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**A Critique of Bob Jessop's Application of Biocybernetic Frameworks in
Regulation Theory**

James Juniper

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Centre of Full Employment and Equity
The University of Newcastle, Callaghan NSW 2308, Australia
Home Page: <http://e1.newcastle.edu.au/coffee>
Email: coffee@newcastle.edu.au

1.0 Introduction

Regulation Theory is an influential and significant strand of thought in social geography. Bob Jessop is undoubtedly one of the major theorists working within the British tradition of Regulation Theory. His knowledge of and contribution to Marxist political economy has been comprehensive and he is a prolific writer whose work appears in a wide variety of geographical, sociological and political journals. In social and urban geography circles, his notion of the neoliberal transition from a Keynesian Welfare State to what he calls the Schumpeterian workfare postnational state, is much cited.

However, in recent contributions Jessop has, in particular, drawn upon the work of the German Social Theorist, Niklas Luhmann, especially his conception of autopoiesis. However, in historical terms, this concept was originally developed by Maturana and Varela's to explain the characteristics of the cell as a bounded and self-maintaining configuration of metabolic processes. As we shall see, Luhmann's own deployment of the concept of autopoiesis is somewhat idiosyncratic and Jessop has added his own unique twist on existing interpretations weaving them together with certain ideas taken from Karl Polanyi's *The Great Transformation*.

The motivation for Maturana and Varela's research, much like that of their contemporary, Robert Rosen (1991, 1989), has been to clarify the difference between living systems and inorganic systems. These authors are united by the contention that the physical sciences cannot adequately account for the functional properties of life itself. Maturana (1980), together with Varela and Uribe (1974), has defined an autopoietic system as,

[...] a unity by a network of production which (1) participate recursively in the same network of productions of components which produces these components, and (2) realize the network of productions as a unity of space in which the components exist (Varela, Maturana & Uribe 1974: 188).

Varela's work (1979) is regularly cited by researchers in the social sciences; including Luhmann (1986, 1995) in sociology, Teubner (1988) in jurisprudence, as well as Jessop (2000, 2001) in political economy and human geography. Other zones of influence, which are not examined further in this paper, include organisational studies and public administration.

This paper is motivated by a series of questions pertaining to this notion of self-organization. First, what motivates the adoption of autopoietic frameworks on the part of social theorists, including Jessop? Second, are there alternative approaches within theoretical biology that may afford more insights into social relations than those currently derived from the application of autopoietic models. Third, what other non-biological approaches have been applied to explain recent neo-liberal developments:

both within social processes of communication in general, and state regulation in particular? With these goals in mind, section 2 of the paper evaluates some of Jessop's recent contributions on Regulation Theory, including his analysis of the Schumpeterian Workfare Postnational State (SWPNS), his attempts to combine autopoiesis with Polanyian perspectives on capitalist accumulation, and his efforts to ground autopoiesis within a Structuration theory framework. Section 3 then examines alternative bio-cybernetic conceptions that provide a different constellation of insights into social processes of reproduction and institutional resilience. The first of these is Robert Rosen's category-theoretic model of metabolism-repair and replication systems, while the second articulates a model of self-directed anticipative learning. Section 4 examines Foucault's interrogation of bio-cybernetic and system-theoretic interpretations in the social sciences before addressing Zolo's more specific philosophical critique of autopoiesis. Sub-section 4.3 draws on Rosen's work to question the validity of Jessop's Structuration-theoretic interpretation of autopoiesis. In Section 5, this destructive and increasingly focused critique is replaced by more constructive efforts to frame an alternative reading grounded in Foucault's work on neoliberalism. Though first, the work of the Australian School of Legal Theory is considered. Concluding comments follow in section six.

Essentially, this paper has been motivated by the desire to understand why such an abstract, arcane, and somewhat unwieldy notion, has been plucked from the theoretical biology literature and then applied willy-nilly to the social sciences, and what this could possibly afford one of the more keen-minded and theoretically attuned of Britain's Marxist geographers. It therefore begins in section two, by reviewing three strands of argument that Jessop develops in support of his autopoietic turn.

2. Jessop's Autopoietic turn

To set the context for Jessop's theoretical innovations the following section of the paper reviews his reading of neoliberal developments within European Nation States. The further relevance of this excursus will become clear in sub-section 5.2 of the paper where Foucauldian interpretations of the shift from *Government* to *Governmentality* will be discussed. Jessop's interweaving of Polanyi's political economy with Luhmann's notion of autopoiesis will be discussed in sub-section 2.2. Sub-section 2.3 then examines Jessop's reading of Structuration Theory.

2.1. The Schumpeterian Workfare Postnational State (SWPS)

Jessop's use of the term SWPS within the context of Regulation Theory suggests the constitution of an entirely new *regime of accumulation* and *mode of regulation* to replace the crisis-ridden *Fordist regime*. The elements of the SWPS are three-fold: the hollowing out of nation state, the transition from Government to Governance, including the development of new regional governance mechanisms, and the redistribution of resources to support internationally competitive industries, regions, clusters, and enterprises¹.

¹ As the primary focus of this paper is on Jessop's use of the autopoietic conceptual apparatus, it has not subjected to criticism his surprisingly conservative political economic analysis of the 'hollowing out' nation state. However, a broader critique of views such as this is presented in Juniper and Mitchell (2006).

Jessop, in his later work, was obliged to concede that his earlier analysis suffered from being too descriptive. His subsequent use of Regulation Theory has therefore focused more on explanation and has applied a neo-Gramscian framework placing more emphasis on hegemonic state projects and issues of political strategy rather than on economic forces alone. Contradictions within a hegemonic social paradigm can lead to legitimation crises for the social bloc from out of which new blocs can emerge that may resonate more closely with “lived experience”. Jessop has usefully defined Liberalism as an ideological discourse, a strategic concept, and a form of social organization predicating social relations on the formally free choices of individual actors. The institutional means for achieving this outcome entail in economic terms, the expansion of the market economy; in political terms, the imposition of limits over the powers of a constitutional state; and a commitment to substantive freedom of legally recognized subjects (Jessop, 2002: 106)².

Along somewhat conventional Marxist lines, Jessop argues that liberalism is a “spontaneous philosophy” within capitalist societies—a seemingly natural and self-evident *imaginary* that corresponds to four features of bourgeois society: (a) the institution of private property; (b) the appearance of “free-choice” within the sphere of consumption; (c) the institutional separation and autonomy of market and state; and closely related to this, (d) the institutional separation of civil society and the state (Jessop, 2002: 108).

By the same token, he notes that opposition to liberalism may emerge spontaneously on the basis of four features that are closely related to the previous set, namely: (a) the growing socialisation of the forces of production; (b) a common but conflictual interest of all producers over the maximisation and the sharing out of total revenues; (c) the contradictions posed by the institutional separation of, yet on-going mutual dependence between market and state; (4) the contradiction between civil society as the sphere of particular interest and the state as the supposed embodiment of universal interests (Jessop, 2002: 109).

