminated. Under the circumstances, a call for a more decentralized way of organising human societies seems to recommend itself.

However, it is crucial to avoid the facile conclusion that meshworks are intrinsically better than than hierarchies (in some transcendental sense)."

Basic process II
(a machine diagram)

Meshworks: self-consistent aggregates

- Articulation of super-positions of heterogeneous elements (dissimilar elements “mesh”)
- Intercalary elements as operators for the articulation (catalysts, intensifiers, densifiers, reinforcers, injectors, showerings, anything that brings about local articulation from within) aiding or creating autocatalysis of the elements
- The interlocked elements must endogenously generate stable behavioral patterns, exhibiting self-consistency

Super-positions : diverse but overlapping elements, in some sense complementary nodes

The joining of nodes is achieved by means of some intercalary operator, catalysts

An articulation of superpositions through nodes joined by their functional complementarities will through the operation of an intercalary operator (or catalyst) create some kind of mutual stimulation, autocatalysis.

Examples of articulation of self-consistent diversity

- In geology: granite (intercalary operator: local articulation from within - cooling triggers sequential crystallization of substances locked within already crystallized matter)
- In biology: eco-systems (intercalary operator: functional complementarities)
- In society: small-town markets (intercalary operator: prices)

Meshworks: Self sustained dynamics

- Self sustaining dynamics
  - Catalyst's lock-in property makes it "mesh" with its key target changing the target's properties to become receptive to a third substance. The product of this reaction may serve as catalyst in another process producing the catalyst for the first. Thus together they produce a simple auto-catalytic loop
- Complex auto-catalytic loops
  - Links a series of mutually stimulating pairs into a structure that reproduces as a whole

Catalyst C1 mesh with substance A making the reaction AB produce catalyst C2

Catalyst C2 mesh with substance C making the reaction CD produce catalyst C1

*The workshop A is located in an area abundant with substance B. Only when skill C1 enters A is A able to process B to produce C2 (a food surplus) needed in the workshop D (a training school) to be able to (continue to) produce people with skill C1

Evolution of meshworks or complex autocatalytic loops

- Dynamic self-sustained systems are
  - Endogenously generating stable states (attractors, eigenstates)
  - Grow and evolve by drift. The chain may be extended as long as new nodes added to the mesh do not jeopardise the internal consistency. The loop becomes more complex but is still reproducing itself.

De Landa(1997:63) "A new node (which just happens to satisfy some internal consistency requirement) is added and the loop complexifies, yet precisely because the only constraint were internal, the complexification does not take place *in order* for the loop as a whole to meet some external demand (such as adapting to a specific situation). The surrounding environment, as source of raw materials, certainly constrains the growth of the meshwork, but more in a proscriptive way (what not to do) than in a prescriptive one (what to do)."

Examples

	Hierarchy - consolidation	**Meshwork - catalysis**
geology	Sandstone - sedimentation	Granite - crystallization
biology	Gene pool - isolation	Ecosystem - symbiosis
society	Social Classes - power distribution	Markets - money, norms

Intercalary elements:

***Granite** – reaction between already crystallized elements and current liquid elements ***Eco-system** – symbiotic relations in the form of food webs (predator-prey or parasite-host) ***Markets** – prices mechanism and money + transaction costs low enough to encourage trade

DeLanda (1997:66) "Thus, much as sedimentary rock, biological species, and social hierarchies are all stratified systems (that is, they are each the historical product of a process of double articulation), so igneous rock, ecosystems, and markets are self-consistent aggregates, the result of the coming together and interlocking of heterogeneous elements. And just as the diagram defining the "stratifying abstract machine" may turn out to require more complexity than our basic diagram of a double articulation, so we may one day discover (empirically or through theorizing and computer simulations) that the diagram for the meshwork-producing process involves more than the three elements outlined above. Moreover, in reality we will always find mixtures of hierarchies and meshworks, of strata and self-consistent aggregates."

