Design
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Government or self-government? British designers and cybernetics, from the 1940s up to 1968

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Abstract

This paper gives an account of some of the ideas of cybernetics as they were developed by W. Ross Ashby, notably the concept of homeostasis in which a control mechanism uses feedback to bring stability to a system. It then looks at the ways in which these ideas were used by the English designer Anthony Froshaug, who picked up Ashby's concept of transformation as a model for the design process. Froshaug's work at the Hochschule für Gestaltung Ulm (1957–1961) brought him into contact with Horst Rittel and others in the nascent design methods movement. After the Design Methods Conference in London, 1962, this work was notably developed in publications by L. Bruce Archer, Christopher Alexander, and J. Christopher Jones: their different developments of these ideas are outlined. The political implications of homeostasis and the self-organizing system are suggested with reference to Grey Walter's work. The moment of 1968 provides the context for a turn in the application of cybernetics and its goal of a self-organizing system: away from any strict method and towards political and philosophical anarchism.

Resumé

Cet article présente certaines des idées de la cybernétique telles qu'elles ont été développées par W. Ross Ashby, notamment le concept d'homéostasie dans lequel un mécanisme de contrôle utilise la rétroaction (feedback) pour apporter la stabilité à un système. L'article examine ensuite la manière dont ces idées ont été utilisées par le designer anglais Anthony Froshaug, qui a repris le concept de transformation d'Ashby comme modèle pour le design process. Le travail de Froshaug à la Hochschule für Gestaltung d'Ulm (1957-1961) l'a mis en contact avec Horst Rittel et d'autres membres du mouvement naissant des design methods. Après la Design Methods Conference qui s'est tenue à Londres en 1962, ces travaux ont notamment été développés dans des publications de L. Bruce Archer, Christopher Alexander et J. Christopher Jones : leurs différents développements de ces idées sont ici exposés. Les implications politiques de l'homéostasie et du système auto-organisé sont suggérées en référence aux travaux de Grey Walter. Le moment de 1968 fournit le contexte pour un tournant dans l'application de la cybernétique et son objectif d'un système auto-organisé : loin de toute méthode stricte et vers l'anarchisme politique et philosophique.

Introduction

> *'We have decided to call the entire field of control and communication theory, whether in the machine or in the animal, by the name of* Cybernetics*, which we form from the Greek [illegible] or* κυβερνητικ[illegible] *or ή or* steersman*. In choosing this term, we wish to recognise that the first significant paper on feed-back mechanisms is an article on governors, which was published by Clerk Maxwell in 1868, and that governor is derived from a Latin corruption of [illegible]. We also wish to refer to the fact that the steering engines of a ship are indeed one of the earliest and best developed forms of feed-back mechanisms.'*κυβερνητικ[illegible]*. We also wish to refer to the fact that the steering engines of a ship are indeed one of the earliest and best developed forms of feed-back mechanisms.'ή. We also wish to refer to the fact that the steering engines of a ship are indeed one of the earliest and best developed forms of feed-back mechanisms.'*[1]

This much-quoted passage from Norbert Wiener's *Cybernetics* introduced a set of ideas and techniques that were picked up by people working in and across many different fields of enquiry in the twenty or so years that followed its first publication in 1948. Wiener (1894–1964) later discovered that the word 'cybernétique' had been used by the physicist André Ampère (1775–1836) to describe the science of government.[2] This gives some license to the idea that the cybernetic governor can be understood in the social and political sense, as well as applying to machines and their control or self-control.

1. Ashby

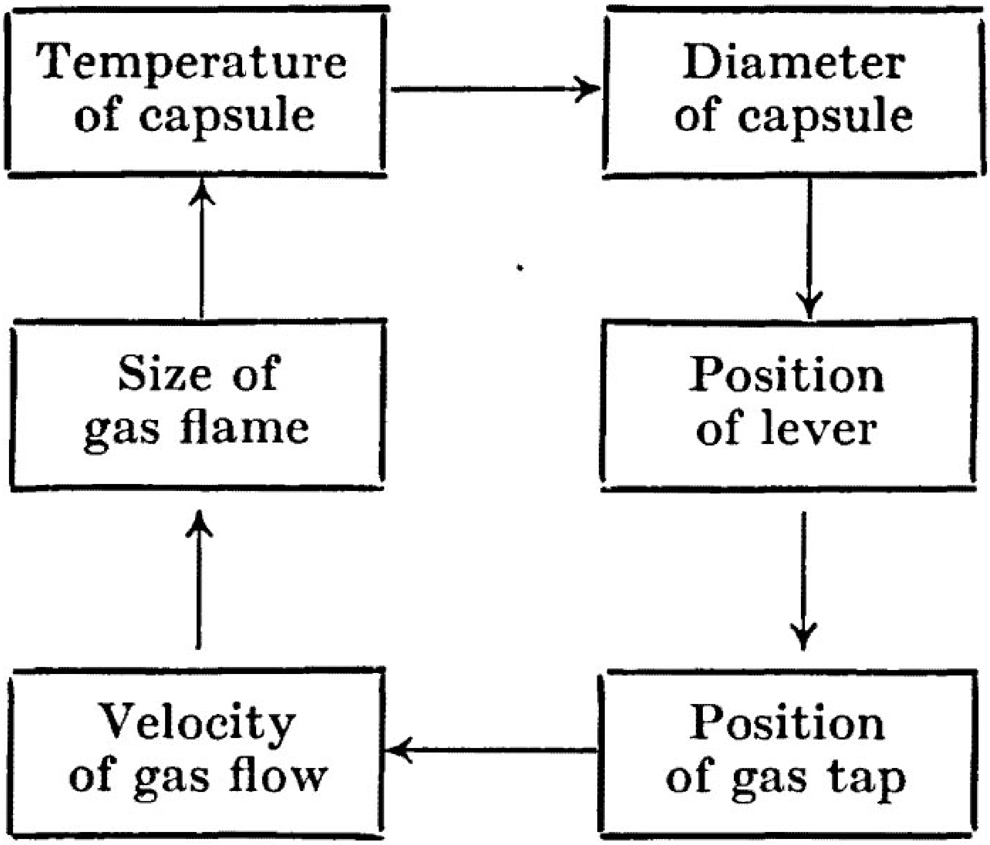
Among those who worked with cybernetic ideas contemporaneously with Wiener was the British physiologist and cybernetician W. Ross Ashby (1903–1972).[3] In his two books, *Design for a Brain* (1952) and *An Introduction to Cybernetics* (1956), Ashby explained these ideas and their mathematical outworkings in English prose of remarkable clarity. *Design for a Brain* does depend for its full understanding on a knowledge of mathematics and of physics that may be beyond many readers (including this one). In *An Introduction to Cybernetics*, however, he suggested that 'no knowledge of mathematics is required beyond elementary algebra'.[4] Nevertheless, in this book too, the extensive use of perhaps quite simple mathematics may be forbidding to people who have other orientations, for example architects and designers. Ashby provided exercises with which readers could test their understanding as they worked through his text; answers were given at the back of the book.

