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the Regulationist Problematique**

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The Issue of Energy within a Dialectical Approach to the Regulationist Problematique

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Abstract

Hitherto, dialectics has been weakly integrated with the regulationist/institutional perspective. This paper proposes a series of hypotheses which, it is hoped, can help to bridge this divide. In achieving this, an important tool will be the issue of energy. Although systems thinking are no stranger to the regulationist perspective, the approach has been defined quite narrowly, resulting in somewhat semantic debates about, for example, structural functionalism and evolution, structure and agency. By focusing on what is inherently the foundation of the study of physical systems theory, namely energy, this paper proposes a dialectical materialist foundation for the study of productive socio-economic systems and their regulation. The paper reviews several of the more promising approaches to the social regulation of energy, which help to fill in the 'missing link' in the ongoing regulationist research project on dialectics and systems. Focusing on a positive study of the operation of capitalism, we first consider the energy issue internal to socio-economic systems, considering the relationship between conservatism and change. We then address the issue of energy and entropy in the dialectical relations between social and physical systems, before concluding with some normative implications.

1. Basic Definitions

Regulation is universal to all systems. In this paper we are taking from systems theory a more general definition of regulation, of which the definition employed in regulation theory can be considered a part. Although our case study is capitalism, we are purposely avoiding an economic approach. Instead, we are taking from general systems theory a central emphasis on energy and entropy. A self-managing (relative) equilibrium conserves energy and maintains order and structure, but running through the overall development is an 'arrow of time' in the direction of greater disorder. This theme will play a major role in our study.

There are two basic **levels of analysis**. Firstly, if we consider the social system within itself, the conservation of energy means avoiding unnecessary regulatory effort. This line of reasoning has often led to an argument for rational planning, aiming to anticipate results to which the free play of forces would arrive by more experimental, trial-and-error, and chaotic means. But there is a counter-argument: systems theory suggests that emergent and self-regulating systems are more robust, and indeed more

rich as a source of institutional and behavioural variation. Planning should therefore aim to work working *with* rather than against such forces. As we will argue, the transition between regimes of accumulation can be explained by a point at which the regulatory energy of maintaining an existing equilibrium exceeds that liberated by embracing its ‘creative destruction’.

The second level of analysis is to consider the social system as being integrally embedded within a physical one, one form of regulation being thus nested within another. A fundamental definition of any social system of production is the harnessing of physical energy (Pearce and Turner 1990). Under capitalism, we witness a constant revolutionisation of the approach to this task, the long cycles which underpin regimes of accumulation being significantly determined by new sources of energy and mechanical ways of accessing it. This in turn raises a wider issue of conservation: the goal of sustainability, which in the largest sense implies respecting the systemic regulation and ‘systemic coherence’ (Amin 1994, Dunford 1990) of the eco-system itself, without which we cannot access the solar energy embodied in plant and animal form.

In a profound sense, the two manifestations of the energy problem are interrelated: a general model of regulation would necessarily embrace both. In this paper, to conduct a dialogue with institutional theory, we primarily focus on the socio-economic aspect. Nevertheless, we will indicate relationships with physical energy as a basis for future work.

In seeking to categorise forms of regulation within the social sphere, it will be helpful to subdivide them in two ways: **Firstly**, a level-of-analysis categorisation: regulation is found at several levels, for example within individual institutions, at the level of various social bodies, at the level of the nation and the international system; it operates in a manner appropriate for the strategic space in question (c.f. Boyer, 1990a), higher levels taking as their ingredients the lower levels. Regulation in general can thus be considered a specific ‘faculty’ within society, using as its vocabulary elements from different branches of social organisation, for example institutions and technical systems (c.f. Delorme and André 1982).

Secondly, we can categorise regulation according to the degree of the change it embraces. All forms of regulation encompass both an aspect of a maintenance of equilibrium (De Bernis 1977) – in particular by deploying negative feedback processes to counter disruptive positive-feedback ones – and an aspect of embracing large-scale step-level change. In this sense, regulation always *presupposes change*, either as a threat or something to be welcomed. But there is an important difference between *routinised regulation* which primarily operates to maintain an equilibrium or restore it after suffering shocks; and one which primarily acts as a medium for major system change. The issue of system *change* has still not wholly received the recognition it deserves within the literature (Hay 1995: 387). If we superimpose both levels of analysis, the most all-encompassing form of regulation is one which both operates at a global level and pursues large-scale system change (c.f. Brenner and

Glick 1991; McMichael and Myhre 1991), thereby combining the time dimension with the highest level of space.

Regulation is both the property of a system and (in the case of human systems) a conscious act. In the physical world, regulation occurs with no intentionality, as in the regulation of temperature in the earth-system (Gaia) model. In human society, we can distinguish between regulation which ‘just happens’, and conscious design. No forms of social regulation are purely one or the other, but the categories may be considered to define a spectrum between which real-world examples fall. There is always an interplay between them. For example, an objective (non-purposive) equilibrium can assert itself *through* the exercise of agency. This is precisely an important contribution of rational choice theory, and in particular of the prisoners’ dilemma model, where a strongly entrenched equilibrium arises from choices which in no way seek it. The equilibrium could be ‘bad’: as Keynes recognised from a different angle, stable does not mean optimal.

2. The Limits to Regulation under Capitalism

Many of the above features are common to all social systems. But there are special features of regulation under capitalism.