On the basis of this framework Jessop goes on to chart the various modes of neoliberalism that have developed in recent times straddling the antagonism between advocates and opponents of liberalism, much as the market economy evolved out of the contradictions of nineteenth century competitive capitalism (Jessop, 2002: 110). However, considered in isolation, this approach conceiving liberalism as a spontaneous philosophy is one resistant to historical analysis. In this light, it is understandable that Jessop has turned to Karl Polanyi’s historical analysis as a supplement. This approach is discussed in the next section of the paper.

² Although the cited paper was written *after* Jessop’s apparent conversion to autopoiesis, it faithfully reflects concerns that have been addressed in his Regulation-theoretic work over much of the 1990s. This paper has been chosen for the richness and sophistication of its analysis of liberalism as an ideology.

2.2. Jessop's Polanyian Interpretation of Autopoiesis

For Jessop, autopoiesis denotes a class of systems (natural, social, or artificial) that are concerned with their self-reproduction, all the while co-existing and co-evolving with other systems in relations of reciprocal interdependence. This class is self-constituting insofar as it “defines and defends its own boundary *vis-à-vis* its self-defined external environment”, and self-organising “to the extent that it possesses its own distinctive operational codes and programmes” (Jessop, 2001a: 217). This co-evolution is “shaped by the ‘lifeworld’ [...] that is formed by various social relations, identities, interests and values not otherwise anchored in specific systems” (Jessop, 2001a: 218).

As such, this capacity for self-organisation and self-production is by no means wholly self-contained. However, Jessop contends that the very incompleteness of such autopoietic systems provides both the possibility of crisis and the need for steering mechanisms. For example, within a capitalist economy labour power is largely produced outside the sphere of the labour process. However, because each social subsystem is primarily concerned with its own self-reproduction rather than with its impact on other systems, forms of heterarchy—self-organization amongst mutually independent actors—may be desirable. In a capitalist economy, for example, Jessop suggests that heterarchy may encompass such activities as interpersonal networking, inter-organisational negotiation, and the intersystemic steering of circumstances in which a variety of operating codes are applied (significantly, Jessop instances the example of taxation rather than more strictly juridical forms of regulation).

From a heterarchic perspective it seems obvious that more communicative forms of social reproduction must go hand in hand with their economic counterparts. Thus, Jessop observes that Autopoietic and Regulation theories share with Karl Polanyi the view that “the universal spread of the commodity form and the resulting dominance of market forces and profit-and-loss calculation throughout society could prove self-destructive. This can occur through the extension of commodification to other forms of social life, insofar as non-commercial domains are subject to secondary forms of economic coding, because the dynamism of a global economy may impose a greater burden of adjustment on other non-economic systems; especially as they seek to conform to the requirements of capital accumulation. For Jessop, the critical issue here is capitalism's greater capacity to escape the constraints and controls applied in other systems, which is in turn a direct consequence of accumulation becoming the dominant mode of social activity and valorisation (Jessop, 2001a: 218-219). As Polanyi himself emphasised, in such cases, specific forms of resistance would arise that extend well beyond traditional forms of class struggle: modes of resistance that would obtain in a wide variety of different sites (Jessop, 2001a: 220).

Jessop contends, that these self-destructive characteristics ultimately reflect the underlying contradictions of capitalism; principally, that labour power as a commodity has both exchange-value and use-value, so that the worker is both a concrete and an abstract individual, so that the wage is both a cost of production and source of demand, so that money is both an international currency and a national currency, so that productive capital is both abstract value in motion and a specific

stock of assets, and so that taxation is both a source of revenue and a source of demand. Accordingly, specific regimes of accumulation require specific spatiotemporal fixes and institutionalised class compromises that provide the basis for on-going development: markets only work well in the shadow of the state (Jessop, 2001a: 226).

In situating Polanyi's work, Jessop usefully distinguishes between three levels of social embeddedness: interpersonal relations, inter-organisational, that of institutional orders—market and non-market, traditional and non-traditional—within a decentered society (Jessop, 2001a: 223-224). While Polanyi's principle focus was on third level, Jessop makes use of Polanyi's analysis of *haute finance* to highlight the manner in which this important feature of *laissez-faire* capitalism was woven together with activities and relations situated within the other two levels of social embeddedness (Jessop, 2001a: 225).

Jessop notes that, for Polanyi, *haute finance* contributed to the governance mechanisms of 19th century civilisation by supporting its key pillars: the international gold standard, the balance of power system, the self-regulating market, and the liberal state. He goes on to emphasise the two important new obstacles to the achievement of successful spatiotemporal fixes in present-day modes of regulation and governance: 'time-space distancing' (enabling control and coordination over longer distances and time horizons) and 'time-space compression' (the increased velocity of material and immaterial flows over greater distances (Jessop, 2001a: 226).

While this deployment of Polanyi's work helps to overcome an otherwise idealistic conception of ideology other alternatives exist that place more emphasis on the role of specific material practices in the constitution of subjects. In their sympathetic reading of British Regulation Theory, McLeod and Jones (1999) note Jessop's efforts to develop a neo-Gramscian conception of ideological hegemony. However, they also concur with his use of Giddens's Structuration Theory as a model for dialectical transformations in the relationship between social actors and institutions. In many respects this attempt to combine Giddens and Gramsci within a critical realist framework represents a dominant trajectory within the British tradition of radical social geography. Therefore, the focus of the following sub-section of the paper is on Jessop's Structuration-Theoretic interpretation of autopoiesis (in sub-section 4.3, it is argued that Jessop's resort to a recursive analysis of the Structure and Agency relationship, is fundamentally flawed. However, as the, at times, complex argument draws on Rosen's modeling of metabolism-repair and replication systems, to be reviewed in section 3.1, it must accordingly be deferred to section 4).

2.3. Jessop's Institutional Turn & Structuration Theory

In another paper published in the same year, Jessop (2001b) approaches autopoiesis in a very different direction. He now draws upon Anthony Giddens' notion of 'structuration' to argue that social systems evolve on a dualistic, though interactive, basis: although structures condition and constitute agents, agents not only reproduce,

but also transform structures³. Jessop has taken this logic of mutual interaction to somewhat absurd depths. His *Strategic-Relational* approach to the structuration paradox attempts to account for deeper levels of recursive interaction between the reflexive behaviour of agents and the strategic selectivity of institutions. While acknowledging the mutual conditioning between emergent structures and socialized agents, he descends to a lower level by each ‘unbracketing’ each of the two ‘sublated’ terms, analysing both the ‘structurally inscribed strategic selectivity’ of emergent structures (i.e. what agents can select from any given structure is, in part, structurally inscribed) and the ‘structurally oriented strategic calculation’ of socialized agents (i.e. agents intentionally intervene along structural gradients in ways that transform given structures). At the same time, Jessop cautions that both reproduction and strategic selectivity are only ever tendential: *strategically* selective structures can be circumvented. In other words failure, conflict and lack of realization of agent intentions is always a possibility; and, institutions embody both contradictions and dilemmas.

