Signs of reality - reality of signs. Explorations of a pending revolution in political economy.

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Explorations of a pending revolution in political economy

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Abstract

This paper explores the interaction between the world of information processes in human society and the non-information dynamics, which the latter set out to understand. This broad topic is approached with a focus on evolutionary political economy: It turns out that progress in this scientific discipline seems to depend crucially on a methodological revolution reframing this above mentioned interplay. The paper consists of three parts. After a brief introduction, which sketches the position of the argument in the current epistemological discourse, part 1 sets out to describe the basic methodological ingredients used by evolutionary political economy to describe the 'reality' of socioeconomic dynamics. Part 2 jumps to the world of languages used and proposes a rather radical break with the received apparatus of analytical mathematics used so successfully in sciences studying non-living phenomena. The development of procedural simulation languages should substitute inadequate mathematical formalizations, some examples are provided. Part 3 then returns to 'reality' dynamics, but now incorporates the interaction with the information sphere in a small algorithmic model. This model – like the introduction - again makes visible the relationships to earlier research in the field. Instead of a conclusion – several, hopefully innovative ideas are provided in passing, throughout the paper - an epilogue is provided, which tries to indicate the implications of this methodological paper for political practice in face of the current global crisis.

Keywords: Scientific methods, evolutionary political economy, formal languages, ideology

Introduction

The global financial crisis is teaching mankind a lesson. Unfortunately the odds are that mankind will only learn it the hard way[1]. The core of this lesson builds on a property, which is common to all forms of money used in human societies: The essence of money forms is that they are systems of signs. The argument put forward in this paper starts with the proposal that at least since the agricultural revolution around 10000 BC a human society is

[1] Even the lessons learned by the scientific community of professional economists cannot be expected to be profound, compare [Colander, 2010].

an entity which enforces and uses money forms to achieve biological success. Narrowly defined biological success is measured by the growth of the number of individuals organized in a society. Any sign needs a physical carrier as well as agents being able to use the sign. As societies grew, their sign systems became ever more complicated; perception and interpretation of sign systems interwoven with many levels of institutional structures developed a dynamics of their own. Parallel to the material environment – though still linked to it – an information environment evolved. The archetypes of the divergence between the two spheres are major ingredients of the types of the large wars observed in history, from religious wars to the financial crisis. Seen from the opposite perspective modern science is the epochal attempt to construct more ***adequate*** sign systems. To understand what an adequate sign system of social interaction should provide it is necessary to treat it like a material tool: The task is permanent improvement of the pre-existing toolset. But contrary to the natural sciences, where this first condition is sufficient for progress[2], the social sciences are operating on the same time scale as their object of investigation – they shoot at moving targets, whose motion they co-determine! An immediate conclusion to be drawn is that their sign systems will have to differ from the more primitive ones of the natural sciences[3]. Contrary to the natural sciences, in the social sciences scientific progress will ***not*** so much be a process of ***discovery*** - of an isomorphism between a statement in the information sphere and a process outside the information sphere - but ***rather*** will be a ***mixture*** between ***interpreting perceptions*** and ***explorative design***.

Compared to the monumental scientific task just sketched the aspirations of this paper are rather modest. It just tries to make explicit some basic properties, which a formalization of social science must consider. In particular it turns out that the analytical apparatus, which has been developed along physics during the last centuries bears itself properties closely and exclusively connected to its object of investigation[4]. The immobility of natural laws which seemed to be discovered[5] produced a mirror image of the desirability of an analytical apparatus, a scientific sign system, as far as possible separated from perceived phenomena. Such a universally applicable sign system - bare of any relation to a specific perception – was projected to be as fundamentally valid as the natural laws of nature, which it helped to discover. 'Pure' mathematics was quickly identified as this profoundest of all sciences. From

[2] This is the reason why natural laws appear as discoveries. They are valid on scales in space and time, which are substantially larger than the respective evolution of scientific sign systems exploring them. Improvements in the shapes of the boats with which we travel on the ocean of natural phenomena seem to be a search for an optimal shape adequate to some eternal properties of this ocean. Any further approximation thus appears as discovery, and interdependences between ocean and small boats usually can safely be ignored.

[3] This probably was the feeling which induced the great mathematician John von Neumann, the developer of the language the natural sciences, to propose a new formal language for the social sciences: game theory [Neumann & Morgenstern, 1943]. Some decades earlier Ludwig Boltzmann had reported that in the face of such a task he capitulated and turned to the development of theoretical physics. How successful his efforts in this easier area were only became visible after he – frustrated - had committed suicide.

[4] A similar point has been made by Mäki in his proposal to enlarge the notion of 'standard scientific realism' to encompass economic theories too, see [Mäki, 2011].

[5] Starting with quantum-revolution (compare [Feinman, 1985])and continuing with Kurt Gödel's result on undecideablity [Gödel, 1931] the methodological fundaments of the first three hundred years of this approach now have several cracks.