Real-world processes consist of a combination of hierarchies and meshworks, a meshwork of hierarchies and a hierarchy of meshworks. The (relative) growth of hierarchies may be referred to as a re-stratification process and the (relative) growth of meshworks as a de-stratification process.

Evolution - the machine diagram

- Hierarchies and meshwork are found also in species and ecosystems
- The evolutionary dynamic (or the "probe head") of biological systems is a new machine
  - The variable replicator
  - The selector
- The same machine is also found in memes and genetic algorithms

Cases:

Evolution of species: genes replicating across generations may trough selection and isolation create new species

Computer programs: genetic algorithms used to optimize computationally difficult problems (Holland)

Birdsongs: memes replicating across a population of birds evolve and create dialects (Dawkin)

De Landa (1997:139) "In each of these cases, the coupling of variable replicators with a selection pressure results in a kind of "searching device" (or "probe head") that explores a space of possible forms (the space of possible organic shapes, or birdsongs, or solutions to computer problems)."

Here the concept of the adjacently possible is obviously relevant: the probe head explores all available niches in the adjacent space of possible forms. (See Kauffman 2000:142-144)

Kauffman, Stuart 2000 Investigations, Oxford, Oxford University Press

Cultures and genes interact

- As sorting devices
- As constraints
- Cultural values becoming institutionalised may form a self-selecting dynamic enhancing or counteracting genetic adaptations
- Autonomy of culture may render some elements maladaptive relative to biological constraints

Culture evolves much more rapidly than genes, but each may affect the retention of the other.

Example of genetic impact on culture: the evolution of terminology for colors.

Possible example of cultural impact on the retention of genes: the prevalence of genes for lactose absorption (LA-genes) making the digestion of raw milk possible is related to environmental factors such as low ultraviolet radiation where vitamin D and metabolic calcium are chronically deficient. This is where consumption of fresh milk may give positive health effects. A cultural practice encouraging drinking of raw milk will give the LA genes higher prevalence and thus enforcing the health impact.

Types of cultural replicators

- Imitation (analogous to memes)
- Enforced repetition (adoption as norms or repetition as rules)
- Vertical flow
  - Parent to offspring
- Horizontal flow
  - One-to-one (person to person)
  - One-to-many (leader to follower)

De Landa (1997:147) "Cultural replicators may be viewed as having phenotypic effects similar to catalysis. A command given by someone of high rank in a hierarchy, for example, can set off disproportionately large flows of energy, as in the case of declaration of war."

However, to describe social dynamics we need, besides replicators and their catalytic effects, "material and energetic processes that define the possible stable states available to a given social dynamic."(de Landa 1997:147)

Languages

- Replicators: sounds (vowels, consonants), semantic labels, syntactic patterns
- They are transmitted to offspring and new members as norms or social obligations
- Group pressures sort the replicators
- Other social processes “cement” them into more or less stable structures

Obstacles to linguistic diffusion (replication):

1. Distance and geographic inaccessibility
2. Emotional attachment to some local variant
3. Mechanical barriers of pronunciation (different articulatory systems)
4. Conceptual barriers (meanings of words may not translate)

(counterparts in biology: ecological, behavioural, mechanical, and genetic barriers to replication)

Language: the machine diagram

- Statistical regularities of language use is transformed through standardisation into required constraints on combinations of words
- Requires norm enforcement, that is it requires a self-conscious group, with power over its members
- Douglas on group-grid dynamics generating different world views

From weak to strong on group loyalty variable and from weak to strong on grid (hierarchy relations to other groups, outside regulation of group) variable give a fourfold table, and we can identify 4 attractors for belief and values defining four distinct worldviews.

Designing self-governing institutions: models of genesis

- Genesis of form from immanent causes
  - Such as phase transitions/ bifurcations
- Self-organising processes.
  - Such as attractors
- From here to there: the adjacently possible
- Norms, languages, rules and bureaucracies

de Landa(1997:270) is basically a champion of a kind of methodological individualism: "But whether these of other diagrams are used to model the structure generating processes involved in the genesis of social forms, what matters is explaining this genesis in an entirely bottom-up way. That is, not simply to assume that society forms as a system, but to account for this systematicity as an emergent property of some dynamical process."