Jessop goes further in positing a fourth level of mutual interaction, where he encounters the reflexive-recursive unity of opposites dialectically interweaving ‘recursively reorganized structural configurations’ on one hand with ‘recursively selected strategies and tactics’ on the other. Finally, descending to a fifth level, he examines recursive interactions between the reflexive behaviour of agents and the strategic selectivity of institutions (i.e. what he describes as the second-order limits to transforming selectivity). At this level, he argues, interactions are finally and comprehensively incorporated within an *autopoietic* process: one that he concedes can either be structurally coherent or incoherent and contradictory (albeit, in a patterned form that is amenable to theoretical description). Why Jessop decides to stop here is a moot point. This kind of mutual conditioning can obviously be carried out *ad infinitum*. It will be argued below (sub-section 4.2) that an alternative and more sensible approach to resolving the structuration paradox would be to abandon its very premises, despite, or perhaps because of its apparently seductive dialectical subtleties. However, before this alternative is examined we first examine some alternative bio-cybernetic interpretations, arguing that these afford more insight at less cost in terms of speculative excess. This review will be followed by a brief review of more general criticisms that have been directed at bio-cybernetic approaches to social theory.

3. Biocybernetic Alternatives to Autopoiesis

The intention of this work of critical analysis is to investigate Jessop’s use of biocybernetic metaphors in greater depth. Two contrasting biocybernetic perspectives—that of Robert Rosen and that of Maturana and Varela—will be compared. The paper favors Rosen’s approach to the modelling of metabolism-repair and replication systems over Maturana and Varela’s notion of autopoiesis. The precise difference between each will be clarified through a demonstration of how Rosen’s

³ Giddens’s interpretation of this dualism differs slightly from Jessop’s usage. For Giddens, this is less a dialectical relationship and more an antagonism between two modes of interpretations in social theory: one that is predicated more on the structuralism, and the other more on actor-theory. He recommends that social theorists oscillate between each of these modes in attempting to account for social phenomena.

categorical mappings can be *inappropriately* interpreted as a temporally recursive processes, which can then be exposed to a formal limiting operation. When taken to the infinite limit this recursive interpretation of Rosen’s categorical mappings attains a ‘self-reflexive’ state. The paper then argues that this erroneous limiting operation is necessarily implied by Jessop’s autopoietic interpretation of Structuration theory.

3.1. Rosen’s Metabolism-Repair Systems

Rosen’s category-theoretic model of metabolism-repair (M, R) and replication systems is depicted below. In this representation, f represents metabolism, ϕ repair, and β replication. The three boundary conditions relate metabolic inputs a , to outputs b , via the functor f , outputs b to metabolism via the repair functor ϕ , and the repair process ϕ , to the replication functor β . Given a one-to-one mapping between the specific group of metabolic outputs b , and the replication functor β , it must be the case that $\beta = b^{-1}$.

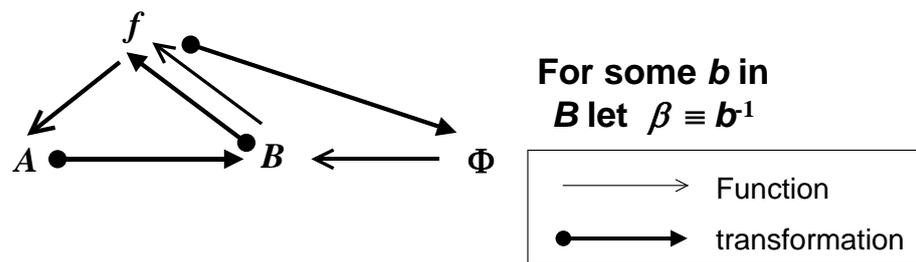
$$A \xrightarrow{f} B \xrightarrow{\phi} H(A, B) \xrightarrow{\beta} H(B, H(A, B))$$

$$f(a) = b,$$

$$\phi(b) = f,$$

$$\beta(f) = \phi \quad \text{with } \beta \text{ equivalent to } b^{-1}.$$

The resulting system of causal entailments is illustrated below,



Rosen models these metabolism-repair and replication systems using category theory—a branch of algebra. He formally argues that any attempt to apply *mechanical* rather than *relational* modes of reasoning to such systems will fail (Rosen, 1992). This is because mechanical simulation is unable to grasp the properties of self-entailment implied by metabolism, repair and replication processes, without falling into infinite regression; either outwards towards larger and more encompassing models, or inwards through fractionation into smaller and more sub-divided models (mirroring the encoding of ‘tangent vectors’ from f itself onto both inputs A and outputs B). For Rosen, the infinite nature of this regressive and dualistic horizon violates the presumed existence of a finite largest or smallest mechanical model, thus undermining the assumption of a finite mechanical model⁴.

⁴ In their recent criticism of Rosen’s arguments Landauer and Bellman (2002:3-4) complain that the f acting as the metabolic function cannot be the same f as the one represented as the output of repair process at a given moment of time, is entirely without merit. is purely logical and algebraic and, thus, devoid of time, states, and state transition sequences. Gwin (2006) points out that the relational mapping in Rosen’s analysis of (M, R) systems are not equivalent to equations. Rosen’s relational models are *atemporal* representations of relations: the category employed is that of *Ens*, whose objects

3.2. Self-Directed Anticipative Learning

A group of Australian and Spanish scholars have developed an alternative conception of biocybernetics based on the notion of self-directed anticipative learning (SDAL). Self-directedness entails adaptive action, aligning needs and opportunities through sensitivity to context. A necessary condition for SDAL is integration across three functional capacities: anticipation, evaluation, and action modulation. While anticipation implies the conditional prediction or evaluation of rewards, reward association does not necessarily dominate over processes of learning and cognition

A constructivist form of realism is espoused: a form predicated on recognition of what is required to deal with fuzzy environments. It is posited that, in the face of uncertainty, organisms achieve reliability, ‘redundancy’ and mutual coordination on the basis of what the authors call the ‘velcro’ principle: in accordance with which binding strength obtains through the cumulative effect of many individually far from reliable connections [Christiansen, 2004:6]. This school of thought draws upon empirical research emphasizing the crucial ‘executive control’ function of the pre-frontal cortex, which achieves ambiguity reduction through the efficient extraction of information about the environmental context. Context-based learning results from integrative regulation across multiple, heterogeneous, information processing mechanisms. Accordingly, both the organisation and retrieval of knowledge is accomplished through error localisation, ambiguity reduction, abstraction [5]. Even higher-level forms of knowledge are seen to be constructed from basic information that is, in turn, derived from interaction with the world. As such, representational formats are construed as embedded within a more broadly determined set of ‘dynamically stabilised constructs’ [7], [19].