Hegel's order of scientific stages (with mathematics on top[6]) via young Wittgenstein's propagation of a logical 'a-priori' (see [Wittgenstein, 1922]) to the praise of pure mathematics by G.H. Hardy [Hardy, 1940] this long-lasting reflex of formally oriented scientists on their object of investigation has penetrated methodological debates. In his programmatic insistence on the ***method*** of a specific inquiry as the watershed delimiting science from everyday knowledge René Descartes (see [Descartes, 1637]) already had insinuated that it is form rather than content which characterizes advances in science. In this view science resembles a discovery process with researchers rediscovering with experiments what the mathematical sign system predicts. With every success of this procedure the simple fact that a specific method used to investigate a specific object of investigation necessarily carries some properties – some limiting features - of what it studies was more and more forgotten. The natural phenomena studied became nature, and finally were thought to be representative for everything outside the sign system of mathematics, they became equivalent to 'reality'. Other sign systems had to be understood as inferior attempts to mirror the seemingly eternal laws of reality, helpful only if they could contribute to the purification of mathematics.

The implosion of this type of relationship between a sign system and the reality it constructed came from within, its limiting deficiencies were recognized by some of the most advanced scholars working with the received analytical toolbox of the natural sciences: Einstein, von Neumann, Gödel, to name just a few. Quantum electrodynamics (QED) and the theory of strategic behavior, Game Theory, are just two early attempts to go beyond this prevailing relationship – and this necessarily implied that not only the perception of the object of investigation changed, it rapidly became evident that the formal apparatus, the sign system itself had to change too[7].

1 - Basic Methodological Ingredients

For any theory concerning human social evolution it is of utmost importance to specify first with which entities it deals. Since any theory is a sign system it always consists of a set of concepts, i.e. of words referring to something. As 'theory of social evolution' indicates, the entity outside language to which this concept refers is a set of individuals belonging to the human species, call it a 'tribe'. A tribe using a sign system is permanently interacting within (and on) two frontiers, which I will label 'perception frontier' and 'action frontier' (compare figure 1).

[6] Though Hegel – in good dialectical manner – at the same time despises mathematics: 'Im mathematischen Erkennen ist die Einsicht ein für die Sache äußerliches Tun; es folgt daraus, daß die wahre Sache dadurch verändert wird. Das Mittel, Konstruktion und Beweis, enthält daher wohl wahre Sätze; aber ebensosehr muß gesagt werden, daß der Inhalt falsch ist.' [Hegel, 1807, Vorrede].

[7] Kurt Dopfer in a similar vein recently has proposed a research program, which grafts complexity research on evolutionary economics, and simultaneously shifts the focus of economic research to the meso-level; compare [Dopfer, 2011].

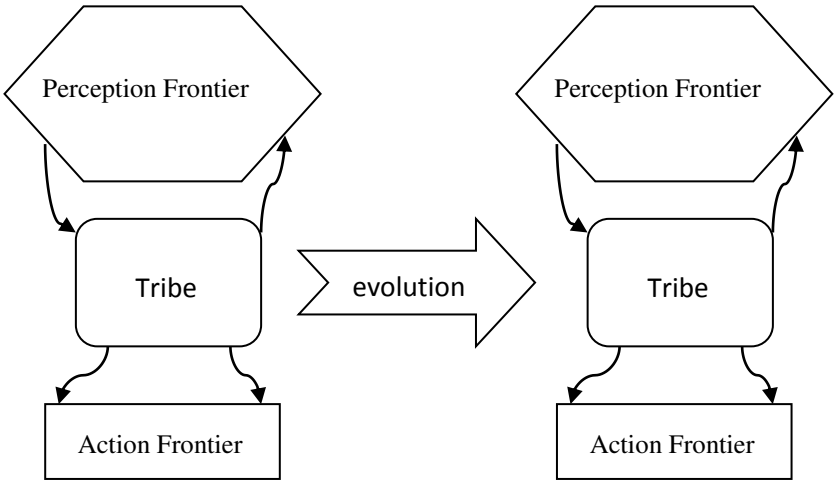

Figure 1: Basic interactions

A tribe is mainly characterized by its ability to build up structure; that is to develop a self-amplifying dynamics working against the general increase in entropy. Since any moves of increasing neg-entropy can only occur temporarily they all are characterized by finiteness, i.e. they consist of three elements: birth, life, and death. It is thus the ***stochastic character*** of the 2nd law of thermodynamics, a natural science law, which induces the fundamental difference between natural science laws and scientific descriptions of living systems. This should be taken as a challenge for further exploration of the concept of probability[8].

Several interesting conclusions are implied by such a positioning of social sciences.

If a tribe is the basic entity of evolution, then its internal organization is an immediate, elementary ingredient of any evolutionary theory. As far as tribes are small enough to be located within a less organized environment, their temporary success to increase neg-entropy is evidently mirrored by a temporary counter-move of increasing entropy in this environment. The basic methodological scheme of the evolution of living structures thus consists of a description of ***two countervailing forces***, of a temporary build-up of a ***contradiction***. Exchanging explanans and explanandum of (one aspect of) the last sentence – Hegel's basic trick to shed light on dialectic processes – one could say that the very notion of time is emerging as the result of contradicting forces enabling the evolution of the tribe. Taking a look at the 1st law of thermodynamics, stating that the total amount of energy in a closed system is constant - and again applying Hegel's trick - the idea that a system can be closed can be discussed as emerging from the perceived contingency (purported by experiments) with which natural scientists have constructed their scientific language. With a bit of reasonable speculation the two fundamental laws of thermodynamics can themselves be understood as reflecting the contradiction between the imaginary limits of a process (no.1) and its imaginary unbounded force (no.2).

[8] Note that John-Maynard Keynes in an early treatise tried to tackle this problem as well [Keynes, 1921].

