behaviour. However, having taken a radical position on causality, predictability, equilibrium, limits on human ability to change social processes through deliberate action alone, and so in many ways decentring the individual, Marion ends up with a view of human psychology and social relating that is not particularly radical, apart from the way he stresses the irrational and the need for deviant behaviour.

Complex evolutionary models of industries

Page 268

Allen and his colleagues (for example, Allen, 1998a, 1998b; Allen *et al.*, 2006) work in the tradition of Prigogine (*see* Chapter 10) to argue that change in organisations occurs through an ongoing process of co-evolution in which behavioural types interact with each other. Allen argues that the underlying mechanisms of such evolution involve micro diversity within a system and it is this that drives ongoing, emergent, qualitative changes in systems and structures. He draws on Darwinian theory in saying that there are selective effects of interaction and also mechanisms that discover new strategies or niches. He also says that human intention, calculation and belief may channel diversity into a narrower range than that which the random micro diversity of nature would produce.

Diversity is defined in terms of the number of qualitatively different types of individuals, each type having different attributes. As an organisation evolves, changes occur in both the attributes internal to each type and the configuration of interactions between types. Individuals are thought of as bundles of attributes reflecting a type and organisations are thought of as bundles of these individual types, with societies being bundles of organisations. These levels of individual, organisation and society co-evolve and the diversity of each level emerges in the co-evolutionary process, driven by diversity at the level below. Evolution requires the invasion of a population by new behaviours which grow to a significant level in the system.

This conceptualisation allows the construction of a mathematical model consisting of differential equations where each equation generates growth rates for a different type in a population and where the growth rate of each type depends to some extent on the growth rates of competing types. The model shows that a new type can only invade the system, the system can only evolve, if it is unstable – stability makes invasion by a new type, and thus evolution, impossible. The model is used to demonstrate that evolution generates coherent diversity and that micro diversity at one system level drives the evolution of the system level above it.

So, a model of macroscopic equations of population dynamics is used to describe how evolution works. This model starts with the assumption that each agent in a type is the average across that type. Errors are then introduced into the replication of the behaviours, or strategies, of agents within a type, amounting to a relaxation of the assumption of averages across a type. This takes account of micro diversity within a type, that is, of non-average agents. Then the model shows how error making, or ignorance, is a robust way of exploring for new strategies.

The conclusion is that, when agents are in a new domain, then learning/exploration leads to better overall performance, despite the opportunity cost of error

The models show that there is no such thing as an optimal st
as one strategy becomes dominant then it will be vulnerable
other strategy.

The model is developed to explore the dynamics of econ
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and the general implications are that:

- error-making diffusion leads to successful performance a
- the whole process leads to the evolution of a complex
  agent;
- successful and sustainable evolutionary systems are th
  freedom and encouragement of exploration – they are
  competitive;
- uncertainty about the future allows actions that are explc

The same authors (Allen *et al.*, 2005) use a macroscopic m
linear responses can generate new (false) information whicl
and lead to evolutionary change. They take the problem
catch criminals. In the first model they assume that the p
random 'stop and search' of people when they seem to be act
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blue. These two types commit exactly the same average rate
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However, to improve performance the police authoritie
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pg 269

making, but in a domain which is not new, exploitation rather than exploration produces better overall performance. Allen suggests that industries display similar dynamics to the model as they gradually switch from exploration to exploitation. The models show that there is no such thing as an optimal strategy, because as soon as one strategy becomes dominant then it will be vulnerable to the invasion of some other strategy.

The model is developed to explore the dynamics of economic markets. Potential customers are modelled in terms of their revenue, recognising that this means ignoring different desires and needs of individuals. The model shows how an ecology of strategies emerges indicating that agents are not susceptible to adopting the same strategy, contrary to the prescriptions for best practice or benchmarking to be found in the organisational literature. Diverse behaviours and learning rules lead to more rapid evolution of market structure at a lower cost than benchmarking. However, the explorations/innovations tried out at a particular time cannot be logically deduced because their overall effect cannot be known ahead of time.

The conclusion is that a system of co-evolving agents with underlying micro diversity, or idiosyncrasy, automatically leads to the emergence of new structures, and the general implications are that:

- error-making diffusion leads to successful performance and innovation;
- the whole process leads to the evolution of a complex community of types of agent;
- successful and sustainable evolutionary systems are those in which there is freedom and encouragement of exploration – they are more cooperative than competitive;
- uncertainty about the future allows actions that are exploratory.

The same authors (Allen *et al.*, 2005) use a macroscopic model to show how non-linear responses can generate new (false) information which can break symmetries and lead to evolutionary change. They take the problem of policemen trying to catch criminals. In the first model they assume that the policemen carry out the random 'stop and search' of people when they seem to be acting suspiciously. Micro diversity is introduced by assuming that there are two types of people – pink and blue. These two types commit exactly the same average rate of crime. However, in actuality there are fluctuations, small deviations around the average, so that in one period pinks commit a higher rate of crime and in others the blues do. On average the rate is the same, but for particular sampling periods there is some purely chance variation around the average. Over a long period, the deviations around the average will cancel out if the police stop and search pinks and blues randomly. The statistics they collect on their arrests will reflect the underlying real rates of crime over a reasonably long sampling period.