In accordance with this view, cognition is thus predicated on the operation of a ‘relational model’ that gradually leads to an improved recognition of relevant information, focuses activity, and supports on-going performance evaluation. Christiansen ignores theories of social intelligence on the grounds that they have nothing to say about cognitive architectures. However, he cites empirical studies focusing on the critical role of interactions between the cortex (in regard to long-term memory) and the hippocampus (in regard to redundancy-suppression and prediction) [21]. Nevertheless, the objectives of this seem to extend well beyond a narrow concern with cognitive architectures as such, focusing largely on ‘reciprocal tuning’ between information acquisition, behavioural patterns and learning processes. In this light, Christiansen and his collaborators argue that there is a deep continuity in the development of cognitive abilities as we move from simple insects to mammals to

are sets, and whose morphisms are mappings among its objects. Landauer and Bellman further accuse Rosen of applying the criterion of non-computability to the actual organism rather than to the formal model of the organism as an (M,R) system (Landauer & Bellman, 2001: 8). In response, Gwin cites Rosen’s careful attribution of the property of computability (and its negation) to *models* of material systems. He notes that Landauer and Bellman (2002: 12) seem especially confused about Rosen’s discussion of analytic and synthetic models. Gwin highlights the fact that Rosen correctly argues that Turing-computability and synthetic models go hand-in-hand, so that it is the specific class of analytic models that are not also synthetic models (i.e. complex systems that result in infinite regress) that are non-computable.

humans. As such, rather than describing the necessary changes in representational cognition that must occur to accommodate situated forms of cognition that can be observed in humans, they favour explanations that trace processes of evolution from simpler forms of situated cognition in lower animals to more representational forms of cognitive ability in humans (Hooker ICBO: 2).

Although higher-order knowledge is supposedly constructed from basic information that is derived through interactions with the world, however, detailed explanations of how this process has evolved are not detailed in Christiansen's work. Instead, he cites Eichenbaum's (2001) research on *declarative* memory, which supposedly incorporates *semantic* memories that, in turn, are constructed through the formation of a multiplicity of links across various elements of *episodic* memory. However, the nature of these semantic and mnemonic structures itself is not specified or described. In their absence it seems reasonable to fall back on the more speculative deliberations of Sigmund Freud about the neuro-cognitive basis for reality-testing and semantic correlates of subjectivity and object-perception.

The specific arguments Christiansen sets out in justifying his abandonment of a 'computational theory' of mind include, first, the apparent correlation between brain size and problem-solving flexibility. Second, Christiansen cites evidence supporting the notion of human general intelligence. Nonetheless, he does acknowledge that words act unconsciously as 'scaffolds' for information grouping (which he labels with the term *unitisation* —a somewhat unfortunate neologism), taxonomies, and the 'setting' of feature space. In this hesitant recognition of unconscious cognitive activity, Christiansen fails to make the well-known Freudian distinction between that which is merely preconscious in the human psyche (and can thus be recalled to consciousness) and that which is unconscious.

Hooker (I&CBO) complains that Maturana and Varela treat multi-cellular organisms in terms of repetition at the level of the whole organism of the autopoiesis applying (as cyclic regeneration) to single cells. In contrast, he point out the fact that multicellular organisms have further capacities allowing them to replace environmental construction with the internal construction of components, and to self-regulate to achieve damage control and acquire food, and the ability to self-regulate metabolism over different time-scales. They argue that mind has essentially evolved from these processes of increasing self-regulation of interactions.

Hooker and Christiansen's analysis of SDAL provides useful insights into the biological characteristics of cognition, perception and learning without resorting to anything resembling Maturana and Varela's construct of autopoiesis. However, it has less to offer for critical social theory because, in coming from a biological perspective, like it autopoietic counterpart it too chooses to focus on pre-linguistic models of cognition and learning. In contrast, Rosen's critique of mechanical reasoning has enormous value for thinkers such as Michael Polanyi and Michel Foucault who are resolutely opposed to biological reductionism in the social sciences.

In fact, the principle target of the critiques of autopoiesis to be examined below, is Spencer-Brown's presumed equivalence between the constitution of boundary and the cognitive act of indication: a notion set out in his *Calculus of Indications* and taken up by Maturana and Varela and Niklas Luhmann. Indeed, it will be argued below that this questionable argument is one that most often leads autopoietic researchers into committing some of their greatest blunders!

4. Critiques of Biocybernetic Applications in Social Theory

The following section of the paper begins with a review of Foucault's wide-ranging critique of biocybernetic approaches in the social sciences. This is followed by a brief examination of Zolo's more specific philosophical critique of autopoietic reasoning. Sub-section 4.3 then provides a specific critique of Jessop's autopoietic interpretation of Giddens's Structuration theory, which is predicated on its demonstrated resemblance to an erroneous, recursive reading of Rosen's work made by scholars who adhere to an autopoietic framework of analysis. This section of the paper serves as a prelude to a subsequent discussion of alternative approaches to that of autopoiesis: namely, the Australian School's conception of responsive regulation, which is rejected; and Foucault's notion of governmentality, which is endorsed as suitably rigorous framework.

4.1 Foucault's Concerns about Bio-cybernetics

Foucault's (1970) early concerns about the use of biological constructs in the social sciences will be examined in this sub-section of the paper. In sub-section 5.2 of the paper it is shown how these insights can fruitfully be combined with Foucault's later works on power-knowledge, governmentality, and neoliberalism (Lemke 2001, 2002), which have informed at least one influential strand of research on governance and regulation (Jose 2005b; Juniper & Jose 2005).

In *The Order of Things*, Foucault characterizes the nineteenth century episteme governing the human sciences as one inscribed by three faces: the mathematical and physical sciences, philosophy as an analytic of finitude, and the three positivities of labour, life and language. Foucault argues that from the nineteenth century onwards—conditioned by a breakthrough in the structuring of scientific knowledge in the natural sciences, political economy, and general grammar—the latter positivities were “folded back upon themselves”, possessed by their own densities, and by their own historical laws and temporalities.

Contemporaneous with the birth of the new sciences of economics, linguistics and economics, he suggests, Man as an anthropological concept comes into being determined by these sciences as a living being, an instrument of production, and a vehicle for words which exist before him, marked by them in his finitude. And now, Foucault suggests, knowledge will be attained in him, he will render all knowledge possible, not through representation, as it was in the Classical period, but in his finitude now understood both in terms of both his anatomico-physiology and the particular historico-social conditions that govern him.