More internal structure breeds more ***diversity*** within the tribe. This diversity is a rather complicated property, since it is built on contradictory forces too: Parts of the population resemble each other and amplify this resemblance, while simultaneously distinctions between parts are getting more accentuated[9]. Similar to the borderlines of the entire tribe any part's borderline is based on contradictory forces. Moving from the center of part A towards part B the force dragging element x to part A at a well-specified point becomes weaker than the contradictory force dragging x towards part B. The set of all well-specified points of this kind then is the borderline of part A. Several qualifications and consequences are needed and implied by this idea.

Though the points forming the border are points in Euclid's definition[10], the border they form is a two-dimensional object. Additional to the two countervailing forces there is a ***third force*** - call it ***persistence*** - which appears as friction resisting any kind of net movement[11]. Borders therefore are the ranges where persistence is able to freeze all weak net forces coming from A and it's neighboring parts. In other words, points form border areas rather than borderlines. Methodologically the part and its border have the same dimension, despite the usual observation that the border is relatively small as compared to the set it encloses.

It is not a trivial problem to determine what the ***elements of a tribe*** are. The obvious solution to consider physical human individuals as smallest units lacks the desirable property that any size of a tribe, disregarding any further property of its elements, should be able to build up neg-entropy. Any tribe size consisting of such human elements of the same sex evidently will not survive the current generation – thus sex is fundamental for human neg-entropy. This hints at something like a family or household as a candidate for a tribe's element. But while this choice helps to solve the riddle of biological growth at any tribe size it also imports additional difficulties. Not the least one is the fact that the size of this unit always is in flux, in cross section consideration as well as in time series accounts. Many of the major obstacles for current economic policy (education, labor organization, pensions, etc.) can be traced back to the profound changes in the characteristics of households and families[12]. For the European continental tribe household and family characteristics not only are changing fast, they also incorporate an element of cultural persistence amplified by language variety. If households and families despite all these problems are taken as basic units constituting a tribe – and this is what is suggested – then they clearly have to be modeled in a rather sophisticated way. Members of the tribe evidently belong to different

[9] Tom Schelling's segregation model is an early formulation of a process simulating the evolution of contradictory micro-forces [Schelling, 1978]. Though the fundamental contradiction remains exogenous in this model it at least made visible how most interesting macro-patterns could emerge.

[10] "A *point* is that which has no part." Euclid states in the first sentence of his first book [Euclid, 2300 BC].

[11] It is tempting to associate the concept of persistence with the well-known transaction cost arguments in economic theory. But what is sketched in this paragraph goes beyond that: To explain the movement of points to all places of the border area, where they then remain, needs the assumption of an asymmetry of persistence, a kind of ratchet effect. This idea has been further developed in [Hanappi, 2003] and cannot be found in standard transaction theory.

[12] See [Hanappi & Hanappi-Egger, 2008] for a more detailed discussion of that point.

partitions (in the sense of set theory) of the tribe, with ***some parts*** at ***some times*** taking on the role of borders[13].

There is, of course, an immediate intellectual appeal to suspect some kind of self-similarity between tribes and their members. And indeed, some biologists - still inspired by the success of their colleagues in physics - instead of going up the evolutionary scale to explain social phenomena in human society rather went down and searched for primal drivers of evolution at ever smaller scales, finally in cells, chromosomes and genes. They currently consider genes as basic motor for neg-entropy, a genetic mechanism for self-copy which simply uses all higher forms of evolution for its 'selfish' purposes. This invasion of a certain kind of socio-biological theorists into the terrain of the social sciences is interesting. From a strictly methodological perspective it is just another example of the outdated approach of atomism, i.e. the search for uniform smallest atoms from which all diverse elements are only different compositions. The hope behind this methodological impasse always was that if the atoms are finally found, then all appearing phenomena can simply be derived by paralleling historical emergence with a theory that – starting with atoms - stepwise combines successive building-blocks. Evidently the old philosophical search for a first cause - the secularized search as substitute for the believe in a first mover, i.e. for the believe in God – retained a very specific believe, namely that causes for the dynamics of an entity are always and exclusively to be found in the smaller elements, which constitute it. In other words, there are no feedback loops from phenomena emerging in larger elements to the working of the dynamics of smaller elements. While this makes certainly sense for classical statistical mechanics of physical systems, where the laws governing Brownian motion will not change if the aggregate state variables of the pure gas considered vary over a wide range, it is rather implausible to assume that living systems can be described with the same methodological prescription. Quite to the contrary, the radical change in direction from increasing entropy to temporarily decreasing entropy, which characterizes living systems, suggests that an appropriate methodology for living systems should include ***feedback between the whole and its parts*** – not the least to ***enable a description of consciousness and communication***. But as soon as this type of feedback is admitted as an essential methodological tool, the unhealthy imperative to search for first causes in ever smaller parts of matter can be disposed of. And this thus is the missing step with which the fiercest fighters for anti-clerical sociobiological 'proceduralism' (e.g. Richard Dawkins[14]) could really free themselves from religious remnants.

[13] The flexible role of border elements has recently been explored by network specialists in biology under the name of 'weak elements' (see [Csermely, 2009]).

[14] The clearest statement of Dawkins' methodological approach as well as the most visible source for his deficiencies of knowledge with respect to political economy can be found in [Dawkins, 1976]. In a more recent book, see [Dawkins, 2006] these deficiencies are blurred by his use of evolutionary psychology, a scientific effort, which itself suffers from severe methodological problems. Despite his most welcome defense of the atheistic character of science, Dawkins (as other sociobiologists) misses the essential methodological starting point of progressive social science.