However, to improve performance the police authorities introduce targets for arresting criminals and reward policemen according to target achievement. The police gather statistics on crime rates over a particular sampling period during which it just happens that more pinks than blues are arrested. So, policemen form a theory that crime rates are higher in the pink population and so focus more attention on stopping and searching pinks. This turns into a self-fulfilling prophesy because the greater police effort in relation to pinks does lead to the arrest of

pinks than blues. Also, the blues may come to feel that they can more easily escape detection and so actually commit more crimes than the pinks, but this fact escapes detection by the police because they are focusing their attention on the pinks. The statistics the police collect will then show that pinks commit much more crime than blues when in fact the opposite is the case. This false information will lead to even more effort being directed at the pinks so leading to the vicious circle of a self-fulfilling prophesy. Complex systems evolve into an unknowable future sometimes with unwanted consequences. The authors argue that uncertainty and surprise are essential features of life itself.

This kind of macro modelling yields important insights which are often counter-intuitive. For example, the models show that following best practice benchmarks actually harms strategic exploration and that apparently rational strategies developed to meet targets can have highly distorting effects on activity. The models can therefore be used to generate provocative generalisations. The interesting question then becomes just how people in organisations use such articulations of *generalisations* in their context-specific situations. However, I argue that macro models cannot capture the detail of unique, context-specific detail of human interaction and so cannot explain how people actually make particular such generalisations in their specific situations. This will be a matter of concern in Part 3 of the book. Also, while the models considered above make an important move to explore the consequences of diversity, mathematical models cannot deal with the full diversity of human behaviour. For example, in modelling markets, the models mentioned above cannot capture differences in the preferences and tastes of individual consumers. Part 3 will also be concerned with the actual diversity of human action in our experience.

Although Allen's models are extremely useful in generating provocative insights, they can quite easily be subtly reproduced as theories of strategic choice and the learning organisation, cast in a new vocabulary. I suggest that this happens because of the continued employment of the language of systems and the adoption of an essentially cognitivist view of human psychology, emphasising the primacy of the individual who knows through making representations of reality and behaves on the basis of these representations. This is an essentially cybernetic view of human knowing and behaving, one that is entirely compatible with systemic management and organisational theory. The result is that the potentially radical implications of the models may not be realised in relation to the management of organisations.

To illustrate what I mean, take Allen's (1998a) analysis of the fishing industry. He contrasts the conclusions produced by equilibrium (cybernetic system), systems dynamics, self-organising, and evolutionary models of that industry. The equilibrium model produces a policy recommendation to constrain fishing effort at, or just below, the maximum that yields a sustainable fish population. However, the dynamics of the fish population and fish markets rapidly render any selected sustainable level of fishing highly inaccurate. A systems dynamics model allows for variations in fish populations and in economic conditions. However, the model uses average data for all of these factors and so cannot capture spontaneous change.

Allen then introduces 'noise' into the equations to represent random fluctuations in fish populations to construct a model of the systems dynamics kind. This model produces boom-and-bust oscillations in fishing fleet catches. On the basis of this model, management should concern itself with overcoming this cyclical behaviour

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11.3 Understanding organisations as c

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Thietart and Forgues

Thietart and Forgues (1995) review

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rate of response of the fleet to fish availability, another for the level of technology and yet another for price responsiveness, to construct a model of the self-organising kind. Now there is still a boom-and-bust attractor, but in addition, another attractor emerges, one of a small high-priced niche where fish becomes a luxury food.

Allen also incorporates different levels of information acquired by each fishing fleet and different attitudes to risk into the self-organising model. He assumes that fishing fleets are boundedly rational decision-makers and so imports cognitivism as his theory of human psychology. The model demonstrates that optimal use of information increases profit in the short term but not necessarily in the long term. Cautious optimisers get locked into the existing situation while more adventurous risk takers open themselves to the possibility of finding new strategies. The model identifies a tendency to follow short-term profit-maximising strategies at the expense of the long term.

Finally, Allen specifies what he calls an evolutionary complex model, which introduces different types of boats and fleet behaviours. The result is a model that can be used to explore the relative effectiveness of different strategies (1998a, p. 33). From this analysis, he reaches the conclusion that sustainability lies not in efficiency, or in allowing free markets, but in creativity. Creativity is rooted in diversity, cultural richness and the will and ability to experiment and take risks. Another conclusion is that uncertainty is inevitable.

Allen very clearly demonstrates the importance of diversity in generating new forms as he moves from one way of modelling the fishing industry to another. He clearly identifies the radical nature of models that incorporate high levels of diversity. However, what he suggests as application in terms of management falls quite easily into the systemic management discourses reviewed in Part 1. For example, his whole methodology implies a cognitivist view of human beings who use rational constructs to explore scenarios with the intention of gaining insight. This easily allows one to sidestep the possibility that management itself is an evolving process. The implication is that managers can step outside their system and model it as the basis of making decisions to manipulate it. The insights he produces are radical but the prescriptions are not. However, in saying this I do not in any way diminish the importance of the generalised insights that complex evolutionary models generate. I am simply arguing that they need to be taken further in terms of the detail of actual human experience in organisations.

11.3 Understanding organisations as complex systems

In this section, I will look briefly at a number of publications that import theories of chaos and complex adaptive systems into theorising about organisations in a qualitative way, as opposed to the quantitative modelling of whole industries explored in the last section.

Thietart and Forgues