From his first book, here is Ashby's description of the governor in James Watt's steam engine (patented in 1788), often cited as the first machine to exhibit cybernetic properties:

> *'A steam-engine rotates a pair of weights which, as they are rotated faster, separate more widely by centrifugal action; their separation controls mechanically the position of the throttle; and the position of the throttle controls the flow of steam to the engine. The connexions are arranged so that an increase in the speed of the engine causes a decrease in the flow of steam. The result is that if any transient disturbance slows or accelerates the engine, the governor brings the speed back to the usual value. By this return the system demonstrates its stability.'*[5]

Later in this chapter (titled 'Stability'), Ashby explained the concept of feedback:

'A gas thermostat also shows a functional circuit or feedback; for it is controlled by a capsule which by its swelling moves a lever which controls the flow of gas to the heating flame, so the diagram of immediate effects would be:



The reader should verify that each arrow represents a physical action which can be demonstrated if all variables other than the pair are kept constant.' [6]

Ashby went on to explain the concept of stability, which was perhaps the guiding principle of his work as a physiologist: to enable disturbances in the human being to be corrected. He draws on biological knowledge of the human body, for example:

'The temperature of the interior of the warm-blooded animal's body may be disturbed by exertion, or illness, or by exposure to the weather. If the body temperature becomes raised, the skin flushes and more heat passes from the body to the surrounding air; sweating commences, and the evaporation of the water removes heat from the body; and the metabolism of the body is slowed, so that less heat is generated within it. If the body is chilled, these changes are reversed. Shivering may start, and the extra muscular activity provides heat which warms the body.' [7]

In *Design for a Brain* Ashby described the machine that he built to explore this concept of homeostasis.[8] His machine – the Homeostat – consisted of four units arrayed in a square formation, each carrying a pivoted magnet. The degree of variation from central positions were the main variables. Each unit emitted an electric current proportional to its deviation, and each sent its output to the other three; and so each received an input from each of the other three. In front of each magnet was an arc-shaped water trough with an electrode at each end; the magnet carried a wire that dipped into the water and which picked up a current, sending it back to the grid, and this current varied according to its position. 'As soon as the system is switched on, the magnets are moved by the currents from the other units, but these movements change the currents, which modify the movements, and so on.'[9] Ashby's machine exhibited adaptive qualities: when prompted to move by variations in the electrical current, the magnets rotated, and interacted with each other. Depending on the values at which the controls were set, the magnets found positions that were 'stable' (like a sphere on a flat surface) or even 'ultrastable' (like a cube resting on a flat surface) or else 'unstable' (a cone balanced on its point).

2. Froshaug

In 1964, these ideas were the subject of an article in the magazine *Ark*, edited and published by students at the Royal College of Art in London.[10] The writer was the typographer Anthony Froshaug, then a tutor in the graphic design department of the RCA. Froshaug focused on the idea of 'transformation', following Ashby's exposition in the second chapter of *An Introduction to Cybernetics*, entitled 'Change'. He remarked that Ashby had provided 'the clearest so-far published statement on cybernetics, clearer than culling Wiener'.[11]

Froshaug took the cybernetic governor or steersman to be a model of 'a decision-maker, a designer … to steer, he must decide, must use his judgement'.[12] Ashby's idea of transformation could, Froshaug suggested, be used by a designer working with given material, analysing it, sorting it, and then using their judgement to put this material into another form or 'another language, another sign system'.[13] His examples, like Ashby's, were of strings of letters that are transformed into other strings of letters. What are the relations between one letter of the first set and the letters in the second set? These relations can be plotted on a 'kinematic graph', and this graph reveals relationships between the component parts: where one part or point depends on another, and where one part is an end-point (termed 'basin' by Ashby, by analogy with the basin of a river). Of special interest to designers, Froshaug wrote, are those relations in which two or more parts are interdependent. For example if F, S, and O are interdependent, then when F is changed, so is S changed and so is O changed and so is F changed, and so on – as in the condition of mutual interdependence that Ashby had modelled in the Homeostat. Froshaug described this as a tail-chase and referred to a passage in *Cardinal Pölätüo*, the novel by his friend Stefan Themerson. In this fiction a dog named Berkeley endlessly chases a boot-lace that has been tied to its tail.[14] If, as in the philosophy of Bishop Berkeley, a thing only exists insofar as it is perceived, then it will take something or someone to intervene and break the chase. Froshaug suggested that this 'is the root sub-problem where, possibly, "aesthetic" judgement enters'.[15] A designer, in possession of aesthetic judgement, is such an intervener.