Coming back to the needed more sophisticated type of modeling mentioned before, it is clear that sociobiology has not much to offer. The feedback loop constituting consciousness by the perception of others as contradictory mirrors is not reducible to deductive aggregation from smaller to larger entities. In the mirrors built within the perceptional apparatus of the members of the tribe other members are perceived as *being the same* as far as tribe membership is concerned, and *at the same time to be different* to the perceiving entity. This experienced contradiction produces tribe identity. Identity thus is not an isolating concept but always has to be understood as referring to a contradictory reflection. ***As this internal reflection is acted out***, i.e. becomes materialized, by all forms of communication between the members of the tribe ***the materialized signs feed back into the members' perception and constitute – the internal consciousness of the tribe***. And then again, by being confronted with other tribes of the human species the ***contradictory reflection produces multiple identities***. This idea, of course, leads back to the importance of emerging diversity.

At this point it becomes necessary to distinguish between ***two dimensions of diversity***, the spatial dimension and the time dimension. The members of a tribe at each point in time are diverse with respect to space, and each single member is itself diverse with respect to the time it exists. In both dimensions diversity is finite. The fact that the human species possesses the capability of advanced internal consciousness (i.e. it can build internal models of reality) enables it to employ the negation of finiteness in its internal models. This basic feature allows mirroring the external world as finite contradictions, to think of perceived objects as such, as name tags sticking constantly to permanently changing views. This is the origin of the ***concept of a sign***: it is an internalized contradiction[15].

It is precisely this property of being a contradiction, which enables signs to be two things at the same time: (i) the ***window through which something called reality can be perceived***, and (ii) ***a tool with which this perceived reality can be influenced***. Such a conceptualization of the notion of a sign presupposes in particular that there is space and time *outside* the world of signs. The title of this paper thus immediately signals that it abhors any kind of monism[16].

To summarize the basic methodological tenets developed so far:

a) The starting point for a theory of social evolution is the entity 'society', *and not any smaller representative entity included in it*.
b) Society is to be characterized as an evolving, dynamic network of heterogeneous entities embedded in a partially non-living environment, relative to which its finite

[15] It is evident that large parts of the arguments put forward here coincide – and sometimes contradict – the standard approach of semiotics (see [Eco, 1973, 1977]). To disentangle overlapping and conflicting issues with semiotics and other disciplines, i.e. to position the presented arguments in the context of other received theory, would go beyond the scope of this paper.

[16] This includes not only Democritus' early atomism (touched upon in the context of sociobiology) but also Hobbes' non-dialectical materialism and forms of idealism Spinoza and his followers propagated.

developments assume contradictory forms; *and thus are not to be characterized by the formal apparatus of Newtonian mechanics*.

c) The diversity of the nodes of this network is an essential feature driving its evolution, *and deviations from the average are not to be considered as exogenous disturbances to be assumed away in a more aggregated view*.
d) Diversity breeds more diversity, in space as well as in time[17], its stepwise evolution thus is a story of the emergence of novelty, *and cannot be described in terms of a smooth transition of known elements, like the increasing entropy in non-living systems*.
e) The emergence of a very specific form of novelty, namely goal-driven consciousness, takes place as feedback loops between parts of society and society as a whole start to be able to assume mirror functions[18] – and in the sequel becomes an endogenous element of progress[19], *and needs not to be assumed as exogenously given set of preference structures of individuals or welfare function*.
f) Consciousness of society starts to speak to itself as language emerges, parts of society start to interact not only in material terms but also via communication using sign systems, evolution of the network structures is interwoven with the evolution of communication (including self-communication) on all levels, *and the almost complete neglect of the latter by mainstream economic theory appears itself as a perfidious ideological strategy of a certain part of society*.

To see what kind of language elements might prove to be helpful to achieve these methodological tasks of social science, the following chapter takes a rather eclectic look at some elements of algorithmic languages used in computer simulation. As mentioned above, the most important scientist for the design of computing machines, John von Neumann, also was the one who early on pushed for the development of a new language for the social sciences. It seems to be not too farfetched to follow his intuition in assuming that society's new scientific language for social science will use technically supporting devices, mistakenly still called computers[20].

2 - Some Syntax Semantics from Procedural Simulation Language[21]

The most elementary operation in programming is to assign a value to a name. What actually happens internally is that a pointer is set, which connect one bit-string, the name, with

[17] Institutionalism and theories of cultural diversity are usually built on this methodological imperative.
[18] Consciousness, knowledge, and its time derivative ‚learning', thus have to be intimately linked endogenous elements of social science, the latter recognizing its own development in the object it investigates.
[19] Progress is just the negative and finite ('stochastic') correlate of entropy on a social level.
[20] It is surprising to see how everyday language has surpassed the mainstream economist's toolbox in that respect: Only few knowledgeable members of the new generation know how to apply the Schur criteria to check the stability of a dynamic system, but many know how to program a java applet for a mobile phone – and vice versa for the older generation.
[21] There is an overwhelming amount of literature treating this topic from many perspectives and with diverse concepts coming to partially overlapping results. For the sake of presenting a streamlined argument, as the apology goes, these interferences will not be dealt with.

another bit-string, its value. The crux in this operation is that a pointer is asymmetric in the sense that it points only from name to value, and not vice versa. The very essence of a ***variable*** is that for the same unchanging name the pointer can move to changing values associated with it. It is called a variable because it mirrors the contradiction between a constant name tag and a variable value linked to it, it can only be variable because this intrinsic change occurs on the background of its opposite: its unchanged name. In the light of the previous chapter, a variable is a sign composed of two signs in a very special way. What makes it special is that it is linked to a process interfering from outside in an asymmetric way, namely the setting of the pointer, the assignment. The latter occurs at a well specified point in time!