The succession of regimes of accumulation all form part of a larger process of reproducing the mode of production as a whole. At this level, the system may appear unchanging, insofar as it remains capitalism. Our focus in this paper is primarily ‘positive’ (as distinct from normative), to understand how capitalism really operates as a system. However, we are conscious of the paradox in the regulationist literature, as a partly Marxist-inspired current of thought, which often seems to be helping capitalism work better. In what follows, there is always a normative dimension close to the surface: we have derived from the energy perspective a strong sense of the entropy whereby the underlying limits of the mode of production constantly posit themselves. The mode of production is therefore not really unchanging, it is exhausting itself.

Let us first consider how the entropy issue arises within the regulation sphere in general.

Capitalism has developed a certain degree of systemic self-consciousness. We could discern this in different realms of the international political economy (IPE), for example, in the field of international relations (IR), by considering realist and neo-realist power-balancing models; but in this exposition, we will concentrate on economics and management. Elements of systemic self-awareness can thus be found in (for example) the classic liberal notion of the ‘hidden hand’; in marginal theory; in Keynes’ contribution in highlighting the existence of different possible equilibria and of the multiplier as an agent of transition (Keynes 1964 [1936]); in second-best theory and Viner’s application of it to regional integration (Viner 1950; c.f. also Gordon, 1997); in Pigou’s approach to externalities (Pigou 1932) and in Coase’s critique of this (Coase 1960); in Hayek’s structural liberalism (Hayek 1964), etc. All such

approaches substantively address processes which we could represent in systems terms as emergence, equilibrium or feedback; they often also acknowledge that it is the *overall* order which is emergent: the intentionality of the individual decisions which lead objectively to it do not necessarily *seek* it.

There is clearly a division which runs through this literature: certain approaches emphasise auto-regulation (*laissez-faire*) and others intervention. The two are in principle complementary, and can be considered a dialectical unity of opposites. Indeed, the process whereby such complementarity is asserted is itself a form of regulation. The sphere of conscious regulation is embedded within an objective regulation, otherwise it would be merely voluntarist, and would waste energy designing systems which would be more robust anyway if permitted to emerge.

But our study will highlight a certain difficulty which at some point undermines this complementarity. This difficulty progressively reveals itself in a manner which could itself be considered an expression of the entropy of the mode of production.

Let us define the scope of this proposition. Capitalism is a complex system, and Jessop, in his analysis of Polanyi's model, correctly characterises it as 'heterarchic' (Jessop 2001). The means of regulation essentially come from outside the market; thus the twin facets of capitalism – as socially-embedded institution and as abstract self-regulating market – should interlock to yield a concrete mode of regulation. This balanced relationship could be disrupted in various ways, the most obvious being, as Polanyi recognised that the market aspect of capitalism will gradually subsume the rest, re-making it in its image. But why exactly is this likely to occur? This can be understood if we read systems theory in terms not just of auto-regulation, but, more profoundly, of entropy.

In this sense, market dominance, i.e. commodification, can be represented as an intrinsic arrow of time within capitalism. If we link Polanyi's model with that of Rosa Luxemburg (Luxemburg 1913), any capital accumulation, or in a larger sense capitalist *order*, requires a continually greater effort to reproduce it. Since this effort cannot come from nowhere, it requires a corresponding degradation of a surrounding environment ('milieu' in Luxemburg's term).

This is entropic for two reasons. One is that successive regimes of accumulation become more difficult to establish: capitalism has a number of cards in its hand which cannot be played a second time (Biel 2006).

The second is particularly relevant to our topic: the onward movement of capitalism undermines its future potential *at the level of its regulatory capacity*. Luxemburg depicted the finite milieu (consumed to fuel accumulation) as 'tradition', i.e. something ancient or uncorrupted; we could draw an analogy with the fossil fuels which provide the non-reproducible *physical* source of capitalist development, and which are likewise laid down over millennia and cannot be reconstituted. This is partly accurate: the commodification process does indeed consume previously non-commercial areas of life (culture, sport, leisure) in a way which is entropic both

because the commodification is difficult to reverse and because there is not an infinite territory to colonise in this way. But we can also take the argument one step further. At a certain point the accumulation sphere needs also to parasitise upon something more modern, and this includes *the 'raw material' of the regulation sphere itself*. In the current phase, the components of the institutional world – regulatory bodies, local government, universities, even the repressive state apparatus – increasingly lose their autonomy vis-à-vis the commodified sphere (Görg 1994), *becoming drawn into the accumulation circuits which they are supposed to regulate*.

3. Voluntarism and Auto-Regulation

The energy issue manifests itself not just as an external condition for the regulation sphere, but within that sphere. Here energy signifies both human capacity and the *regulatory effort* made and conserved. In a conventional economic model of regulation, wealth, natural resources and factors are dispersed within the social space; viewing regulation as *function* (Boyer 1979: 100), its role could be seen as one of strategically focusing these, a fact recognised albeit in an ex-post manner in Aglietta's model (Aglietta 1979: 32; c.f. also Jessop 1995; Perkmann 1996). If instead we speak of *capacity*, regulation functions to conserve it (avoiding unnecessary dissipation), but also more importantly to prioritise it for particular strategic spaces. In this task, bureaucracy and routine play the conserving role, innovation the dynamic one.

Cybernetics suggests that emergent systems are more robust than designed ones: they find ways to maintain their stability in the face of disruption, or to adapt to change which cannot be resisted. A crucial aspect of conserving energy is thus to avoid unnecessary intervention (which may expend unnecessary energy and arrive at a worse result) and respect naturally-occurring structure.