Froshaug had long been engaged with the ideas of cybernetics and with the possibilities of machine intelligence. He was certainly a marginal figure in British design, but he was present at crucial moments in the development of these ideas, at the Hochschule für Gestaltung Ulm (1957–1961) and at the first Design Method conference (London, 1962).

Already in the 1940s, Froshaug had been interested in electronics and its applications. During the war years in London, he had been part of a project to develop a machine for treating frostbite; some of those involved were anarchists resisting call-up into the armed forces. He became a partner in the company, Pasta Developments Ltd, that ran the work; its scope covered 'Products of Applied Science, Technology and Art'. Froshaug was also working on the publication of a series of short books, among which was *Electronics in Industry* by Geoffrey Bocking, his partner in Pasta Developments. The summary of the contents of this book read as follows:

> *'Introduction, social relations of industry, effects of a new technic, historical background and conditions necessary for its practical development, explanation of concepts, electronics as a technic, structure and organisation of industry, analysis in terms of social value, applications, interrelations and functional synthesis, future development'[16].*

This vague outline never materialized into a finished book, but it may serve as an index of ambition.

In 1946, ENIAC (Electronic Numerical Integrator and Computer), the first digital computer, was launched formally at the University of Pennsylvania. In 1947 Froshaug included some discussion of this in a text with the title ‘On Typography’. This was written just at the time that he started the transition from designing – formulating and then giving instructions to a printer – to becoming a printer himself. As a printer he could then internalize some of the processes of designing, interacting directly with the machine.

Froshaug made a contrast between ‘the tool’ and ‘the machine’:

> *‘The emphasis on technical & mechanical development has changed the tool, powered and controlled by the individual, into the machine, powered by exterior energy and controlled only within the limits of freedom given by its designer. The machine is not so much the extension as the concretion of the hand. The hand may be trained to be as creative as the mind with which it is symbiotic; each machine is designed as a solution to a problem. Even in its most highly developed forms, such as ENIAC (the ‘electronic brain’), the machine is based on principles of behaviourism; the symptom of the mind is its capacity of configuration. The mind produces gestalten, the machine and-summations.’*[17]

He concluded that, rather than ‘machine keyboard and machine-minding’: ‘Workshop organization is therefore required: the freedom of hand-setting, simplicity of equipment, responsibility & self-discipline in the artisan.’[18]

In 1949 Froshaug moved from London to the countryside in Cornwall, in the far west of England, to work as a one-man printer, doing mostly commercial work for clients in London. With considerable difficulty, he carried on until 1952 when he took up a full-time teaching position in London.

3. Ulm

The Hochschule für Gestaltung Ulm has a reputation as an austere school in which design was reduced to method. But the more closely one examines the work done at the HfG Ulm, the more various in character it seems. As Anthony Froshaug once suggested, when writing about the HfG it is necessary first to describe its origins in the resistance to the Nazi regime, and the events of 1942, when members the ‘White Rose’ group of idealistic young Germans were caught and killed, among them the brother and sister Hans and Sophie Scholl.[19] The school was always in some senses a political institution, and a critical one. It was independent in spirit and in important respects a self-determining organization that existed in tension with the institutions that partly funded it. Looking back on his working life, Froshaug described the school as an ‘anarchist dream’.[20]

In its short life, the HfG was certainly in constant development. The school was opened officially in 1955 and in its first years the Rektor and presiding spirit was Max Bill. The Argentinian Tomàs Maldonado, who joined the HfG in 1954, from a background as an abstract artist and who had first met Max Bill in 1948, is credited as the figure who steered the school towards its phase of interest in design method. But these subjects had been introduced already at the start of the school in 1953, in lectures by Max Bense on cybernetics and information theory. Norbert Wiener gave a guest lecture at the school in July 1955. After Bense had left in 1958, Maldonado took over responsibility for the development of these ideas and approaches in the school. Among others, he invited two figures who became prominent voices in the field that became known as design method or just ‘design research’. These were the mathematical physicist Horst Rittel (at Ulm 1958–1963) and the engineering designer Bruce Archer (at Ulm 1960–1961). Froshaug joined in projects that had a strong ‘method’ flavour, both in the foundation and visual communication departments.

One result of Froshaug’s teaching was the article ‘Visual Methodology’, which was published in 1959 in the fourth number of *Ulm*, the school’s journal.[21] This is a report on a teaching project, in which students were asked to map networks or patterns of circulation (for example, in a building) onto grids or three-dimensional lattices. It is thus an investigation of method, using and developing knowledge of mathematics and skills in technical drawing; alternative outcomes to the same problem were possible and could be evaluated. The exercise was therefore, as its title indicated, precisely one of ‘methodology’: the investigation and discussion of method.

There seems to have been no sustained engagement with the possibilities of machine intelligence and computers at the HfG. The cybernetic ideas of control were present rather in the idea of method, and the interplay between method and discovery or creation in the design process. The justification of method in design ran as follows: the modern world is a place of many competing needs and possibilities, and it is no longer enough for a single designer to work by intuition. In 1961, Horst Rittel explained the approach to education at the HfG as an attempt to meet the conditions of this modern world:

> *‘We live in almost exclusively, industrially produced and highly technical environments; we are part of complex communication networks such as radio, television, the press and transport systems; each of us simultaneously plays different parts in areas of our complex social processes – consumer, tax payer, customer, voter, etc. With the coming of large-scale systems of production and communication, the design of a chair becomes a difficult problem; yet 150 years ago this was a transaction between a manual worker and a purchaser who was at the same time the user. Now it will be a matter of planning for production a series of 20,000 chairs for an unknown quantity of users who, at best, can be described statistically; the manufacture takes place in an extensively mechanized production process, which in turn extends over several levels of trade.’*[22]