When the sciences of life, labour and language are intertwined with philosophy what arises are the respective philosophies of life, of alienated labour, and of symbolic forms. When, instead, they are related to mathesis, the outcome is that which can be rendered into mathematical form in the empirical sciences. Finally, when philosophy is wedded to mathesis the outcome is all that is formalizable in thought. However, Foucault notes that a relation to mathesis, as such, can never constitute the human sciences despite the fact that they share the use of mathematics as a tool with the other sciences. Instead, he argues that there is no new advance within mathematics that would justify such a reductionist approach, but rather a common retreat of mathesis, a disruption of the unitary field that mathesis possessed in the Classical period, which effectively made it possible for man to constitute himself as an object of knowledge. And this retreat is occurring in response to the convolutions of the positivities of labour, life, and language upon themselves (349).

Elaborating further on this architecture of the human sciences, Foucault observes that in determining the form of their positivity, two different types of models have been adopted. The first of these involves concepts introduced from another domain as figures or images (Foucault specifically cites the role of energetics in Janet and dynamics in Lewin). At first sight, Cybernetics and General Systems Theory would seem to fall into this category of model insofar as they draw upon algorithmic and optimising principles from mathematics. However, things are obviously more complicated than this. Foucault goes on to discuss a second approach that has been adopted in the human sciences. This involves the fabrication of constituent models that extend beyond their initial zone of appearance (pp. 356-57). Foucault instances three sub-categories of constituent models drawn, respectively, from biology which are associated both with *functions* (homeostasis, adaptation, evolution) and *norms* of adjustment; from economics where divergent interests and needs lead to situation of *conflict*, which can later be resolved into a resulting body of *rules*; and finally, from language, which at first conceives of social customs and rites as *systems* of signs, and then examines resulting fields of meaning or *signification*.

He further notes that all three sub-categories can be superimposed as secondary models on analyses conducted using other models as their primary vehicle (p. 358). Maturana and Varela and Luhmann afford obvious examples of such an approach. They commence with a primary model based on mathematical theories of information and communication, which is then overlaid by a secondary model based on biological notions of self-reproduction. Foucault warns that whenever this kind of borrowing occurs it always operates in such a way as to bypass the *epistemic* complexity discussed above, which, instead, is replaced by mere opposition between various models.

Foucault's analytical approach applied in work published after *The Order of Things* is not predicated on the dichotomy between social structures and individual or collective agency to be found in Structuration-Theory. As Deleuze cogently argues, Foucault instead examines the correlation between power relations and knowledges (Deleuze 1999, 33-4). Where power incites, provokes and produces different forms of

knowledge, knowledge itself actualizes, modified and redistributes categories of power. In this context, Foucault's critical interrogation of power relations and the human sciences emphasizes sites of resistance to the differing forms of power in regard to their position, their point of application, the relevant methods used, and the antagonism of their strategies (e.g. resistance to the power of men over women, parents over children, psychiatry over the mentally ill, medicine over whole populations, and administration over the way people live).

Power-knowledge relations are constituted within diagrams, assemblages or machines: Bentham's *panopticon* providing an anodyne or exemplary case-study. Bentham's plan for a model prison involves a central observation tower, surrounded by a circular and multi-levelled tier of cells. At any time, the prison guards can observe the occupants within each of the backlit cells without being observed themselves. For Foucault, this abstract diagram of total surveillance governs the concrete mechanisms of a disciplinary society, whose various instruments and practices are oriented by the overarching goal of producing docile and subservient subjects. As Deleuze explains,

...the diagram acts as a non-unifying immanent cause that is coextensive with the whole social field: the abstract machine is like the cause of the concrete assemblages that execute its relations; and these relations between forces take place 'not above' but within the very tissue of the assemblages they produce (Deleuze 1999, 37).

Deleuze contends that *immanent causality* is a crucial concept for Foucault, which he defines in the following response,

What do we mean by immanent cause? It is a cause which is realized, integrated and distinguished in its effect. Or rather the immanent cause is realized, integrated and distinguished by its effect. In this way there is a correlation or mutual presupposition between cause and effect, between abstract machine and concrete assemblages (it is for the latter that Foucault most often reserves the term 'mechanisms') (Deleuze 1999, 37).

Situated within these abstract apparatuses or assemblages, the power-knowledge 'couplet' operates as a strategic force binding together what would otherwise be two irreducible strata: *visibilities* (or what is perceived as the expression of specific conditions of emergence), and *statements* (or what is articulated as the expression of certain conditions of enunciation)⁵.

There is no presumption of an isomorphism between the two strata: Foucault rejects a Neo-Kantian position because the inter-weaving occurs on the side of the object and historical formation, rather than through a universal and transcendental subject (or inter-subjectivity). Nor is Foucault a Heideggerian because he refuses to speak of a

⁵ See Foucault (1983) and Deleuze (1999: 64 & 63; citing Foucault 1984: 93-4). Of course, it can now be appreciated how this Foucauldian approach entirely overcomes the ludicrous recursive arguments that Jessop becomes snared by, in his efforts to articulate the relationship between structure and agency.

lighting conceived as a pre-ontological horizon opening up to both a seeing and a speaking.

While power is condemned to operate within the strategic constraints of the apparatus, *resistance* to power turns within that impossible space where the immanence of the non-self obtains as a redoubling of the other. Resistance, for Foucault, resides within the intimate fold of the outside: an outside that is not external to thought, but is situated at its very heart⁶. Thought standing ‘outside the subject’ is conceived neither as a foundation nor a justification, but as an unfolding or void where the subject is constituted: it is the site of slippage of the subject’s certainty. Similarly, thought from the outside is the silence beyond all language, the nothingness beyond Being, it is the lost rift where language loses its bearings. It simply gestures towards the emptiness or destitution.

This *topos* of subjectivation where the ‘immanence of the non-self’ obtains arises from the relation of force to other forces, which enables the relation of force to itself. It problematizes the past, frees one from the present, establishes the possibility of thinking otherwise—thus answers Kantian questions: What can I do? What can I know? What can I be? In this aspect it supports the self-imposition of moral codes by the subject (*enkrateia*). Moreover, the fold in the Outside of Thought does more than explain how it is that we can relate to and transform ourselves via technologies of power; it also opens up the possibility of a non-reactive mode of resistance leading to transformations of the Diagram. As such, it is more primordial and autonomous than power-knowledge relations, because the latter are always condemned to operate within topological confines of the Diagram.

From this archaeological perspective we can follow Foucault’s lead in conceiving of both good and bad forms of self-organisation, autonomy and reproduction. For Foucault, domination emerges when the fluidity of forces and social relations is constrained and arrested by a rigid and ossified system of power that is “permanent, repetitious, inert, and self-reproducing”. In this way, we become ‘trapped within our own history’ by forms of life that have in some way become set and congealed. In this context freedom is conceived as contestation, creative transgression, and transformative action that enables new social forms to emerge.