But large-scale choices are, and should be, inherently a part of the human social endeavour. A balance between these two imperatives is in principle independent of social system or of the interests of any particular dominant class. There is always a need to intervene to redress structure-disrupting tendencies, in conventional economics seen as externalities, or more dynamically as feedback loops. Thus, in urban development it is important as far as possible to respect self-regulatory processes inherent in the formation of neighbourhoods, their specialisation in branches of production etc. But this goes hand in hand with accepting a need to intervene in order to counter dangerous positive feedback tendencies, e.g. cycles of insecurity and deprivation. Here, regulation forms a specific faculty, watching over the tendencies which may develop within its 'environment' – the whole ambient social system including its vocabulary of institutions.

Although all social systems must do this, under capitalism the relationship between auto-regulation and intervention is never neutral, but strongly class-determined. *This is expressed most importantly in the way in which conscious choice approaches the sphere of emergence*: class interest in maintaining a specifically *capitalist* structure determines which emergent processes are tolerated, and how they are channelled. In

our urban planning example, the apparently neutral goal of reducing social entropy is hard to separate from social control.

The current phase of capitalism seems to have progressed further, in comparison to earlier periods, in the direction of systemic self-consciousness, of readiness to embrace emergent and self-regulatory processes, reducing the sphere of unnecessary conscious and deliberate regulation.

Obviously the free market is *itself* an instrument of regulation, eminently emergent in the sense that it simply ‘happens’. It is characteristic of capitalism, but at the same time insufficient to its real operation. The latter recognition is of course central to the regulation approach: our common aim as regulationists is to understand the concreteness of a really existing capitalism, both in ‘social space’ (i.e. the institutions which form the regulatory focal points of that social space, cf. Gordon 1997) and in periodisation of time (the transition between regimes of accumulation, e.g. Jenson, 1991). In the following argument, we will however seek to address this in a new light.

The liberal position implies that high-level order can *only* be emergent or non-purposive, which is clearly not true: there is an element of ‘information about the future’ (Roederer 2003) in all the information-exchanges which are the *essential* mode of interaction of all the processes in the human system; and more concretely, the transition between regimes of accumulation always includes an element of strategic thinking by key actors. Whereas for liberalism only the micro-level is purposive, and the macro purely emergent, in a sense the opposite may be true: structural development at lower and intermediate levels is encouraged to ‘happen’ (in order to conserve the energy which would be dissipated through excessive design-efforts), but ‘orchestrated’ with a high degree of intentionality.

A conventional Marxist condemnation of capitalism refers to its anarchy, but we should analyse this more precisely. Even a post-capitalist social order would cultivate a healthy sort of anarchy conducive to the emergence of regimes and self-regulating relationships at every level. The issue with capitalism is not the ‘anarchic order’ per se but the unequal class relations, which ensure that the benefits generated by it (the security produced by well-functioning regimes, the economic benefit for which they create the framework) is mainly siphoned upwards, whereas the risk produced by anarchy-disorder is exported downwards. Under capitalism, emergence is always heavily constrained, corralled by the needs of capital accumulation. Robinson has rightly emphasised the concept of ‘polyarchy’ as a representation of a highly constrained and manipulated pluralism and civil society (Robinson 1996); a supposedly self-regulating ‘heterarchy’ could never be understood outside this context.

The above is the negative problem which capitalism poses to society *in general*. But capitalism also poses a problem to *itself*. Here, we must distinguish between the ‘welcome’ anarchy – expressed both in a space dimension as spontaneous emergence and in a time dimension as the necessary disorder associated with structural crisis – and that which begins to appear when entropy become unmanageable.

Most obviously, regulation is the complementary opposite of the anarchy, acting to tame and constrain the latter, for example in Keynesian regulation of the money supply, or generally in the role of (class-determined) public policy in constraining feedback (externalities). But in a more all-round sense, regulation is itself the interplay between the voluntarist sphere and that of emergent relationships, which it must also embrace and encourage.

If we define institutions as nodes or clusters within the political economy, they can be organisations, informal regimes or production chains. They exhibit characteristics of emergence alongside ones of conscious design and intervention. They internally regulate the activities of their own constituency, as well as constituting building blocks for broader levels of regulation. It is interesting to note that the forms of these institutions are not necessarily specific to capitalism (c.f. Boyer and Hollingsworth 1997): they access a basic human faculty of auto-regulation via networks.

In a deeper sense, the systemic aspect of liberalism is not really cancelled out by the institutional perspective, but partly re-asserts itself in a new form within it. As Boyer rightly says, the point is that the economic actors themselves do not have to internalize the structural principles governing the overall social system (Boyer 1990a: 43). We could develop this argument to say that there is a particularly institutional dimension of *laissez-faire*, with its own ‘hidden hand’. In this sense, a mode of regulation is a set of rules and individual and collective behaviours which render potentially conflicting decentralized decisions mutually compatible without the need for actors to understand the working of the entire system. If the unit of analysis becomes the institution (c.f. Villeval 2001: 293), successful regulation would encourage spontaneity in this sphere as much as constrain it, resulting in an ‘institutional *laissez-faire*’ rather than the fiction of the market.

The nodes of emergence, i.e. the self-forming and self-regulating clusters or regimes, constitute the most important expressions of our institutional-systems model *in the spatial dimension*. Here we must define ‘space’ in a special way. Of course, the conventional sense of geographic space remains important (the clustering literature is increasingly pulled towards the disciplines of geography and regional studies, e.g. Peck and Tickell 1992). But in addition, we are emphasising a notion of ‘institutional space’ (c.f. “new institutional spaces” in Jones’s terminology, 1997). Now, the important point is the direction of change *within* the overall map of the institution-world: the realm of emergent forms like clusters and regimes appears to grow, that of bureaucratic institutions to shrink; simultaneously, the mythical liberal notion of a featureless landscape dotted with individual consumers or firms is increasingly replaced by a richer tapestry of strongly determined networks and information-nodes. There is thus an internal redistribution of emphasis within the institution-world. This is both the strength of the current phase of capitalism and its weakness: the interventionist aspect of regulation remains necessary to control unwanted externality-feedback, and the tools which could be used to achieve this have been dismantled to a dangerous extent.