The name as well as its value is a sign; the pointer is an operation, namely sticking the address of the value to the name. This additional element that now sticks to the name usually remains invisible for the programmer. To use it – though again without seeing it – another operation can be invoked: referencing. By calling the name, e.g. typing the name and press enter in an interpreter language, the machine shows the value of the variable[22]. With some electrical engineering methods and a bit of Boolean algebra these simple operations can mimic mathematical calculations. But to be sure: they transform mathematical expressions, which typically are timeless tautologies, into time consuming procedures represented as changes of electrical states of bit-strings. Two principle types of changes are needed: (i) 'no change', which usually means that the bit-string acts as name tag, and (ii) 'change', which means that parts of the bit-string are altered according to pre-defined rules. Such a set of predefined rules is called a ***program***. Enlarging a name by adding the address of its value to it, i.e. assigning it a value, is an elementary form of program. Referencing is a simple program too, since it changes the bit-string of the name to the bit-string of its value. What is crucial for the construction of symbol manipulating devices[23], commonly called computers, is that the operations constituting a program can be given specific names. Using these names these rule sets can be applied to different areas of bit-strings within the same large storage of bit-strings. The interchange of roles between variables and programs enables simulations to mimic highly complicated dynamic structures. What is even more important is the fact that in this language – contrary to standard analytical mathematics[24] – time actually *takes place*!

Even in the simplest cases this linguistic novelty leads to interesting results. Assume that the name 'β' is assigned to the name 'α' that is referencing 'α' leads to 'β'. Assume further that 'γ' is assigned to 'β', and 'α' is assigned to 'γ'. Once these assignments have been made (in

[22] Several steps of a longer chain of signs of signs are omitted in this simplified description, e.g. you do not see bit-strings on computer screens.

[23] Alan Newell and Herbert Simon coined this term recognizing the universality of computation early on [Newell & Simon, 1976].

[24] The way time has been incorporated in analytical mathematics again is a topic to be discussed in more detail elsewhere. The apparent crucial differences between the assumption of continuous time and that of discrete time in mathematical models touch upon the concept of infinitesimal considerations, and thus on the status of laws of nature as opposed to man-made laws.

any order) the process of referencing produces a periodic sequence of names whose respective probability to occur at a given point in time depends on the relative speeds the three referencing processes (internal, in the machine) need. Periodic sequences, which in a more developed jargon are dubbed ***recursive calls***, point at a new problem imported with the more accurate mimics of time: When will the referencing ever stop? The quite universal experience of programmers that a misconceived program is caught in a recursive call without stop condition – the machine seems to freeze – thus leads to the introduction of another new, exciting linguistic element, the ***conditional jump*** to operations outside the recursion[25]. The explicit time line followed by the execution of operations thus enables mirroring decisions about what to do next at a certain point of time, with decisions depending on what happened earlier. This is a feature, which in a sense replaces – or at least complements – the eternally valid laws of natural science usually mimicked in mathematical equations. Discontinuities and kinks of functions, which are the most hated and avoided elements of mathematical analysis are now brought to the center stage of algorithmic formulations.

But variables and programs are not only particularly convenient to reflect processes happening outside language within the borders of a closed, though sophisticated, algorithmic framework. They also push the model-builder, the scientific 'poet', to be aware that there is a ***borderline between the model and its object of investigation***: This border-zone – remember the respective argument of the last chapter – is occupied by the names and rules[26] which are assigned within language, but do not refer to elements within the language; they refer to objects outside language. These names are the numbers, the measurable properties of investigated reality; these rules are the rules governing reality (usually both types of rules, natural laws and man-made rules). The number '5' thus refers to a measurement of something outside the language which has a property that can be characterized to be 5 at a certain point in time[27]. The rules for tax payments in a certain country at a certain point in time, pictured as a program of the border-zone, need not refer to another element within the model (though this tax program certainly is called from within the main algorithm). Both ***border-zone elements***, numbers as well as some programs, derive their validity from actions different from model-building: they ***can be adequate*** with respect to reality. It is perception and its enhancement called 'correct measurement', which provides a scale for more or less adequate elements of this border-zone. It is remarkable how this argument provides a ***second concept of truth***, now being something to be measured on a continuous scale based on adequate perception, and ***contradicting*** in a

[25] In the simple example this could be done with the help of an additional variable which counts periods, and a conditional jump to the operation 'stop' in case the counter exceeds a predetermined upper level. With respect to complexity (the opposite end of this overly trivial example) the issue is occupied by the still unsolved questions of NP-completeness.

[26] The concept of a rule is introduced here to free the concept of a program from its context of 'computer use'. A rule as well as a program is understood as a sequence of operations transformed into an abstract algorithmic language and given a name.

[27] Note that flow variable measurement can simply be *derived* from stock variable measurement from *within* the model language.

highly creative way the ***Boolean truth concept*** used in mathematical logic and algorithmic formalizations. The creativity of contradictions seems to lie close to the heart of the fruitfulness of human model-building.