4.2 Zolo’s Critique of Autopoiesis

In an influential paper Zolo (1990) complains that the notion of Autopoiesis, which views organisations as closed systems with respect to both the environment and to other organisms, blurs the distinction between the observed, objective system and the

⁶ As Deleuze argues, from *The Order of Things* onwards the unthought is not conceived by Foucault as external to thought but as what lies at its very heart, hollowing out and doubling the outside (Deleuze 1999: 96-97; citing Foucault 1970: 327-8 & 339). Rather than a doubling of the One, it is thus conceived as a redoubling of the Other, rather than the reproduction of the Same it is conceived as a repetition of the Different, and rather than an emanation of the ‘I’ it is conceived as the immanence of the Non-self, a Self that lives Me as the double of the Other (Deleuze, 1999: 98).

cognitive meta-domain on the justificatory grounds that the nervous system is unable to distinguish between internal hallucination and external perception⁷. Accordingly, because no distinction can be drawn between the logic of description (pertaining to external reality), the logic of describing (as a cognitive process) and the living system itself (which is engaged in cognition) Maturana and Varela adopt the ontological position that human knowledge is entirely internal to the cognitive meta-domain. It is not so much the case that reality is merely a fiction of the descriptive domain, rather, reality pertains to very domain of interaction between: us as describing systems and the descriptions we make about our own cognition. All scientific explanation lies in the domain of the discourse: the observer trying to explain the observer, there is no 'object of knowledge'

For Maturana and Varela autopoiesis, as an 'idea,' is not a constitutive condition of (independent) empirical objects but rather, a necessary for the existence of living organisms as a unity. However, they acknowledge that it is not observable in its integrity. Instead, we project it onto space of our interactions (whether through description or modification) with the component parts of these observed objects. Accordingly, as a condition of knowledge, they suggest that the observer must recognize the relations and boundaries defining system as a unity. Following the precedent set by Spencer-Brown, it is this operation, which they characterise as the making of a 'distinction'. As such, autopoietic knowledge and prediction has universal validity because in description an ontological isomorphism obtains between the structure of logic and the 'substratum matrix' of the object-realm⁸.

In all this, Spencer-Brown's Calculus of Indications plays a crucial role. For Spencer-Brown, making a distinction is equivalent to the selection of form and the subsequent emergence of what is observed as an 'entity'. Thus, simultaneously, the domain of interaction (of the observer and the observed) is specified while the observer defines himself insofar as he specifies his own domain of interactions. This occurs through a recursive loop within which the observer observes his own observation process, and describes his own descriptions, in this way, completely overcoming the subject/object dichotomy. Moreover, for Maturana and Varela, both of these aspects are clearly rooted in the 'closure' of the nervous system, without any requirement for the enaction of processes of consciousness or symbolization (which, of course, does not preclude any further analysis of how these linguistic and ideational processes build on pre-linguistic cognition).

In what Zolo terms their *Epistemologia imaginabilis*, Maturana and Varela thus return to a traditional metaphysics that, he wryly observes, has long been abandoned or elided by modern science. In particular, Zolo complains that such a regression entirely ignores the insights afforded by the philosophies of language, thus rendering the

⁷ Of course, this contention is one that Freud and one of his most acute interpreters, Jacques Lacan, would entirely reject. on Freudian Thing).

⁸ Although at first sight, some resemblance between this isomorphism and Foucault's conception of the 'fold in the Outside of Thought' may be discerned, it is important to stress that for Foucault, the fold in the Outside is the source of resistance against both the relations of power-knowledge at work within the diagram or assemblage, and historically given technologies of self.

nature of the autopoietic problem scholastic and tainted by a positivist naïvete. Seeming to offset this naivety, however, is Maturana and Varela's adherence to a quasi-realist 'experimental epistemology', on which they constitute a biocybernetics of knowledge, which Zolo conceives to be predicated on three principles: (1) observation is conceived to be a characteristic of all living organisms; (2) neurophysics can be deployed to analyse both their own cognitive processes and those of other organisms; and (3) their own theoretic work is also accounted for as biological. Zolo complains that the first and third of these principles establish a severe reductionism while the second posits an equivalence between scientific knowledge and psychological introspection⁹.

4.3 Jessop's Error: An Erroneous Autopoietic Take on Rosen's Mappings

Sub-section 2.3 of the paper reviewed Jessop's somewhat bizarre interpretation of autopoiesis based on Structuration theory. There, it was pointed out that, as a matter of logic, Jessop's recursive argument should be taken to the infinite limit. It is this very feature of infinite recursion that Letelier et al (forthcoming) resort to in their erroneous attempt to subsume Rosen's analysis within a broader autopoietic frame. This they accomplish by making the substitutions of ϕ_0 for f , $\phi_1 = \phi$ and $\phi_2 = \beta$ while $c_0 = a$, $c_1 = b$, and $c_2 = \beta$, implying that Rosen's original mappings can supposedly be reconceived as a recursive process that can be taken to the infinite limit:

$$\begin{aligned}
 & A \xrightarrow{f} B \xrightarrow{\phi} H(A, B) \xrightarrow{\beta} H(B, H(A, B)) \\
 & f(a) = b, \quad f \in H(A, B) = C_0 = A \\
 & \phi(b) = f, \quad \phi \in H(B, H(A, B)) = C_1 = B \\
 & \beta(f) = \phi, \quad \beta \in H(H(A, B), H(B, H(A, B))) = C_2 = H(C_0, C_1) \\
 & \text{In general, } C_n = H(C_{n-2}, C_{n-1}) \\
 & \text{Let } \phi_0 = f \Rightarrow c_1 = \phi_0(c_0) \\
 & \quad \phi_1 = \phi \Rightarrow c_2 = \phi_1(c_1) = \phi_0 \quad (\text{i.e. } \phi(b) = f) \\
 & \quad \phi_2 = \beta \Rightarrow c_3 = \phi_2(c_2) = \phi_1 \quad (\text{i.e. } \beta(f) = \phi) \\
 & \text{Thus, } c_{n+1} = \phi_n(c_n) = \phi_{n-1}, \quad \phi_n(\phi_{n-2}) = \phi_{n-1} \\
 & \Rightarrow \lim_{n \rightarrow \infty} \phi_n(\phi_n) = \phi_\infty
 \end{aligned}$$

Once again though, as with Landauer and Bellman's (2002) work, Rosen's *atemporal* categorical mappings are being inappropriately interpreted as *temporal* recursions! The ludicrous nature of these substitutions can readily be highlighted simply by asking what C_4 could possibly represent in the terms of a functional biology.