In addition to the dimension of space, we must now consider that of time. This contributes to an important quest to identify issues of socio-economic management, regularisation, and governance which could provide a 'time-space fix' (Harvey 1982) or 'time-space envelope' (Sum 1998).

4. The Relationship between Conservatism and Change

We should first consider an institutional definition of sustainability. In the wider sense, this signifies *the maintenance/reproduction of the reference system*. Conservation is an instrument serving this goal, representing both the need to limit the energy expended in regulation (by reducing voluntarism and encouraging emergence where possible), and the conservation of structure itself. In contrast to sustainability, equilibrium is a weaker, more limited (but nonetheless necessary) criterion of organisation, the temporary balance, within which mature the contradictions which ultimately will come to fruition in a new state.

The wider sustainability imperative defines the regulatory sphere in more precise instances and in shorter time-scales. The larger system is always conservative (maintaining its nature as capitalism) but in the smaller scale it *may or may not* be: either the larger conservation is mirrored in conservation of particular structures which embody this goal; or the wider goal may be realised in the opposite way, accepting the need to destroy such temporary or local structures and replace them by better ways of maintaining the system as a whole. This defines the relationship between the mode of production in general and its individual institutions or regimes of accumulation.

Where the system is locally conservative, it either responds to feedback from disruptive tendencies, or conservatively employs 'information about the future' in a manner analogous to 'feed-forward' in systems theory, i.e. anticipating the disturbance *before* it occurs. This does not mean a denial of change, on the contrary: on the principle that "every determination is negation" the main definition of equilibrium is precisely the *possibility* of its disruption, in this case regarded as a threat. Equilibrium is here associated with a normal and acceptable form of conservatism and routinisation. It is self-reproducing in the following aspects: firstly, any regulation system (including those of the natural world) has some self-righting faculty analogous to a gyroscope. Secondly, within human systems, there are stable norms of behaviour which govern system-roles, including expectations of the behaviour of other actors – in a certain reading of regime theory, such roles and norms are themselves institutions. Thirdly, there is a clear tendency to mimesis in terms of what is defined as 'best practice' within the hegemonic norms of a particular accumulation regime, for example the rapid imitation of the new ('Japanese') management practices.

But while cherishing the temporary equilibria which embody sustainability at particular times, or the *local* nodes which embody it within the uneven landscape of institution-space (e.g. the 'see-saw' theory of uneven geographical development, Smith 1984), regulation must not be too attached to any of these. It must also accept

and embrace large-scale systemic transformation and qualitative change (c.f. Lipietz, 1982). Again, this is a universal property of all systems: we again see it in different climatic states in the earth-systems model. At the level of the IPE, it is primarily expressed in the different regimes of accumulation, which together represent the acceptance of change as a token of international capitalism's commitment to its overall goal of system sustainability at the level of the mode of production.

From this standpoint we can say that regulation *in general* refers to the overall commitment to sustainability of the capitalist mode of production, embracing disequilibrium (or 'cumulative disequilibrium' – Coriat and Dosi 2001: 306-308) as the price of a transition to new states which embody that general commitment. As Boyer rightly says, the regulation approach is an improvement on the neo-classical perspective, which considered crisis an absurdity (Boyer 1990a). Regulation *in particular* is normally conservative but a phase transition occurs precisely at a point where the commitment to regulation in general cannot be fulfilled other than through system-change. Aglietta is partly right that systems function by modifying the regulation mode in order to 'plug the gap' whenever a weak point occurs (Aglietta 1979: 20). But actually this image seems most appropriate to the maintenance of equilibrium within a particular regime of accumulation than the transition between them. At the level of capitalism as a whole (as a mode of production), radical step-level change is normal. Within the particular institution, or (on a time-scale) within the particular regime of accumulation there is a strong conservative function, which is nevertheless an 'adaptive conservatism' which accepts the possibility of disruption circumvent it.

5. Whole System and Individual Actor

Does the adaptation occur at the level of the whole system, or of its individual 'cell' or component? In some sense, we need to consider the "consistency of individual behavior with the schema of reproduction (Lipietz 1986b, *cited in* Gordon 1997)". But the unit of analysis may also be the whole system. This is a fundamental issue which we will now explore.

The regulationist perspective is vulnerable to an accusation of structural functionalism (Bonefeld 1987; Clarke 1988). Perhaps out of sensitivity to this accusation, Lipietz emphasises both the accidental character of regimes, and that they must to a significant extent be explained through the behaviour of the individual actor, i.e. business decisions (c.f. Lipietz 1985). This implies an evolutionary ('blind watchmaker') approach as against a mystical vision of a capitalism which 'thinks' at a whole systems level. But, as Clarke notes (Clarke 1988), this defence is not entirely convincing, since there remain strong structural-functionalist elements particularly within Aglietta's (1979) model.

This debate posits the issues somewhat undialectically, and in too stark a way. To begin with, in the real world the resolution of the 1970s structural crisis was strongly influenced by a strategic core of capitalist class interest, represented in the Trilateral Commission, G7 etc., and the need to smash at all costs threatening forms of

‘information about the future’ represented for example by the Southern project for a New International Economic Order (itself capitalist, but dangerous to the dominant interests). The 1980s regime of accumulation therefore partly pre-evolved as a strongly class-determined form of ‘information about the future’. It defined the parameters within which evolution *subsequently* occurred, providing an ‘environment’ conducive to the self-evolution of ‘organisms’, for example raiders (predators) preying upon the bureaucratic inertia of the conglomerates or new-style corporations preying upon newly-privatised resources.