4. Design method: Archer and Alexander

In the 1960s design method emerged as the focus of research and pedagogy, not just at Ulm but elsewhere in Europe and in North America. Britain became one centre of this interest. In September 1962 the Conference on Design Methods was held at Imperial College in London. Design research was taken up at the Royal College of Art (a short walk from Imperial College) at its industrial design department, in which Bruce Archer was now working. Anthony Froshaug, now teaching in the RCA’s graphic design department, gave a talk at the conference. This took a critical approach:

> *‘I very much doubt if there is “a” method of solving problems in design, unless they are so elementary as to be tautologous – and tautological problems have, I’m afraid, been used too much as methods for design training – too much, because they are not at all open-ended; and it’s precisely the development of open-ended problems, systems too, with which we should be concerned.’*[23]

The speakers at the conference ranged from engineering designers through to artists. The middle of this range was represented by designers engaged with questions of philosophy and method, such as Froshaug, and figures who – from different directions and professions – were coming to represent the new field of design method. Perhaps the most prominent of these, in the years that followed were J. Christopher Jones, Bruce Archer, and Christopher Alexander.[24] The differences of approach that each of these figures represented can be seen with a look at how each regarded the fundamental ideas of cybernetics: control of a machine, feedback, the part that a 'governor' might play.

In 1964 Archer and Alexander published texts that, within the community of architects and designers, were at once recognised as significant. Archer's *Systematic Method for Designers* gathered articles written for *Design* magazine; this was a publication of the UK government's Council of Industrial Design, which gave these writings a certain weight and prestige. Here design was seen as a process of reconciliation of many factors that emerge in the modern world, very much as Rittel had sketched. Archer's procedure was linear, taking us through the processes of design: getting the brief for the job; refining the brief; 'the creative leap'; making drawings and models to test intuitively found solutions; making specifications for production. This procedure was then itemized in detail, over several pages, in verbal lists. Flow or arrow diagrams that recapitulated the process were added in later presentations of this material.

In his discussion of formulating the brief, Archer did include an outline of the cybernetic vision in which control mechanisms may shape a course of action in the natural world, but it is not clear how much of this can be incorporated into the process of design.[25] In Archer's scheme of the design process, feedback seemed to be confined to the phase of refining the brief in dialogue with the figure (the client, typically) who had made the initial request for design to take place. In their discussion of Archer's work, Boyd Davis and Gristwood remarked that cybernetics, in dealing with 'ongoing, unpredictable, dynamic systems and with emergent properties' is 'quite distinct from the pipeline model that at first sight seems fundamental to Archer's system'.[26]

In his book of 1964, *Notes on the Synthesis of Form*, Alexander outlined a process of design that did embody the cybernetic ideas. He described the conditions of traditional, unselfconscious cultures in which things are made by hand, often with impermanent materials: 'Failure and correction go side by side. There is no deliberation in between the recognition of a failure and the reaction to it.'[27] And: 'The vital feature of the feedback is its immediacy. For only through prompt action can it prevent the build-up of multiple failures which would then demand simultaneous correction – a task which might … take too long to be feasible in practice.' To avoid too rapid or drastic change, which would upset a state of equilibrium, 'feedback must be controlled, or damped, somehow'.[28] Tradition provides this resistance to change. 'Once a form fits well, changes are not made again until it fails to fit again.' He cited a dialectic of 'rigid tradition' and 'immediate action'. Both are necessary. And: 'it is the very contrast between these two which makes the process self-adjusting. It is just the fast reaction to single failures, complemented by resistance to all other change, which allows the process to make series of minor adjustments instead of spasmodic global ones …'[29]

Alexander went on to describe modern, selfconscious cultures. These are unstable cultures, without any means of self-correction: users are no longer close to the design process, failures are no longer directly reported and corrected. The craft worker turns into a 'master', who in turn becomes the architect or specialist designer, who will work for individually distinctive outcomes. More fundamentally, despite a possibly sophisticated and complex verbal analysis of needs: 'the selfconscious design procedure provides no structural correspondence between the problem and the means devised for solving it.'[30]

Despite his apparently hopeless analysis of the modern condition, Alexander went on to propose a solution that could engender good form with the aid of rigorous mathematical analysis. He argued that the 'articulations and hierarchies' that we may perceive in the physical world are really there, and not merely projections of the articulations and hierarchies of our minds.[31] The task of the designer is to use the hierarchical program to find 'the major physical components of which the form should consist'.[32]

5. Walter and Anarchy

In 1963 the social implications of a cybernetic view were discussed in two articles in *Anarchy*, the monthly journal published by Freedom Press in London. In an issue on the themes of 'technology, science and anarchism', the neurophysiologist W. Grey Walter wrote an introductory article on 'The Development and Significance of Cybernetics'.[33] Walter was then well-known as a public intellectual and as the author of *The Living Brain*.[34] In this book he adopted a specifically cybernetic approach in explaining the functioning of the human brain, which he modelled in physical form in the *Machina speculatrix* (given the name of 'tortoise'). The device was equipped with a photo-electric cell, giving it sensitivity to light, and an electrical contact that gave responsiveness to material obstacles. Where Ashby's Homeostat – named *Machina sopora* by Walter – achieved stability, the *Machina speculatrix* exhibited an opposite behaviour, moving towards light of moderate intensity and being repelled by bright light as well as by physical obstacles and steep slopes. It thus demonstrated 'the establishment of a feedback loop in which the environment is a component'.[35]

Towards the end of his *Anarchy* article, having introduced and explained cybernetic ideas in their application to machines and to systems such as traffic control, Walter turned to consider the larger social and political uses that they might have: 'who is to control whom and with what purpose?'[36] He cited Western democracies as 'more steersman-like than even Ampère would have imagined'. For example, the American constitution provides for Presidential elections every four years and for one third of the Senate to be elected every two years. 'This constitutes introduction of a small component at the second harmonic frequency of the pulse repetition-rate, leading to an effect similar to rectification of an alternating pulse waveform.'[37] Thus any violent swing of policy between successive Presidents is dampened by the powers of the Senate. Walter concluded as follows:

> *'In comparing social with cerebral organisations one important feature of the brain should be kept in mind; we find no boss in the brain, no oligarchic ganglion or glandular Big Brother. Within our heads our very lives depend on equality of opportunity, on specialisation with versatility, on free communication and just restraint, a freedom without interference. Here too local minorities can and do control their own means of production and expression in free and equal intercourse with their neighbours. If we must identify biological and political systems our own brains would seem to illustrate the capacity and limitations of an anarcho-syndicalist community.'*[38]

Later in 1963, in response to Walter's article, *Anarchy* published 'Anarchism and the Cybernetics of Self-organising Systems' by John D. McEwan.[39] McEwan acknowledged help in his exposition from lectures by two of the leading British cyberneticians of that moment, Gordon Pask and Stafford Beer. From the apparently unpolitical nature of cybernetics, he went on to draw out some explicitly political themes. If one definition of a self-organizing system was ' "a system in which the *order* increases as time passes", that is, in which the ratio of the *variety* exhibited to the maximum possible variety decreases; variety being a measure of the complexity of the system as it appears to an observer', this would seem to be restrictive and not attractive to anarchists.[40] So too, the cybernetic focus on hierarchy in a system would not seem to recommend itself to anarchists. But McEwan returned to the example of biological systems, such as the brain: 'it is *impossible to pick out the critical decision-making elements*, since this will change from one time to another, and depend on the information in the system'.[41] He then described Pask's experiment with a group of people all working with the same machine and trying to achieve an agreed goal. The most successful groups were those that refused any fixed roles and any stereotyped procedures to members. McEwan suggested that this model could apply to a production workshop: 'the organisation of the group is largely determined by the needs of the job, which are fairly obvious to all concerned. There is continual feed-back of information from the job to the group. Any unusual occurrence will force itself on their notice and will be dealt with according to their resources at the time.'[42] If, however, this work is controlled by a committee outside the workshop, rapid feedback and correction is lost; the committee will work with reports of past and possibly superseded production, and meanwhile it will have its own problems of organization.

McEwan went on to report on the work of Stafford Beer with larger units of human organisation, from the firm up to the size of the economy of a country. Beer returned to Ashby's 'principle of requisite variety': 'the variety of the controlling system must be as least as great as the variety of the system to be controlled'.[43] A negative illustration comes from the practice of 'working to rule', in which workers protest against management simply by following the rule-book, as they normally do not. Labour is not withdrawn, but the effects of following stiff and perhaps outdated rules has something of the power of a strike.

From Pask's and Beer's work, McEwan drew an outline of the self-organizing system. 'Here we have a system of large variety, sufficient to cope with a complex unpredictable environment. Its characteristics are changing structure, modifying itself under continual feedback from the environment exhibiting redundancy of potential command and involving complex interlocking control structures. Learning and decision-making are distributed throughout the system, denser perhaps in some areas than in others.'[44] And had any social thinker thought about human society in these terms? McEwan proposed Kropotkin writing in the 1890s, and brought in other anarchist writers – P.-J. Proudhon, Gustav Landauer, Martin Buber.

In conclusion, McEwan warned against the idea that cybernetic technique could be applied rigorously and directly to social situations. He gave two reasons for this scepticism: an observer will always be biased in their picture of society, and the cybernetic concept of 'information' is an abstract and reduced one. Nevertheless, the cybernetic idea of the self-organizing system offered something to set against the governmentalist tendency to 'include a fixed isolatable control unit to which the rest, i.e. the majority, of the system is subservient'.[45]

6. 1968

In 1968 some of these themes were presented to the general public at an exhibition and a series of talks at the Institute of Contemporary Arts in London: 'Cybernetic Serendipity'. The subtitle of the show ran as follows: 'the faculty of making | happy chance discoveries | by means of control and communication machines | both human and electronic'.[46] The organizer was Jasia Reichardt, then assistant director of the ICA, who as a writer and critic had been interested in the peripheries of what has been conventionally considered to be 'art'. The book that resulted from the event included essays and texts by Stefan Themerson, Max Bense, Abraham A. Moles, Iannis Xenakis; the British scientists contributing included Gordon Pask and Donald Michie. In her introductory text, Reichardt suggested that two aspects of the project were particularly significant. The first: 'at no point was it clear to any of the visitors walking around the exhibition, which of the various drawings, objects and machines were made by artists and which were made by engineers; or, whether the photographic blow-ups of text mounted on the walls were the work of poets or scientists.' And the second: 'whereas new media inevitably contribute to the changing forms of the arts, it is unprecedented that a new tool should bring in its wake new people to become involved in creative activity, whether composing music, painting or writing. … Many of the computer graphics made by engineers in Europe, Japan and the USA, approximate very closely to what we have learned to call art and put in our public galleries.'[47]

Gordon Pask's essay in the book, 'A Comment, a Case History and a Plan' consisted of three sections.[48] First, 'A Comment on the Cybernetic Psychology of Pleasure', which put forward general considerations on aesthetic experience seen in the perspective of the cybernetic watchwords: control, problem-solving, goal-seeking. Pask's 'Case History' reported on the Musicolour machine that he had designed and made in 1953 with Robin McKinnon Wood. Inspired by the concept of synaesthesia, the machine accepted a musical input through a microphone; its output was a selection of coloured forms, projected onto a large screen in front of an audience. Pask and Wood discovered that the real interest here was not the synaesthesia but the learning capability of the machine. The controller/performer 'trained the machine and it played a game with him. In this sense, the system acted as an extension of the performer with which he could co-operate to achieve effects that he could not achieve on his own.'[49] The Musicolour device was taken on a tour around England and Wales, playing in clubs and theatres, and finally at a dance party in London. In the third part of his article Pask reported on the 'Plan' that he showed at

‘Cybernetic Serendipity’. This was a ‘colloquy of mobiles’, in which these entities (mobiles suspended from the ceiling) interacted with each other. Movement was induced by light falling on a receptor, as in Walter’s *Machina speculatrix*. There was no intervention by any human operator, but human significance was imparted to the system, because two identifiable categories of mobile were produced: female and male. Sound as well as light was emitted, and the spectator might have thought that human behaviours were being enacted by the mobiles.