3 - Reality strikes back

After this brief, though necessary linguistic detour[28] it is possible to tie together some of the loose ends provided in the previous chapters with the help of a small prototype model of the current global crisis.

It is helpful to start the explanation of the global crisis by a look at its various appearances, and then to link these appearances - backwards in logic and time - to their substantial causes. As will be seen a natural sequence of the treatment of these appearances is possible, which lends itself to provide smooth transitions from one argument to the next one. In doing so, the features developed in the previous chapters should, of course, be considered.

One of the epochal crisis elements to be considered is the rapidly unfolding global ***environmental crisis***. Its sources lead back to a biological characteristic of the human species, namely its ability to exploit growth processes of other living systems. From a biological perspective growth of a species simply is defined as the increase of the numbers of individuals belonging to this species in the course of time. The growth rate is a dimensionless scalar, since physical units describing nominator and denominator cancel out. This is an important feature, necessary to define exploitation, since it makes these scalars comparable; it thus only has to be assured that the measurement of the physical units of a given species are possible and consistent over time. For fauna and flora such conditions can mostly be assumed as given, numbers of animals and plants of a given species can be counted. The same is true for the human species as long as it is only seen from a biological perspective. But if its defining characteristic of developing qualitatively enhanced consciousness, i.e. model-building capacity, is considered, then this measurement is transformed into the measurement of *perceived* social value. And this certainly is not a trivial concept. As described elsewhere in more detail (see [Hanappi, 2006]) dynamic exploitation can be defined as the consciously guided transfer of growth from an exploited living system to the exploiting human species. ***Exploitation of nature in biological terms*** can be described as

[1] $$h_t \leftarrow \left(1 + g^h_{t-1} + x(c_{t-1}, \dots)\right) \cdot h_{t-1}$$

[2] $$c_t \leftarrow \left(1 + g^c_{t-1} + y(h_{t-1}, \dots)\right) \cdot c_{t-1} \ ,$$

[28] In several respects this detour is building on Ferdinand de Saussure's ideas about signs ([Saussure, 1915]). In particular his insistence that language has to be understood as a vital part of social evolution has been path-breaking and still needs support today. Moreover, Saussure often uses parallels between linguistics and political economy in his text. And recent attempts of sociobiologists to reinterpret linguistics as a specific form of cultural Darwinism has led to a defense on the side of linguists, which can be compared to the respective paragraphs in this paper (compare [Holdcroft & Lewis, 2000]).

where h_t denotes the number of members of the human species and c_t the number of individual elements (of 'corn') in the living environment at time t. The respective growth rates, g^h_{t-1} and g^c_{t-1}, are given by biological determinants. The programs $x(c_{t-1}, \dots)$ and $y(h_{t-1}, \dots)$ formulate the idea of interdependence between the human species and its living environment. These programs specify the impact of the size of one species on the growth rate of the other species. The dots in the argument lists of these programs indicate that the growth processes also depend on resources available in the non-living environment. Program y typically would mirror how the use of agricultural techniques during the agricultural revolution 10.000 BC enabled a higher growth rate of food, which in turn – as to be modeled in program x – did lead to a higher growth rate of human population. As the example immediately shows, the greater generality of such a formulation implies the need for more precise historical specification. It is more than an exercise in formal versatility.

To understand how these dynamics imply contradictions which then pop up as crisis, it is necessary to ***shift the perspective*** from biology ***to social science***: Due to their model-building capacity human tribes develop languages, first only spoken (Saussure's 'parole') and fixing perceptions across individuals, later written (Saussure's 'langue') and fixing perceptions and interpretations[29] across generations. Science itself can be considered to be just the most recent outgrowth of this evolution. As social value becomes fixed as mental element traded in the communication processes of a tribe, it becomes a sign which gains independence from its purely biological roots as a measure of success of the primary metabolism. Identities of groups within tribes can constitute themselves by reproducing their ability to exploit the forces of the primary metabolism of oppressed individuals in direct biological as well as in ideological terms. The transformation of 'exploitation of nature by man into the exploitation of man by man' (Marx' expression) implies the emergence of ideology, a kind of second nature falling like a cover over all purely biological processes. Exploitation is extended to include exploitation between classes of the human species, measured as the transfer of growth of acquired social value from the exploited class to the exploiting class. Social value itself becomes an element of a society's sign system, which is linked to the material world of perception by its diverse carrier systems, by money forms. In a broad historical perspective money forms were forms of specific carrier systems of social value enabling a ruling class to secure reproduction of its regulation regime, while at the same time extracting the largest possible social value from the exploited group. The carrier system, from materials like salt to bit strings in computers, always had to have an institutional link (what since Montesquieu's classical distinction between state powers [Montesquieu, 1748] has been labeled 'executive power') to some directly coercive power. The development of money forms[30], of classes and modes of production, of the ideological forms with which these processes were interpreted by classes; all these elements are to be considered as one and the same process of evolution

[29] Written language definitely leaves the stage of reflecting perceptions, and adds an interpretative model. The definition of the species itself is provided by belonging to the same type of language capacity, the same types of commonly used models. The fact that a multitude of languages (and thus of tribes), i.e. 'cognitive diversity', is beneficial for the evolution of the human species is the core issue of Scott Page in [Page, 2007].