At the same time, insofar as a notion of evolution is valid, we would argue that it is not in any way incompatible with a whole-system perspective: biologically, it is precisely at the whole-system level that evolution is most important, and single-gene reductionism is actually a distortion (Goodwin 1996). The problem with structural functionalism in general is its over-emphasis on the conservative aspect of regulation, but this can be critiqued without sacrificing the whole-systems perspective, which remains valid. In fact, regulation could have done more to consider crisis in macro-structural terms (c.f. De Vroey 1984; Leborgne and Lipietz 1992).

While on the one hand, the issue of ‘structural selection’ remains an issue for consideration Offe (1974), it can be accepted that part of development can be seen as evolutionary at the basic-unit level: it is indeed the most logical solution is for the base units of capitalism not only to self-organise but to ‘self-select’ by processes which do not require too much intervention. Here, institutional theory would have some equivalent to the micro level in pure economics. It is important that, as Hodgson and Knudsen correctly observe, in an evolutionary model, development does not necessarily lead to the highest efficiency, and could even take a fundamentally ‘wrong turn’ (Hodgson and Knudsen 2005). In relation to our energy perspective, this raises interesting normative issues about capitalism’s status within human history as a whole to which we will return later.

We must be aware of dangers in the social-Darwinist approach. Notably, we must not confuse the fact that social regulation is intrinsically linked to that of the natural world with an assumption that both operate in the *same* way. In practice, evolutionary models have always been used to give legitimacy to capitalism as an inevitable ‘natural’ system and to cover over the extent to which the ‘environment’ within which firms evolve is heavily constrained at a macro level by class interest. This issue cannot be sidestepped.¹ Similarly, Schumpeter’s model of innovation is attractive to evolutionary biologists because it distinguishes between the ‘genetic’ raw material (invention) and its ‘fixation’ in successful life-forms (Erwin and Krakauer 2004); but if an image from capitalist development is used to conceptualise natural processes, and then these models in turn are made to depict capitalism itself as natural, the reasoning becomes circular. The evolutionary level of analysis should not, therefore,

¹ It is noteworthy that the examples Hodgson and Knudsen give of the external impact of societies in promoting change are deliberately very anodyne ones, glossing over the real-world instances in which social-Darwinism has been used to justify the ‘spread’ of capitalist relations, i.e. colonialism and genocide.

supercede the class analysis of the classic Marxist model, but rather provide a realistic context in which it operates.

Having established these warnings, it remains true at a certain level that the development of the system must be explainable in terms of the behaviour of its basic units; we should therefore build into our model a certain element of evolution propelled by the basic cell of capitalism, the firm.

At this point, it is helpful to consider the implications of the notion of path-dependence. A useful way of conceptualising the dialectical relationship between conservatism and change, will be to posit a notion of ‘developmental conservatism’. Path-dependence is developmental and not static. For example, institutions have their own social dynamics (Favereau 1995: 517). Development occurs, but along an established trajectory. The literature suggests that the path will be followed if participants derive ‘increasing returns’ (Pierson 2000), which could be represented as a form of feedback. Interestingly, in parts of the management literature, routine itself appears as a resource – for example, takeovers may occur in order to acquire it (Karim and Mitchell 2000). Let us now apply our energy perspective to this idea. It should be clear that path-dependence is a form of inertia. For example, the resource is ‘conserved’ in the accretive process of business takeover. A supplementary input of energy is necessary to depart from the path-dependent trajectory. But in certain circumstances this appears necessary; here, major change can arguably arise from the perception, at a ‘single-cell’ level, that more energy can be released by the creative destruction of the routine.

At any level, there comes a certain point where the necessary conservatism – or conservation of momentum – which fulfils the indispensable task of safeguarding the individual institution or regime of accumulation receives feedback from the social realm it is supposed to be regulating, showing it that it is expending more energy in trying to keep it in the mould than it is would by accepting the need to smash the mould. On such occasions, routinisation appears as a hindrance. An extra input of energy is needed to overcome the inertia and push capitalism onto a different course.

Again, the notion of ‘creative destruction’ is helpful if approached from a systems perspective. It is recognised that the current regime of accumulation since 1980 was strongly *associated* with the destruction of a certain category of institutions, most obviously the state, as well as transnational corporations and conglomerates (c.f. Jenson, 1989; Jessop, 1996), the result being a more heterogeneous regime (Delorme 1991). We would emphasise the reduction in “order and intentionality” (c.f. Robles 1995: 99) within this regime. But, in applying the energy perspective we would further emphasise two things: firstly (the more optimistic aspect from capitalism’s point of view), energy could in a sense be ‘freed’ through the destruction of such bureaucratised and over-centralised economic governance institutions. Secondly, (the more pessimistic dimension), the entropy which runs through this creative destruction: forms an arrow of time, both in the sense that what has been destroyed cannot easily be reconstituted – it is easier to move from simplicity to complexity than the other way, so it may be very hard to return to an *effective* top-down

governance, should this become necessary – and in the sense that the same material cannot be creatively destroyed twice.