One may begin to draw some of the threads of this discussion together by referring to the ‘events’ that took place in France in May of this year. The repercussions were certainly felt in Britain and in London especially. The phenomenon of ‘May 1968’ is that of an incipient revolution that seemed to come out of no organized political movement. Political groups and parties found themselves either catching up with the rebellion, or standing at some suspicious distance from it.

In an essay dated July 1968, the political philosopher Tom Nairn sketched an analysis of what had been happening.[50] Nairn was then a lecturer at Hornsey College of Art in north London, where he was among the teachers who joined the six-week long student occupation of the building, very much in the spirit of students and teachers at the universities and schools in France. There were actions in sympathy at other colleges in England, and the directors of the ICA in London invited Hornsey students to put on an exhibition-protest.[51] Nairn, an independent Marxist, recognized that what had happened could not be modelled on the patterns of previous revolts in France (1789, 1848, 1870). ‘1968 did not fail because it was too weak and secondary an event, a mere accident unworthy of comparison with the great dates. It failed because it was too big, and too novel, and inevitably dwarfed most of the circumstances around it.’[52]. The events could be described in the terms that Nairn demanded of Marxism, and which are reminiscent of cybernetics, as ‘a never-ceasing dialectic of idea and practice’.[53] The spark of the revolt came not from the Leninists or Trotskyists, but from anarchists. There were no leaders or central authorities. Rather, within ‘society’s “higher nervous system” ’ (the universities), authority was dispersed.[54]

In the autumn of 1968 the Hochschüle für Gestaltung Ulm closed itself down. The immediate cause was the financial deficits of the body that ran the school, the Geschwister-Scholl Stiftung, and which had guaranteed its independence and its internal self-direction. The school certainly felt the disturbances of the times, and the demonstrations of the students and staff echoed those in France and elsewhere in Europe. The ‘Land’ of Baden-Württemberg and the city of Ulm, which had always partially funded the school, now declined to meet the deficits. These state and city governments chose not to further support an unruly institution. Members of the HfG voted to close the school down, rather than be incorporated into the educational system of the ‘Land’.

7. Conclusions

In the 1950s and 1960s, cybernetics had been taken up in design circles, and particularly in schools of design. But the cybernetic ideas, which proposed a dialectic of movement and control, of movement and self-correction, were habitually turned into a description of method. Often this method was turned into a study of method – methodology. In the later 1960s there was an evident shift away from some conception of a formal design method towards looser, sometimes anti-method views. This can be seen in the work of the writers cited here.

Already in 1965, the year after his *Notes on the Synthesis of Form*, Christopher Alexander published ‘A City is not a Tree’.[55] This essay rejected the use of a tree model as a basis of city planning. Alexander now argued that the tree model of analysis tended to be implemented too literally in city plans, leading to rigidly zoned conurbations in which functions were partitioned off from each other. Instead, he sought to find ways in which functions and uses could overlap, not as in the chaos of slum cities, but rather according to some beneficent order of overlapping: a semilattice rather than a tree. Alexander, with numerous collaborators, then began to develop the ‘pattern language’ that would occupy the rest of his working life. Mathematics was largely left behind, and instead he employed a descriptive and often imperative approach, in the attempt to generate the sense of beauty and good function that he had found in unselfconscious societies.

In 1971, in an interview published in the Design Methods Group *Newsletter*, Alexander responded to a question about future directions:

> *'I believe passionately in the idea that people should design buildings for themselves. In other words, not only that they should be* involved *in the buildings that are for them but that they should actually help* design *them. I also believe passionately in the importance of information. But the moment these two ideas are brought under the rubrick of methodology, I start laughing or crying. It is just nonsense. Why call it methodology? Why be so pretentious?'*[56]

In his turn away from method, Alexander certainly grappled with the easy equation of the designer as 'governor', seeking ways in which the 'anarchist dream' of the designer as self-governor could be allowed to happen again.

In 1970 J. Christopher Jones had published his major work *Design Methods : Seeds of Human Futures* and also took up the position of Professor of Design at the Open University (England's distance-learning university, based at the new and thoroughly zoned town of Milton Keynes). The book offered a compendium of knowledge and ideas on its subject, just as its author himself was beginning to turn away from some strict idea of 'method'. In the years that followed, Jones took up the principle of chance in preference to any articulated method. Rather than the engineers of his professional background, he now looked towards John Cage as one of his sources of intellectual inspiration.[57]

Unlike Alexander or Jones, Bruce Archer made no breaks with design method, and his later writings continue the approach that he had put forward in the early 1960s. For example, a paper published in 1969, 'The Structure of the Design Process', elaborated his earlier systematization of design methods in even greater detail, with numerous diagrams and graphs.[58] Here too there were some paragraphs summarizing the cybernetic ideas; these were then incorporated into the flow of his description of process.

Leaving Ulm in 1963, Horst Rittel had taken up a professorship, teaching the science of design at the University of California, and he continued to work in the USA as well as in Germany until his death in 1990. In his article 'A History of Design Methodology', Nigel Cross credited Rittel with two key insights in papers published in 1973:

'Fundamental issues were also raised by Rittel and Webber (1973), who characterised design and planning problems as "wicked" problems, fundamentally un-amenable to the techniques of science and engineering, which dealt with "tame" problems.