[30] Compare [Hanappi, 2009].

of the political economy of the human species[31]. To summarize this grand object of investigation of social science in a most cursory way (laying emphasis on the concept of exploitation) one could split statement (1) into a pair of statements sketching class struggle:

[3] $$r_t \leftarrow (1 + g^r_{t-1} + x^r(c^r_{t-1}, \dots) + z^r(w_{t-1}, \tau_{t-1}, \dots)) \cdot r_{t-1}$$

[4] $$w_t \leftarrow (1 + g^w_{t-1} + x^w(c^w_{t-1}, \dots) + z^w(r_{t-1}, \tau_{t-1}, \dots)) \cdot w_{t-1}$$ with

[5] $$c_t = c^r_t + c^w_{t-1}$$ etc[32].

In statements [3] and [4] the variables r_t and w_t represent social value of the ruling class and of the working class at time t, with their respective growth rates defined analogous to [1]. Program x now has to be taken apart into x^r and x^w since the influence of environmental dynamics on different classes has to be distinguished. Note that program y in statement [2] will not have to be altered – the environment experiences no split – though content and argument list of this program will have to be adapted to the refinements of [3] and [4]. But the split into classes produces side constraints [5] which have to be met; e.g. at any point in time the physical quantities of food supplies c_t are finite and the amounts available to different classes have to take this fact into account. Program z^r shall transport the idea that the social value that the ruling class can achieve at time t depends on the social value remaining for the exploited class at the time point before. In a first approximation the distribution of world GDP in two consecutive years could be used to measure r_t and w_t. In the last 300 years a decisive role for this second type of exploitation was played by technical progress, which shall be indicated by the explicit inclusion of variable τ in the class struggle statements. In principle technical progress can benefit all classes, either directly (via [3] and [4]) or indirectly by enhancing exploitation of nature (first entering the argument list of y in [2] and then entering [3] and [4] via programs x^r and x^w). Though considering the fact that technical progress is implemented only by the ruling class, it is evident that only those enhancements will be installed which are thought to increase r_t. This is a prime cause for emerging contradictions[33]. In program z^w the negative feedback from higher shares of the ruling class for certain finite historical epochs might be compensated by positive contributions from technological progress, at least this is the argument of Marx and Schumpeter. In this perspective the historical epoch of capitalism can be specified as the time period when this overcompensation occurs. But as any epoch it is finite, and in the course of time undermines its own basis. Note that assumptions on waning benefits of

[31] The crucial evolutionary step from 'growth of the size of a species' to the 'growth of social value' ascribed to the circumstances under which a species has experienced the change from the year before, this giant step will be dealt with explicitly in a forthcoming paper [Hanappi, 2011].

[32] Similar constraints will have to be made for other physical quantities not yet specified but occurring in the different programs.

[33] The immediately visible form, which this contradiction assumes is that the ruling class will try to reduce the wage share by new techniques, and the mass of products thus will have to be sold, and will then have to be bought by those commanding the increased profit share. If exploiters and exploited live on the same continent, then the taste of the rich to some extent can be imitated in products for the poor. But if they live on different continents, then the exploited are simply left behind by inappropriate technological innovation. This then leads to rebellions.

technical progress for the workers and lower limits for acceptable profit rates have to be assumed to arrive at this finiteness. Both assumptions look empirically plausible.

Yet another idea provides valuable insight. Assume that the changes in growth rates of r_t and w_t deriving from the exploitation of nature are small and rather constant as compared to the speed with which the relationships between classes change. This leads to the following two assignments:

[3'] $$r_t \leftarrow ((1+\gamma^r) + g^r_{t-1} + z^r(w_{t-1}, \tau_{t-1}, \ldots)) \cdot r_{t-1}$$

[4'] $$w_t \leftarrow ((1+\gamma^w) + g^w_{t-1} + z^w(r_{t-1}, \tau_{t-1}, \ldots)) \cdot w_{t-1}$$

The two constants γ^r and γ^w now incorporate the influence of exploitation of nature. Simplify further by assuming proportional interdependent influence of growth that is programs z^r and z^w are only computing constant fractions of the respective other assignments growth rate. The two assignments now read

[3'] $$r_t \leftarrow ((1+\gamma^r) + g^r_{t-1} + \delta^r \cdot w_{t-1}) \cdot r_{t-1}$$

[4'] $$w_t \leftarrow ((1+\gamma^w) + g^w_{t-1} + \delta^w \cdot r_{t-1}) \cdot w_{t-1}$$

With constants δ^r and δ^w representing the strength with which growth of wages and growth of profits influence each other[34]. Now take another step towards the standard tool set and assume that instead of assignments the two relations are just a system of two dynamic equations. With some simple transformations we get

[3''] $$r_t - r_{t-1} = ((1+\gamma^r) + g^r_{t-1} - 1) \cdot r_{t-1} + \delta^r \cdot w_{t-1} \cdot r_{t-1}$$

[4''] $$w_t - w_{t-1} = ((1+\gamma^w) + g^w_{t-1} - 1) \cdot w_{t-1} + \delta^w \cdot r_{t-1} \cdot w_{t-1}$$

The final step now looks easy, use continuous time instead of discrete time to have a differential equation system instead of a difference equation system.