Equilibrium state x^* of $x' = f(x)$ is an **attractor** of x if by starting x in some set omega zero containing x^* it obtains that x(t) asymptotically goes to x^* as t goes to infinity.

Attractors will change as parameters defining a system change, and sometimes abruptly in system bifurcations.

Evolutionary dynamics
Herbert Gintis (2000:188-219) Ch 9

Some preliminaries from biology

- Strategies are held by species, not individuals
- By analogy cultures have strategies not individuals
- Instead of a Nash equilibrium, Meynard Smith uses the concept of an evolutionary stable strategy. A strategy is evolutionary stable if a population which is using it, cannot be invaded by a small group with a mutant genotype.
- A body of law may be seen as evolutionary stable, if no group of players have to power to change the body of law for their own benefit.

Ch 7 p 148 Evolutionary Stable Systems

John Meynard Smith and GR Price write about game theory applied to behaviour of animals (see John Maynard Smith 1982)

On strategy:

It is not players that have strategy, but species (genotypic variants). Individual specimens inherit variants of this strategy (possibly mutated), which they use in interactions.

This may be extended to apply to culture in society. Individual persons inherit (or choose) a variant of the societal strategy.

This may again be specified as prescriptions given in law. A body of law may be considered to prescribe a strategy for action in a particular setting.

On equilibrium:

Instead of a Nash equilibrium, Meynard Smith uses the concept of an evolutionary stable strategy. A strategy is evolutionary stable if a population which is using it, cannot be invaded by a small group with a mutant genotype. Similarly a cultural form used by every member of the culture, may be seen as evolutionary stable if a small group using a different culture cannot invade and replace it.

Thus a body of law may be seen as evolutionary stable, if no group of players have the power to change the body of law for their own benefit.

On history and evolution

- Meynard Smith introduces repeated random pairings of agents with particular strategies inherited from their genome. The history of the play does not matter in these biology games.
- <u>But in culture history will matter.</u>

It has been shown that mixed strategy Nash equilibriums in asymmetric evolutionary games with a replicator dynamic are never evolutionary stable (§9.15). This reflects a "deep and important regularity of social interaction". "In asymmetric evolutionary games, the frequency of different types of behaviour goes through periodic cycles through time." (p. 162)

The replicator dynamic

- A replicator is an entity capable of making approximate copies of itself. A replicator can be a gene, an organism, a strategy in a game, a belief, a technique, a convention, or a more general institutional form.
- A replicator system is a set of replicators in a particular environmental setting with a structured pattern of interaction among agents.

In the two-player evolutionary game modelled by Gintis, the two players are assumed to be picked at random from the population and to play their hard-wired strategies determining their rate of reproduction. Gintis views the replicator dynamic as representative for evolutionary dynamics in general. De Landa expands on this.

The replicator dynamic depends on learning, but it is imperfect depending on the size of the difference in payoffs.

The replicator dynamic is derived as the partial derivative of the fraction p_i of players using strategy i with respect to time period (rate of change in time) **as a functions of the payoffs to strategy i.**

Here the partial derivative of p_i with regard to t (time period) = (constant) p_i (π_i - π*) -- (all also indexed by t)

Where (constant) determines the rate of adjustment to stationarity, p_i is the fraction of players playing strategy i in time period t and π_i is the payoff to strategy i and π* is the average return across the population.

Dynamics of two-player games can represent asymmetric evolutionary games in general. But the restriction of random pairings – panmictic pairings – is not realistic for human players. Various forms of assortative interactions based on local interaction such as kinship and frequency dependent interaction are more realistic.

Evolutionary dynamic

- An evolutionary dynamic of a replicator system is a process of change over time in the frequency distribution of replicators (and in the nature of the environment and the structure of interaction), in which strategies with higher payoff reproduce faster in some appropriate sense.