Intrinsic to the systems approach is an uncertainty principle. Change is open-ended, and although transition to a new regime of accumulation can be analysed *ex post* as a resolution of contradictions in the earlier state and the logical possibilities for such resolution, this does not mean that a particular outcome is predetermined. Regulation *in particular* can therefore mainly be reconstructed from hindsight, and Lipietz is *in this sense* correct in emphasising the accumulation regime as a chance discovery emanating from social and political struggles for new institutional forms (Lipietz 1986a, 1986b; c.f. also Boyer, 1990b), as is Jessop in emphasising regulation as *result* (in distinction to process) (Jessop 1990). But while this correctly pinpoints the open-endedness of change and the absence of pre-determination, it underestimates several factors. Regulation *in general*, as a property (process) of all systems undoubtedly exists *a priori*: we can be sure to witness processes of emergence, feedback, qualitative transition between conservatism/equilibrium and the embrace of change. We can use the dialectical principle of the negation of the negation to reconstruct the outlines of a certain broad logic. The ‘arrow of time’ represents certain general entropy running through the mode of production, requiring to be addressed somehow (even if we can’t predict exactly how). Finally, there is the class-interested character of “information about the future,” about the choice of solution from among the open-ended possibilities.

This is where the Gramscian dimension of regulation becomes crucial. The dominant ideology of society will emphasise either the forces of inertia or change, according to the circumstances. Sometimes, equilibrium is sacrosanct (the classic, right-wing conservative approach); sometimes the seemingly inexorable objective forces of *change* are highlighted, as in the globalisation discourse (Jessop 2005). The key importance of the Gramscian dimension is that here ‘hegemony’ unifies on the one hand the *instrumental*, manipulative aspect of information about the future, which lies at the core of really-existing capitalist regulation; and on the other hand, a certain dimension of systemic co-evolution which is not entirely purposive and partly emergent. Indeed at the most macro level of all this reflects the alienation highlighted in the origins of Marxian dialectics: a dynamic created by humanity has acquired a momentum – the highest-level path dependence of the capitalist mode of production as a whole – which threatens to devour it, and where even the most conscious sphere of regulation remains largely a prisoner of a destructive impetus inherent in capitalism itself.

Together, these elements of hegemony act to constrain the institution-world of structures, which are emergent at the meso-level, as well as seeking to influence the bifurcation of step-level change, to channel pluralism and complexity. A certain vision of ‘information about the future’ is asserted, partly as a *real* strategic choice of direction, partly as ideological disinformation, confusing the nature of change or falsely pretending it to be more objective than it really is.

The hegemonic character of regulation is undoubtedly a way of trying to harmonise different antagonistic aspects of capitalist society (Demirovic 1988). At the same time, we would reject a reading (for example, Torfling 1991) where this operation is *essentially* discursive. Hegemony is on the one hand strategic, political and class-oriented (Hirsch 1988: 2); on the other, it is itself emergent, *co-evolving with the system it regulates*, receiving real-world feedback from its success in promoting not just the expanded reproduction of capital, but also social control.

The relationship between regulation at the level of the mode of production as a whole and at the level of the individual accumulation regime *within* that mode of production, between mode and regime of accumulation, between macro and micro, between cyclical and accumulation crisis: these are all important issues within the literature (c.f. Lipietz 1985; Coriat and Dosi 2001). While acknowledging the importance of these debates, we feel it is important not to be bogged down in formalistic terminology. This is why our model draws from Marxism an important distinction between the positive and normative. At first sight, it seems that the transition between regimes of accumulation is merely ‘positive’, the reproduction of the capitalist mode of production, without raising any normative issues. But the day-to-day development, even in its apparently finest details, always has a certain normative aspect, i.e. one which calls into question the mode of production as such. Our argument is that what gives expression to this ever-present normative dimension is the entropy: each act of regulation consumes the material of future regulation. Aglietta correctly identifies *a certain* relationship between creation and destruction within capitalism, but his identification of a “regime of growth” which achieves “progress for society” (Aglietta 2000: 403) assumes somehow that regulation signifies a conquest by capitalism of its darker side. We regard this distinction as simplistic: at the level of energy, regulation is an act which permits a more efficient destruction and *it itself embodies the entropy of the mode of production*.

The concept of imperialism becomes important here, since it centrally embodies a certain notion of capitalism exhausting itself, as in Lenin’s definition (Lenin 1938 [1916]). With the rise of corporate capitalism, it would seem that the micro processes are superseded to some extent by organisation. The classic Marxist critique of imperialism took the normative view that capitalism, having lost its former dynamism, was irrational from the viewpoint of human history as a whole, the benefits of greater organisation being destroyed in the wastefulness of inter-corporate (and international) conflict, premised on exploitation of the periphery. There appears to be an arrow of time in the sense that features introduced by imperialism cannot be reversed.

How does this measure up to the realities addressed by institutional theory? We argue that in the largest strategic sense, the normative vision is still correct, but the unfolding of the dialectic is different. What capitalism has done is to adapt to the changes. Initially it seemed that the *organisational* aspect of the institutional role would expand, that of micro-evolution and emergence shrink. The adaptation in this case would be for innovation to acquire a new form: as Schumpeter observed (c.f. Langlois 2002), it becomes more bureaucratised and organised, implicitly, therefore, less evolutionary. But this could not be a complete solution because one would lose

the emergent ‘spontaneous order’ of market capitalism, of a Darwinian natural selection of successful innovation, in favour of an explicit, centralised, and top-down organisation which is more wasteful in regulatory energy. This provides a context to understand the developments of the post-1980 phase whereby, through a form of adaptation which one can really only understand as a whole-system-level evolution, capitalism discovered a way to make bureaucracy co-exist with spontaneous emergence. For example, with respect to innovation, researchers of top corporations regularly network with one another irrespective of the boundaries of the firm (c.f. Pyka 1999).