Of course, the whole point in highlighting this error on the part of Letelier *et al.*, is too suggest that Jessop falls into the very same trap in his recursive analysis of structuration. From the preceding discussion it should be obvious that Jessop's

⁹ This forceful critique goes some way towards explaining Varela's later efforts to ground his 'neuropsychological' research in more conventional phenomenological tradition, as expounded by Husserl and Merleau-Ponty.

conception of autopoiesis is broader than that espoused by Maturana and Varela (or by Luhmann for that matter). In this regard, it more closely approximates Rosen's notion of metabolism-repair and replication systems than that of autopoiesis, as understood in the strict sense intended by its originators¹⁰. At a social level, metabolism is entailed both in the production of commodities and in the performance of discursive acts of communication. And social processes of communication, in a generic sense, maintain and reproduce themselves, as do systems of production and accumulation, even though human bearers of social relations come into being, acquire linguistic competencies and productive skills, and ultimately die within a relatively short temporal horizon compared to the time-periods required for major mutations to occur within languages and technologies of production. To this extent, Rosen's category-theoretic perspective captures some important aspects of social reproduction. Maturana and Varela put questions of reproduction to one side because they are primarily concerned with boundary maintenance and the constitution of entities. However, issues of reproduction are crucial for the human sciences. In fact, Marx argued that individuals are effectively subsumed within the process of capital accumulation as a mere means to the ultimate end of reproduction of capitalist relations on an ever-expanding scale.

5. Alternatives to Biocybernetics

While bio-cybernetic models have provided an influential account of moves towards self-regulation and governance (Aalders & Withagen 1997; Teubner 1988; Luhmann 1995), alternative approaches have already been foreshadowed¹¹. As discussed, Robert Rosen's claims about the unique character of living systems can be gainfully compared with Michael Polanyi's steadfast opposition to 'Laplacean reductionism' in the social sciences. Polanyi's critique relies on an insightful notion of ontological stratification. He argues that the social domain cannot be reduced to the psychological, nor can the psychological be reduced to the biological, nor the biological to the physical. Although each ontological layer sets boundary conditions for the layers above it, succeeding layers are relatively autonomous. Moreover, as we ascend to higher levels Polanyi argues that we attain higher and higher levels of meaning and ethical responsibility.

One way to reconcile Polanyi's views with those of the theoretical biologists is to acknowledge that different orders of repair and self-reproduction are entailed at each ontological stratum. For example, at the juncture between the physical and biological strata these notions apply both to cells and individual organisms, at the juncture between the biological and psychological strata they may apply to the constitution of subjectivity and self-consciousness, and at the juncture between psychological and social strata they may apply to the maintenance of broadly determined social structures. The latter interface is the most significant for the purposes of this application. However, this raises the question of which social structures should be

¹⁰ This insight has profound implications that cannot be taken up here, for it means that Rosen's critique of mechanistic reasoning can be directed against much of what passes for economic analysis.

¹¹ The relationship between Maturana and Varela's conception of autopoiesis and that of Luhmann is investigated in Juniper (2006). In this paper, the influence of Talcott Parsons over Luhmann is also reviewed.

taken as the objects of analysis: should it pertain, say, to the mode of production, to social institutions, or as Jessop argues, following a precedent set by Niklas Luhmann, to communicative processes as such?

The first alternative framework considered below is that afforded by the Australian School of juridical analysis has developed largely out of a pragmatic concern for improved forms of public policy and regulation. Justifications for the approach, range from psychological studies of motivation through to theories of legal pluralism. The second approach is one applied by a diverse group of scholars (Rose 1999; Hopwood 1987; Miller & O'Leary 1987; Power, 1994) who have been inspired by Foucault's conception of 'Governmentality'.

5.1. The Australian School on 'Responsive Regulation'

In Australia a number of scholars such as Ayres, Drahos, Braithwaite, Grabosky, and Gunningham have emphasised the limitations of 'command law' relative to "smart" (Gunningham & Grabosky 1998) or "responsive" (Ayres & Braithwaite 1992) regulation. Gunningham & Grabosky (1998: 54) also relate successful regulation to participants recognising that they are part of a "community of shared fate".

Braithwaite and Grabosky studied 96 different regulatory agencies over 1984-85 with a view to describing the culture of business regulation. Their findings were published in *Of Manners Gentle: Enforcement Strategies of Australian Business Regulatory Agencies* (Grabosky & Braithwaite, 1986). They noted that adversarial legal powers were rarely used: most regulatory executives treated business as socially responsible and willing to be law abiding, favouring a cooperative approach with prosecution as a last resort. They classified agencies into three types: 'conciliators' who relied mainly on conflict resolution; 'benign big guns' who walked softly but carried big sticks; and, 'diagnostic inspectorates' who largely provided technical assistance. Other agencies were more proactive and willing to undertake prosecutions. In addition, they observed that most regulatory agencies were "hopelessly under-resourced" with large back-logs of cases awaiting action (Grabosky & Braithwaite, 1986:11). The authors detected a shift towards more punitive approaches in the late 80s and early 90s largely in response to waves of corporate scandals over the 80s decade (Grabosky & Braithwaite, 1986:12). At the same time, a zeal for microeconomic reform and a renewed appreciation of the role of corporation in economic growth has led to an overriding concern for economic efficiency. Grabosky and Braithwaite speculated on the increasing likelihood of convergence and harmonisation in regulatory styles under the influence of globalisation trends, along with a greater involvement of non-government actors in the regulatory process, and greater devolution of responsibilities to the private sector (Grabosky & Braithwaite, 1986:21-3). The provision of economic incentives for corporate citizenship will also see growth in commercial inspection, certification, and testing services. Thus, the challenge is "to determine those circumstances in which private actors are best suited to further the public interest, to identify appropriate incentives to self-regulation, and to provide incentives to private parties to ensure responsible corporate conduct" (Grabosky & Braithwaite, 1986:23). Significantly, Braithwaite observed that conversational regulation where multiple stakeholders are a given a voice "can be effective, though only when it is backed up by the possibility of credible state enforcement" (Braithwaite, 2002: 230).

However, this approach to Responsive Regulation combines a largely implicit and traditional ethical presumption of human rights (one supporting conjectures about the desirability of a shift in the balance away from retributive to more restorative notions of justice) with a pragmatic approach to legal issues (evidenced in Chapter 4 of Braithwaite's 2002 work, "Theories That Might Explain Why Restorative Justice Works," which gathers together a hotchpotch of theories drawn from cognitive psychology, including those of reintegrative shaming; procedural justice theory predicated on procedures of empowerment, fairness and respect; defiance and self-categorization theory; and deterrence theory). As such, the Australian School does not engage directly with the more speculative and philosophical aspects of the European tradition of autopoiesis.