> *'Design methodology was temporarily saved, however, by Rittel's (1973) brilliant proposal of "generations" of methods. He suggested that the developments of the 1960s had been only "first generation" methods (which naturally, with hindsight, seemed a bit simplistic, but nonetheless had been a necessary beginning) and that a new second generation was beginning to emerge. This suggestion was brilliant because it let the new methodologists escape from their commitment to inadequate "first generation" methods, and it opened a vista of an endless future of generation upon generation of new methods.'*[59]

In a later appreciation of his work, Rith and Dubberly wrote: 'At the University of California Berkeley, he also introduced ideas from cybernetics into his teaching. For example, his course notes show explicit references to feedback models and to Ashby's models of requisite variety. In his writing, Rittel also explicitly linked cybernetics, feedback, and the design process.'[60] This seems to confirm the suggestion being made here that cybernetics was used to inform the procedures of designing and was not much taken into the workings of what was actually produced.

In his contributions, as discussed here, Anthony Froshaug made a concerted attempt to explore and incorporate cybernetic insights. But his writings on the subject are brief and fragmentary. He gave the impression of taking from cybernetics just what he wanted and what would help him in the journey that he was already making. I suspect this applies to other designers and other researchers: cybernetics offered a set of terms and ideas, and a way of thinking, all of which could be plundered. In the 1980s, late in his life (1920–1984), Froshaug returned to mathematics. He took courses in maths, as an adult student, at the Open University, and he taught evening classes in 'visual mathematics' at the Central School of Art & Design in London. He was also an early adopter of the micro-computers that were beginning to become available in Britain for quite modest prices. Much as in the 1940s he had explored printing by hand and with simple machines, in the 1980s he explored the workings of digital computers, taking off the case to examine the circuitry and its operations. True to his wish to treat machines not as 'black boxes', but as knowable engines, he commissioned a transparent persepex case for one of his small computers.[61]

Froshaug worked as a typographer and graphic designer on material that issued typically as printed sheets. Though it seems not to have been much discussed, this points to an obvious issue with the application of cybernetics to design. Design typically results in a material product – a house, a chair, a kettle, a printed sheet of paper. Change can be built in to a product, and this flexibility and adaptability may be part of a cybernetic vision. Feedback may have been part of the process of design: as, for example, Archer provided for. But, once the thing has been made, if the product is not in itself adaptable, feedback has to play another role. Then feedback becomes no more than 'what the users say about the product', and indeed this has become the popular understanding of the term: consumer reports on products. Months or years after the product has been made, the designers may be able to turn this feedback from users and customers to advantage, but it is then quite different from the rapid, guiding and inbuilt intelligence of the cybernetic model.

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1. Wiener, Norbert, *Cybernetics : or Control and Communication in the Animal and the Machine*, New York: Wiley / Paris, Hermann, 1948, p. 19.
2. Wiener, Norbert, *The Human Use of Human Beings : Cybernetics and Society*, London, Eyre & Spottiswode, 1954, p. 15. Wiener gave an extended account of the writing and publication of *Cybernetics*, his 'scientific bestseller', in his autobiography: *I am a Mathematician*, London, Gollancz, 1956, pp. 314–332.
3. Ashby's journal, written throughout his working life, constitutes a record of his intellectual journey. It has been digitized and indexed: www.rossashby.info. Ashby is one of the main subjects in Andrew Pickering's *The Cybernetic Brain : Sketches of Another Future* (Chicago, University of Chicago Press, 2010). Besides Ashby, Pickering, discusses Grey Walter, Stafford Beer, and Gordon Pask, in a thorough and well-illustrated discussion that covers some of the material I report on here.
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5. Ashby, W. Ross, *Design for a Brain*, London, Chapman & Hall, 1952, p. 44. [http://www.rossashby.info/Ashby%20-%20Design%20for%20a%20Brain%20-%20The%20Origin%20of%20Adaptive%20Behavior.pdf].
6. *Ibid.*, p. 52.
7. *Ibid.*, p. 59.
8. *Ibid.*, p. 100 ff.
9. *Ibid.*, p. 102.
10. Froshaug, Anthony, 'Cybernetics', *Ark*, n°. 35, 1964, pp. 4–6, reprinted in: Kinross, Robin (ed.), *Anthony Froshaug : Typography & Texts*, London, Hyphen Press, 2000, pp. 170–173.
11. *Ibid.*, p. 171.
12. *Ibid.*, p. 171.
13. *Ibid.*, p. 173.
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15. Froshaug, 'Cybernetics', *op. cit.,* p. 173.
16. 'Isomorph prospectus 1944', in: Rosenau, Helen, *Woman in Art,* London, Isomorph, 1944, pp. 99–100.
17. Froshaug, Anthony, 'On Typography', in: Kinross, Robin (ed.), *Anthony Froshaug : Typography & Texts*, *op. cit.,* pp. 107–110 (at p. 109).
18. *Ibid.*, p. 110. Here as in much of Froshaug's writing of that time, there are echoes of Lewis Mumford's *Technics and Civilization* (1934): a foundational work for him and other designers of his generation.
19. Froshaug once gave me this advice in conversation. He exemplified it himself in his article 'Foundation Course, Ulm 1953–61', in: Kinross, Robin (ed.), *Anthony Froshaug : Typography & Texts*, *op. cit.*, pp. 133–146. I have followed this account in what I write here.
20. Froshaug, Anthony, 'Biography', in: Kinross, Robin (ed.), *Anthony Froshaug : Documents of a Life*, London, Hyphen Press, 2000, p. 245.
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22. Rittel, Horst, 'Zu den Arbeitshypothesen der Hochschule für Gestaltung Ulm', *Werk*, vol. 48,

n°. 8, 1967, pp. 281–283 (at p. 282; my translation). Rittel's text is as follows: 'Wir leben in fast ausschließlich industriell gefertigten, hochtechnisierten Umgebungen: wir sind angeschlossen an komplexe Kommunikationsnetze, wie Rundfunk, Fernsehen, Presse und Verkehr; wir sind gleichzeiting Akteure auf den verschiedenen Spielfeldern unserer komplizierten Sozialgefüge: Konsumenten, Steuerzahler, Käufer, Wähler usw. Mit der Entstehung der großen Produktions- und Kommunikationssysteme wird der Entwurf eines Stuhles zum schwierigen Problem: Noch vor 150 Jahren war dies eine Angelegenheit zwischen dem Handwerker und dem Kunden, der auch gleichzeitig der Benutzer war. Heute gilt es, eine Produktionsserie von 20,000 Stühlen zu planen für eine anonyme Menge von Benutzern, die höchstens statistisch beschrieben werden kann; die Herstellung erfolgt in einem weitgehend mechanisierten Produktionsbetrieb, der Vertrieb läuft über mehrere Handelsstufen.'