This appears superficially to reverse the arrow of time, but this is only an illusion: the dissipation is simply displaced into other realms: a massive (non-reversible) increase of commodification and the decay of the social fabric in many areas of the world. To understand this in a full sense, we must now transcend the limited framework of our argument so far, and address the central issue within dialectics, that of humanity’s relationship to nature.

6. The Dimension of Energy in the Relationship between Social and Physical Systems

If we approach the world from the socio-economic sphere looking outwards, it is already apparent that the capitalist economy is not wholly self-contained. This ‘non-self-containedness’ has two aspects. **Firstly**, at an intra-societal level, ‘pure’ capitalism depends on a substratum or ‘life-world’ of social relations existing outside the value form, underpinning the ‘exoteric’ world of everyday economic life (c.f. Jenson 1993); these relationships, despite their commodification, are largely reproduced outside any immediate capitalist labour process (c.f. Hübner 1990), placing the working class (the sole source of value) outside as well as inside the logic of capital. This raises many questions about the social sustainability of institutional ‘fixes’ (for example, Peck and Tickell 1992, 1995).

Secondly, of particular relevance to this part of our argument, is the *extra*-societal dimension, expressed in the relationship with nature. As Polanyi noted, ‘land’ (in the broad sense, nature) is a fictitious commodity whose times of reproduction do not coincide with those of the capital relation (Polanyi 1957; also Altvater 1973, O’Connor 1994). The fictional ‘pure capitalist economy’ is thus intrinsically structurally coupled to other systems with their own operational logics or instrumental rationalities (Gordon 1997).

Our argument goes further, however: rather than ‘looking outwards’ from the sphere of capital, we should take the standpoint of nature and ‘look inwards’. Here, the issue of energy in its original and more direct sense is fundamental.

Since regulation within any system constitutes an increase or at least maintenance of order, this satisfies the Second Law of Thermodynamics only if it is counterbalanced by some dissipation into an ambient system, its ‘environment’. This is true of the self-

regulation of physical systems, and it is a constraint which social systems must likewise observe.

All usage of energy is a form of ‘creative destruction’ but where this is essentially based on the degradation of the sun it can be considered sustainable in an ecological sense (Georgescu-Roegen 1975). An embedded social form of regulation of the human socio-economic system which satisfies this sustainability criterion is in principle possible. This is the essence of traditional approaches, for example in Capra’s model (Capra 1975), premised on a conscious dialectical unity between creation and destruction (the ‘dance of Shiva’). If we translate this into regulationist terminology, it signifies respecting, and to some extent *learning from* (importing, so to speak, into the vocabulary of human regulation) the modes of operation of the natural system.

However, as the early Marxian analysis shows, the relationship with nature is ruptured under capitalism. The limitation of considering ‘creative destruction’ merely from an intra-capitalist perspective would be to neglect the natural basis and falsely assume that such a process *can* occur within a closed system; indeed, despite having coined such a potentially dialectical concept, the weakness of Schumpeter’s actual treatment of the creative destruction idea is precisely to emphasise that it proceeds *from within* (Schumpeter 1975: 82ff), a mistake which traditional belief systems would be less likely to make.

By viewing this concept in regulationist terms, we can say that what is new with capitalism is that it opens the possibility for *social regulation processes to have extremely high costs in terms of dissipation into the physical environment*. Or to put it another way, what seems to be a beneficial elimination of harmful externalities within the social sphere can merely signify their export in the form of physical-environmental externalities.

The physical basis of the non-sustainable, capitalist energy degradation, is expressed in the reliance upon exergy or negative entropy (c.f. Dincer 2002), i.e. raw materials and fossil fuel which are available in a particularly concentrated (simplified, non-chaotic) form, whose order is destroyed as they are used up. This is the equivalent to the ‘arrow of time’ inherent in the non-repeatable creative destruction of institutions which we discussed earlier: Thatcherism in Britain fuelled itself both from a non-repeatable ‘institutional windfall’ (the destruction of the public sector) *and* from a non-repeatable ‘exergy windfall’ (North Sea oil).

The complementary opposite of this *continuous* form of energy-degradation, is the sense of ‘creative destruction’ to mean step-level changes, major qualitative changes in the *technological and institutional framework* whereby the more continuous creative destruction unfolds. The energy transitions (Leach 1992, Melosi 1982) can be considered to underpin the long cycles of the capitalist political economy which mark such step-level changes (Braudel 1979, Mumford 1934). The energy transition *in the general sense* is thus a transition from solar energy to one premised on the destruction of negative entropy (exergy), but this transition is not sudden: it is broken into a

number of phases, which form the basis for the energy transition in the *specific* sense, i.e. the qualitative development of the capitalist mode of production through a succession of long wave cycles of capitalist expansion and interrelated regimes of accumulation. More specifically, it was primarily the 20th-century long cycles, premised on a more intensive ability to exploit finite fossil fuel resources, which made it seemingly possible to rehabilitate a Promethean growth ideology taken from the anti-Malthusian trend of earlier capitalism (and of the utopian modernisation perspective, c.f. Rich 1994). Since under capitalism there are no negative feedback mechanisms to counter the fundamental *reproduced* mechanism of the mode of production itself, namely capital accumulation (an issue valuably highlighted, albeit with some weaknesses, by the ‘Limits to Growth’ Report, Meadows *et al* 1972), a process of enhanced environmental degradation would then take on a momentum of its own, but at a hidden cost. The scope of regulation increases, but with an equivalent increase in entropy which at a particular point in long-cycle development begins to bite back.