For example: one may think of the legislative process as a replicator system with an evolutionary dynamic. The process makes approximate copies of existing acts. The mutations introduced however are not random. They are designed and introduced in a negotiation process.

In an evolutionary stable situation, the replication will be perfect, except for elements designed to adapt to changing environments. Random mutations may be introduced through environmental disasters, social revolutions etc.

In the static asymmetric game row players stand against column players but in the dynamic asymmetric game it is row players (predators) competing against themselves for the privilege of having their offspring occupy a niche in the next round. They do so by becoming better at catching prey, And similarly the prey compete among themselves for the privilege of having their progeny occupy the prey niche. They do so by becoming better at evading the predators.

“So, in all but trivial cases, evolutionary stability does not obtain in asymmetric evolutionary games.”

Evolution of human societies

- When payoffs represent individual reproductive fitness, the replicator equation is a natural first cut at modelling evolutionary dynamics.
- But when payoffs are less directly related to reproductive fitness, as is usually the case in human cultural evolution, the replicator dynamic is rarely a plausible model of behavioural change.
- According to de Landa the model can be generalized (it applies to culture sui generis)

The behavioural repertoire of Homo sapiens (sociality, language, brain size, emotional predispositions) has doubtless evolved in this manner.

Analysing cultural change in the biological short run (say the last 5000 years) the replicator dynamic is not a plausible model. Use of it can be motivated by individuals changing behaviour by imitating others. However, the main way individuals acquire behavioural traits is by transmission from others, including parents (vertical transmission), peers (horizontal transmission), and influential individuals and institutions (oblique transmission).

The pioneering contributions in modelling cultural evolution came before evolutionary game theory grew up (starting with Meynard-Smith 1982), so there is a lot of work to be dome reintegrating this with evolutionary game theory.

Frequency dependent adoption of new behaviour has been modelled, none of the developed models predicts the general adoption of more fit behaviours.

If the dominant cultural transmission mechanisms and our epigenetic predispositions to be influenced by them, can be modelled evolutionary, the task remains to be done.

Human behaviour

- In many decision making and strategic settings people do not behave like the self-interested "rational" actor depicted in neo-classical economics and classical game theory
- But human behaviour can be modelled using game theory and optimisation subject to constraints
- There are plausible models of human cultural and genetic evolution that explain how we have gotten to be the way we are.
- Our models, however, can be improved considerably

Chapter 11: "Homo Reciprocans, Homo Egualis, and Other Contributors to the Human Behavioural Repertoire".

Here Gintis possibly contributes something very valuable: how to model other kinds of rationality than old-fashioned "Economic man".

Gintis goes on to discuss modelling of various public goods games and common pool resources games. He finally introduces alternatives to "Economic man" called "Homo Egualis", "Homo Reciprocans", and "Homo Parochius". In between he discuss the evolution of altruism and strong reciprocity

Different rationality models

- Homo Economicus
- Homo Egualis
  - Inequality aversion
- Homo Reciprocans
  - Strong reciprocity: propensity to cooperate and share with others similarly disposed even at personal cost, and a willingness to punish those who violate cooperative and other social norms
- Homo Parochius
  - Discrimination between insiders vs. outsiders at a personal cost

<u>Baseline model:</u>

Homo economicus: self-interested, self-serving, and maximises utility subject to constraints

<u>Efforts at modelling some experimental results:</u>

Homo egualis: if individuals have inequality aversion, we can explain some experimental results, including why altruism appears in ultimatum and public goods games but not in market-like interactions.

Homo reciprocans: in modelling strong reciprocity we model some of the experimental results that depend on the tendency of people to cooperate and punish as forms of pro-social behaviour.

> **Strong reciprocity**: propensity to cooperate and share with others similarly disposed even at personal cost, and a willingness to punish those who violate cooperative and other social norms, even when punishing is personally costly, and even when there are no plausible future rewards or benefits from so behaving.

Homo parochius: even though condemned by most ethical systems the reality of this type of person seems abundantly documented. Homo parochius favours his own group even at a net material cost to himself.