23. Froshaug, Anthony, 'Conference on Design Methods', in: Kinross, Robin (ed.), *Anthony Froshaug : Typography & Texts*, *op. cit.*, pp. 130–132 (at p. 131). This is quoted from an unfinished text, not presented for publication in the book that published the proceedings of the conference.

24. In 2002, on the 40th anniversary of the conference, J. Christopher Jones published a sample of the conference on his website, with brief extracts taken from all the contributions. [www.publicwriting.net/2.2/dmconference1962].

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27. Alexander, Christopher, *Notes on the Synthesis of Form*, Cambridge Mass., Harvard University Press, 1964, p. 50.

28. *Ibid.*, p. 51.

29. *Ibid.*, p. 52.

30. *Ibid.*, p. 69.

31. *Ibid.*, p. 129.

32. *Ibid.*, p. 130.

33. Walter, W. Grey, 'The Development and Significance of Cybernetics', *Anarchy*, n°. 25, March 1963, pp. 74–89. [https://libcom.org/library/development-significance-cybernetics]. It is not surprising that Walter should publish in *Anarchy*: he came from a radical and politically active family; also his son Nicolas Walter was a regular contributor to this consistently interesting and intellectually creative journal. For a history of *Anarchy*, see Daniel Poyner, (ed.) *Autonomy : the Cover Designs of* Anarchy, London, Hyphen Press, 2012.

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36. Walter, W. Grey, 'The Development and Significance of Cybernetics', *Anarchy*, n°. 25, March 1963, p. 87.

37. *Ibid*., p. 88.

38. *Ibid*., p. 89.

39. McEwan, John D., 'Anarchism and the Cybernetics of Self-organising Systems', *Anarchy*, n°. 31, September 1963, pp. 270–283. [https://libcom.org/library/anarchism-cybernetics-self-organising-systems].

40. *Ibid.*, p. 270.

41. *Ibid.*, p. 271. McEwan referred to Pask's account 'Interaction between a group of subjects and an adaptive automaton to produce a self-organising system for decision-making' in: Yovits, M.C., Jacobi, G.T., and Goldstein, G.D. (eds.), *Self Organising Systems*, New York, Spartan, 1962, pp. 283–312.

42. *Ibid.*, p. 274

43. *Ibid.*, p. 276. McEwan referred to Stafford Beer's book *Cybernetics and Management*, London, English Universities Press, 1959.

44. *Ibid.*, p. 278.

45. *Ibid.*, p. 282.

46. See the poster for the exhibition, designed by Franciszka Themerson and using the line-breaks represented here. It is reproduced in Reichardt, Jasia, and Wadley, Nick (eds.), *Themerson Archive*, London, Themerson Estate / Cambridge Mass., MIT Press, 2020, vol. 2, pp. 98–99. 'Cybernetic Serendipity' ran between 2 August and 20 October 1968. Among those speaking in the programme of events were Abraham A. Moles and Gordon Pask. Further documentation (including photographs) can be found in: Muir, Gregor, and Massey, Anne, *Institute of Contemporary Arts, 1948–1968*, London, Institute of Contemporary Arts, 2014, pp. 154–159.

47. Reichardt, Jasia, *Cybernetics, Art and Ideas*, London, Studio Vista, 1971, p. 11.

48. *Ibid.*, pp. 76–99.

49. *Ibid.*, p. 78.

50. Nairn, Tom, 'Why it Happened', in: Quattrocchi, Angelo, and Nairn, Tom, *The Beginning of the End : France, May 1968*, London, Panther Books, 1968, pp. 103–173.

51. For contemporary documentation, see: Students and Staff of Hornsey College of Art, *The Hornsey Affair*, Harmondsworth, Penguin, 1969. As well as the ICA exhibition, in July 1968 a national conference on art & design education was held in London, sponsored by the Movement for Rethinking Art and Design Education (MORADE). See *The Hornsey Affair*, pp. 171–173, and also 'Conference Report' in: Potter, Norman, *What is a Designer*, 4th edn., London, Hyphen Press, 2002, pp. 160–161. The chair of this conference was Geoffrey Bocking, early cybernetician and Anthony Froshaug's work partner in wartime London.

52. Nairn, Tom, 'Why it Happened', *op. cit.*, p. 104.

53. *Ibid.*, p. 130.

54. *Ibid.*, p. 156.

55. *Architectural Forum*, vol. 122, n°. 1, April 1965, pp. 58–62 (part 1), vol. 122, n°. 2, May 1965, pp. 58–62 (part 2). It was soon reprinted in several other places; in 2015, on its 50th anniversary, the essay was issued within a book of this name along with much added commentary. [www.patternlanguage.com/archive/cityisnotatree.html].

56. This is quoted from a reprinted text of the 1971 interview, within a symposium on 'The State of the Art in Design Methods', *DMS–DRS Journal*, vol. 7, n°. 2, April–June 1973, pp. 132–147 (at p. 135). Other interviewees included J. Christopher Jones and Horst Rittel.

57. See: www.publicwriting.net/.

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