As we have argued, capitalism has developed ways of economising *regulatory* energy, by means of the shifting equilibrium (itself a form of regulation) between agency – including not just centralised agency but the bottom-up agency of regionally located actors (c.f. Peck 1995; Peck and Tickell 1994) – and self-forming emergent structure. *The question is whether regulation could achieve similar successes in conserving physical energy.*

Apparently this might be the case. Physical productive systems can be designed to minimise unnecessary dissipation, and systems of work-organisation could follow exactly the same approach (Wall 1993). This implies the possibility of unifying the organisational principles of machines and society.

But, whereas such a possibility is indeed potentially interesting under a post-capitalist order, it seems unlikely to be realisable under capitalism. Instead, the argument serves primarily an ideological role, endowing the notion of social efficiency with a spurious class-neutral objectivity and masking the fact that its primary purpose is efficiency in the expanded reproduction of capital rather than the conservation of energy per se. *It seems more plausible, as some evidence suggests, that capitalist organisational order is negatively related to the physical environment* (Biel 2006). The hypothesis we are advancing as a basis for future work, is that a negative relationship between regulatory efficiency and energy efficiency is intrinsic to capitalism. If this is the case, we would expect the disorder *apparently* reduced in the regulatory sphere to be exported into the physical environment, in the form of a more intense degradation to nourish the expanded reproduction of capital.

Liberal economics’ emphasis on scarcity provides an apparent ecological dimension for capitalism, but this always goes hand-in-hand with developmentalism: the *boundaries* of the scarce resource-base can be expanded, apparently without cost. In our dialectical model, the development is fully recognised, but it *has* a cost. Development does occur, the limits are ‘pushed’, visible in the introduction of new technologies and energy sources to inaugurate new long cycles and provide a material

underpinning for the possibility of resolving the accumulation problem in a macro-regulationist way, i.e. through the introduction of new regimes of accumulation. The limits are not absolute, Malthusian ones, but rather ‘dynamic limits’, unveiled in and through the process of development. This is fully consistent with the Marxian vision, which espoused neither absolute limits nor developmentalism.

We are here formulating in a new way what institutional theory has always correctly recognised, that capitalism remains developmental and can in some sense tame its destructive side. But we are also emphasising the hidden *cost*. The entropy will catch up with it. This is implicit in the very successes of regulation, which both – in the socio-economic sphere – exhausts the vocabulary of *future* regulation, and – in the physical dimension – always requires the depletion of fresh sources of exergy through fresh technological means. Ultimately, regulation under capitalism exports into the future the entropy inherent in that mode of production’s alienation of people’s relations to nature.

How would this express itself within the institutional sphere? Institutions, like organisms, process energy. We are subdividing this into social and physical energy, with a strong possibility of a trade-off between them; the large-scale institutional framework oversees this in a global sense. Our hypothesis is that the ‘dynamic limits’ would be revealed in two interrelated ways: as a feedback from the physical environment attacking the regulation sphere from without, i.e. by posing problems of increasing complexity; and within that sphere itself, as a shrinking capacity to regulate them.

7. Conclusion: The Normative Dimension

There are two limitations specific to capitalism: its class character and its historically-unparalleled willingness to dissipate the costs of social regulation into the physical world. The two are clearly interconnected. There is overlapping and feedback between the two aspects, for example social power confers control over nature (land, resources), which in turn reinforces social power. And the inefficiency of a social order where class power has to be preserved at all costs leads to a loss of energy within the regulation sphere which can *only* be dissipated into nature. Although in a class-neutral definition, the increase of self-organising (emergent) processes (as in the new management systems) would lead to an efficiency gain, *this is not necessarily true when one takes into account the social energy consumed in moulding and distorting the emergent process (production chains, clustering) to maintain the mode of production.*

At the highest level, regulation is a property of the human social system itself. This may cause it to slough off the capitalist mode of production as a whole, even as the latter, within its own compass, sloughs off different regimes of accumulation in the interest of its own *particular* sustainability criteria, i.e. capital accumulation. The transition between modes of production therefore poses the sustainability issue at an even more macro level than that between regimes of accumulation. In this sense,

capitalism as a whole becomes conservative, even as it desperately seeks to cling to its creative faculty at the regime of accumulation level.

We hypothesise that the current era witnesses a complex regulation-transformation in which two processes overlap: one is the shift to a new regime of accumulation to preserve the mode of production; the other calls it into question. For example, the current social ferment in Latin America partly proposes a certain outcome to an open-ended transition between regimes of accumulation *within capitalism*, but also carries elements of calling into question the mode of production itself. Both the voluntarist side (the state) and emergence (the civil societal fabric) can possibly be targeted as an object for capture by either side. In the deepest sense they pursue contradictory criteria, but nevertheless in the real world closely interpenetrate, making them sometimes difficult to distinguish in concrete cases.

The rise of the normative dimension could be considered a kind of negative feedback at a level of human society as a whole. The dialectic is as follows. A dangerous entropy feedback is induced within capitalism, as the proliferation of accumulation-agents unleashed by neo-liberalism entail an extremely high cost in exergy, which in turn requires an increase in the social power required to *appropriate* the exergy (petroleum, raw materials, products of unsustainable cash-crop agriculture), which in turn translates into militarism and undermines the more subtle manipulation of civil society necessary for pluralistic or 'polyarchic' modes of governance. On past precedent, capitalism would tend to rescue itself by inventing a new regime of accumulation. But at a particular point in its history (which we are suggesting is now), the rise to the surface of the entropy means that it must divert so much organisational energy into safeguarding the mode of production itself that it cannot invest enough in discovering that regime. At this point, we enter a situation where the agent becomes human society in general trying to rescue itself.

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