[3'''] $$\dot{r} = ((1+\gamma^r) + g^r_t - 1) \cdot r_t + \delta^r \cdot w_t \cdot r_t$$

[4'''] $$\dot{w} = ((1+\gamma^w) + g^w_t - 1) \cdot w_t + \delta^w \cdot r_t \cdot w_t$$

For constant 'average growth rates' g^r_t and g^w_t of a certain epoch of exploitation of man by man – what David Gordon has called a social structure of accumulation[35] - this system is a Lotka-Volterra system characterized by limit cycles of the two growth rates around the equilibrium constellation:

[6] $$r^*_t = -\frac{\gamma^w + g^w_t}{\delta^w}$$

[7] $$w^*_t = -\frac{\gamma^r + g^r_t}{\delta^r}$$

[34] Recently this question has been dealt with using the standard formalization tools of macroeconomics by Amitava Dutt [Dutt, 2011]. He suggests that both interaction channels between growth rates are to be considered as relevant.

[35] See [Gordon, 1989] and [Hanappi, 1989] for an early and detailed treatment of this concept.

As Goodwin's classical growth cycle [Goodwin, 1955] the model is dynamically unstable, i.e. small changes in parameters (exogenous shocks of class struggle) send the system immediately on a different cycle. But more important, the system is structurally stable, it always moves along closed limit cycles. It is this latter property, which shows the weakness of the stepwise introduction of standard analytical tools[36]. Once the last step of assuming continuous time is removed, no limit cycles occur! For plausible parameter values the cycles will quickly explode, and this leads back to an outstanding capability of simulation languages mentioned in chapter 2: conditional jumps.

Analyzing the dynamic behavior along the lines of simulation methodologies working with discrete time steps thus comes up to identifying the next possible bottleneck of the exploding system with respect to political and economic feasibility. This takes the argument back to the beginning of chapter 1, since this description can be understood as a formalization of the concept of an evolving contradiction. Note that 'contradiction' in this context now occurs in several dimensions: (i) On the model-building side (the information sphere of society's tribes) it provokes the transition from an exploding growth model to a re-combinatorial model of social innovation; (ii) beyond the perception border (in reality, i.e. the dynamics of the primary metabolism) the structure of neg-entropic entities becomes unstable, starts to be co-determined by the old (structurally stable) regime and a new (structurally unstable) regime with multiple basins of attraction. For the human species the result of the second contradiction depends on the development of the first. At the breakpoint of the bottleneck, internal model change implies somewhat erratic behavior at the 'action frontier' (compare chapter 1) of the tribe. A new set of essential variables re-orients the tribe's neg-entropic goals, eventually a new structurally stable evolution will emerge[37].

After this tour de force along arguments - activating fragments of diverse disciplines – we are back at the second part of the opening statement: The reality of signs can be understood as the power exerted of ideological models at crucial points in history.

Epilogue

The main new ability to be gained by travelling along these ideas is to be able to see how dimensionless growth, in its abstract scalar form, is currently in a rapid process of metamorphosis. It changes from a quotient of physical quantities to a quotient of ascribed social value; current and expected social value ascribed to mankind's activity as a whole by mankind itself and mediated by highly complicated communication and self-communication processes. It should not take wonder that this rupture in social evolution comes with a quick sequence of global financial bubbles leaving policy-makers in a state of helpless confusion. Indeed there are several possible new combinations of social innovations, which easily could

[36] Nevertheless interesting properties of this system can be investigated. They lie somewhat outside the major thrust of this paper and therefore will not be developed here.

[37] In [Hanappi, 2011] a proposal for a European pilot project exploring the trajectories of a future global mode of production is made.

take hold of the human species' fate in the near future. A break-up of the highly integrated global political and economic system into more independent parts, a reinforced global military dictatorship by one hegemon, or a highly sophisticated global democracy – or any of the mixes in between these alternatives might emerge, and bring its own manifestations of social value.

Money has been the carrier of social value ever since it emerged. In the course of history it has changed its forms dramatically, becoming ever more abstract with each new global mode of production. Today it resides almost purely in the expectations of powerful social entities, which nevertheless have to express them as streams of figures on computer screens. Nevertheless this abstraction process always has been accompanied by the build-up of coercive state power, which potentially could be used to enforce any latent accumulation goal. In particular in times when ownership of abstract social value is highly concentrated in the hands of a few social entities - eagerly jumping on expected bulls, and off expected bears at stock exchanges – thus producing ever larger asset price bubbles, in particular in such times the threat of a return to direct coercive power as a better alternative to restore global exploitation becomes attractive for powerful social entities. It is evident that such a restoration of direct coercion can only be envisaged with attack on both battlefields: (i) In the information sphere coalitions between confused parts of the population (in particular religious movements) and those anxious to lose status[38] have to be formed, while on material grounds military weaponry (nowadays equipped with information techniques allowing extremely precise targeting of possible enemies) has to be built up. This is what currently can be observed; ever larger funds are either moving to financial markets preparing the next bubble, or are used to stock up military expenses to police emerging conflicts. The obvious challenger to this project would be a program of global democracy, which redefines social value (thus produces a new money form), redistributes power across globally and democratically legitimized social entities, and thus comes up with a new set of social institutions and their epiphenomena[39]. That's all.

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[38] Efforts to distort the internal evaluation of households concerning their relative social status are a traditional ideological weapon to direct aggression against artificially constructed scapegoat groups. A careful choice of potential coalition partner (classical example: Arian German unemployed) and scapegoat group (e.g. Jews, immigrants) is important, but allows for some flexibility.

[39] A more detailed treatment of how global democracy can be reached, i.e. a political program paving the way from the current defensive battles fought by progressive, democratic forces towards a global counter-attack, goes far beyond the scope of this text.

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