5.2. Foucauldian Interpretations of the Neoliberal State

In Britain, the work of the British scholars (Rose 1999; Hopwood 1987; Miller & O'Leary 1987; Power, 1994) offers a perspective on regulation based on Foucault's notion of 'Governmentality'. For Foucault, this notion reflects a shift in the 'art of governing' to a mode that clearly separates government from the State; joins government with new kinds of political rationality; links power to processes of subjectification thus bringing together what Foucault has called 'technologies of self' with modes of political domination. Governmentality thus entails a rendering of the self as visible to itself (both as it is and as it might be). Government is exercised at the contact point where the way individuals are driven by others is tied (in both directions) to the way they conduct themselves. From this perspective there is both complementarity and conflict between those techniques that assure coercion, and those processes through which the self is constructed or modified by itself.

In his discussion of the varieties of liberalism, classical and modern, Foucault singles out the Chicago School for particular comment (Lemke, 2001). He observes that members of this neoliberal school of thought, seek to impose the narrowly-defined economic form and its mode of rationality onto all other social spheres including the non-economic. Under the sway of Chicago-style neoliberalism, the rational economic actor even serves as a model for government itself. Individual subjects are rendered responsible for social risks, which are thus transformed into problems of self-care. A good example of this is the much-vaunted neo-liberal notion of human capital. Under this rubric, Marx's distinction between abstract and concrete labour is simply reduced to the individual outcome of choices made about investment in education and training (even criminality is construed to be the outcome of rational choice).

Thus, Foucault's work on 'governmentality' highlights the systematized, and more or less reflected modes of power that seek to regulate conduct via political rationalities (combining means and ends) (Lemke, 2002). Included are renewed forms of 'pastoral care' that make people 'responsible' insofar as social problems are deemed to those of individuals (i.e. they arise through mistaken approaches to governing ourselves). In this light, Foucault defines states of domination as stable, hierarchical, fixed, and difficult to reverse. Accordingly, resistance must be included in any analysis of

governmentality as something situated at the heart of power relations; as a particular exercise of freedom that, in part, implies a capacity to refuse imposed forms of individuality.

6. Conclusion

It remains to draw the various strands of analysis and critique together. The overview of Jessop's work in section one delineated an oscillation between a more conventional Neo-Gramscian approach emphasizing the hegemony of neo-liberal discourse and practice to one grounded in the biocybernetic autopoiesis. However, for Jessop notions of both structural coupling between and, by implication, the incompleteness of autopoietic systems are deployed to highlight the possibility of crisis and the need for some kind of steering mechanism. To this end, Jessop turns to Karl Polanyi's historical analysis to emphasize the self-destructive effects of neo-liberalism, which he associates with the dominance of market forces through a universal spread of the commodity form and the absence of the requisite 'spatio-temporal fix'. These concerns are revisited in Jessop's alternative route to autopoiesis via Structuration-theory. Here, recursive interactions between the reflexive behaviour of agents and the strategic selectivity of institutions are incorporated within an *autopoietic* process. However, the resulting process is one that can either be structurally coherent or incoherent and contradictory.

Foucault's critique of biocybernetic approaches to the human sciences is concerned with epistemic and ontological incompleteness. Insofar as it combines biological notions of metabolism, maintenance, and cellular boundary with both a logic of distinction and indication and mathematical models of infinite recursion, mappings and fixed points, biocybernetics ignores the positivities of labour and language and closes itself off from a deeper philosophical engagement with what Foucault characterises as an 'analytic of finitude'. Moreover, nowhere in Maturana and Varela's (1992) inquiry into the "biological roots of human understanding" do we find any reference to power relations or disciplinary practices. While Jessop cannot be faulted with these absences, his amalgam of biocybernetics either with Marxism and Polanyian historical analysis, or with Structuration Theory are each fraught with epistemological and ontological contradictions. Zolo chooses to focus on Maturana and Varela's reductionist and *imaginary epistemology*, where the biological constitution of boundary and entity is both an empirical phenomenon and a transcendental act of cognition act, as described by the calculus of indications. This reflexivity closes the epistemic circle, grounding a second-order cybernetics and collapsing the very distinction between subject and object¹². In sub-section 4.3, Jessop's 'autopoietic' deployment of Structuration-Theory is questioned by comparing it to an equally erroneous, recursive interpretation of Rosen's metabolism-repair and replication mappings.

¹² Second order cybernetics was developed by Heinz von Foerster in response to an observation made by Margaret Mead at one of the Macey Foundation workshops on cybernetics. Mead reasoned that any rigorous cybernetic analysis of the mind would have to be able to explain how cybernetics as a body of theory could itself be generated through metabolic and neuronal processes. Maturana and Varela's 1992 text is a popular attempt to constitute such a second order cybernetics.

While Rosen's analysis was primarily intended to defend functional approaches in the life sciences against mechanistic forms of reasoning, his preferred analytical framework does not suffer from the inadequacies of autopoietic thinking. Similarly, those contributing to the development of the Self-directed Anticipative Learning model of bio-cognitive development seek to avoid the more mystical aspects of Maturana and Varela's autopoietic reasoning, while taking advantage of their useful concept of autonomy. However, their analysis is not intended to operate as a philosophical foundation for social theory and, arguably, the semantic elements of the theory are currently underdeveloped.

In the context of this review of Jessop's work, it can be seen that, in autopoiesis, he was seeking to describe both the substantive stumbling block to the stable accumulation of capital and a potential vehicle for the strategic regulation and ultimate resolution of crises. It is a case of the familiar imperative, "physician, heal thyself!" For Jessop, autopoietic mechanisms represent both an explanation of both the problem and its solution. However, this social incarnation of autopoiesis is an evolutionary one, that departs notably from Maturana and Varela's original conception, which was itself predicated more narrowly on notions of metabolism, configurations of components, and the constitution of boundary and entity, while considerations of replication or reproduction were deferred to a later and more derivative stage of analysis. Organisms first had to be generated as entities before they could engage in processes of replication.

Jessop's reproductive conception is vague, generic and, thus, highly elastic. In this regard it has all the hallmarks of notions such as the 'mode of regulation' and the 'regime of accumulation' that were designed to replace more clearly defined Marxist conceptions of the forces and social relations of production with those with the potential to account more explicitly for the role of the State in facilitating capitalist accumulation¹³. In contrast, Foucault's notion of the diagram, and the transformation from disciplinary assemblages to those pertaining to governmentality, is both more philosophically rigorous and more conducive to detailed historical analysis of strategies, practices, discourses, and institutions. As such, it also affords more insight into what may be required of political intervention, intended to overthrow neo-liberal relations of power-knowledge and their related technologies of self.

¹³ For a powerful critique of these concepts in earlier incarnations of Regulation Theory, see Brenner and Glick's 1991 paper in the *New Left Review*.

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