



Cwarel Isaf Institute

Stafford Beer

Ten Pints of Beer

The Rationale of his Cybernetic Books

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1959 – Cybernetics and Management

English Universities Press, London. John Wiley, New York. Reprinted 1960, 1965, New Edition (with new Chapter) 1967, reprinted 1970, 1971, 1973 etc. Translated into Spanish, Russian, German, Czech, Polish, Dutch, Italian, Portuguese, French and Japanese.

The foundation of cybernetics as a science by Norbert Wiener, and characterized by him as “control and communication in the animal and the machine“, was marked by his publication of *Cybernetics* in 1948. Stafford Beer encountered the book in 1950, and at once recognized its direct relevance to his own work in management science in the British steel industry. Having written and lectured extensively about the new field, he presented three plenary addresses to the International Association for Cybernetics at the founding assembly in Namur, Belgium. As an outcome, he was invited in 1957 to give a series of lectures and seminars by the Royal Swedish Academy of Engineering Sciences in Stockholm and Uppsala. He was urged by the sponsors, who presented him with the Silver Medal of the Academy, to incorporate these lectures into a book. *Cybernetics and Management* was the result, and it was first published in 1959.

The context of **system** was set against the reductive processes that have dominated our culture. From the managerial point view, systems were seen as being essentially in control or not in control -- these turning out to be functions of perception, conditioned by the ubiquity of feedback. The description of complex situations as black boxes, and the notion that a purposive system is defined by the black-box output itself [rather than by wishes or intentions], was the origin of Stafford Beer's later celebrated dictum *the purpose of a system is what it does*. The role of theoretical logic as conditioning the world, and leading to a cybernetic account of management itself was revolutionary. Above all, the book was the first to argue the possibility of designing an organization scientifically to be a **learning adaptive and evolving** system.

The book was selected as the management book of the year by the prestigious reviewers of the Sunday Times, and Norbert Wiener himself came to refer to Stafford Beer as “the father of managerial cybernetics“. Despite adding a new chapter in 1967, to comment on the progress of automation, the basic book has never been amended -- because, it offered a new perspective on the history and philosophy of science, which are themselves matters of record. The book was constantly reprinted over a period of more than twenty years, after which it was lost to view in a series of publishers'-takeovers and reorganizations.

That new perspective was essentially an appeal for holism, to be achieved through the study of total systems, as distinct from the reductionism which already pervaded the scientific method. Forty years later, reductionism is triumphant everywhere, from its base in academia, through science and medicine, to the social sciences. Those seeking to understand the work of Stafford Beer as a whole would do well to begin with his own first book.

In a preface to *Cybernetics and Management*, the author pointed out that the ultimate source of energy in the hydrogen-helium fusion had been discovered and put to work. It needed to be balanced by equivalent advances in the ultimate source of control -- that is, in the cybernetics of natural processes, especially in the evolution of the nervous system and brain itself. Forty years later that ambition remains compelling.

1966 – Decision and Control: The meaning of Operational Research and Management Cybernetics.

John Wiley, 1966, reprinted 1967, 70, 71, 74, 78, 79, 88 etc. Translated into Spanish. 1994 - paperback.

Intended as a definitive statement about holistic science and problem-solving, this book has been continuously in print for more than thirty years. It was awarded the Lanchester Prize by the Operations Research Society of America as “the outstanding contribution to the literature of management science in the world“ for 1966.

From the early days in World War II, the objective of Operational Research was to address intractable problems, and to increase the probability that decisions taken under conditions of extreme uncertainty would be effective. The approach was formalized by Stafford Beer at the invitation of the Operational Research Society when he first joined the Council, and was officially adopted by the Society. The definition was printed in the front of every issue of the Society’s Journal for a great many years. It reads:

“Operational Research is the attack of modern science on complex problems arising in the direction and management of large systems of men, machines, materials and money in industry, business, government and defence. Its distinctive approach is to develop a scientific model of the system, incorporating measurements of factors such as chance and risk, with which to predict and compare the outcomes of alternative decisions, strategies or controls. The purpose is to help management to determine its policy and actions scientifically.“

The purpose of the book was to elucidate and illustrate these propositions in the management context. The Preface points out that Stafford Beer had already spent more than twenty years working in the field -- all of it

in active leadership of operational research in the biggest steel company in Europe. The multidisciplinary professional staff reached 70, and by 1965 had installed the first computer ever dedicated to management science. The outcome was not a product of academic research. Indeed, his first academic appointment followed publication of *Decision and Control*, and was as a full Professor at the Manchester Business School, where he remained for 24 years. He has held the same title in many universities around the world. All of his teaching work has always been on a part-time basis, however, because he has remained a senior manager or consultant to this day.

Stafford Beer still believes that his problem-orientation is vital to society, and that his advocacy of cybernetics offers the most powerful approach to multidisciplinary model building available. That is why the book remains fresh. In the meantime, academic demands for curriculum, for a list of techniques that lend themselves to ritual examination, have turned OR into something approximating to applied mathematics, and removed from the creative solution of problems. *Decision and Control* does not regard all models as mathematical, although mathematics may serve as a powerful language in discussing them. He has used models ranging from the A of Apiary to the Z of Zoology. In the book’s index, under the entry listing types of model, there are 31 entries.

That leaves the problem of the appropriate methodology for selecting and handling models. In Chapter 6 About *Models* [pages 95 to 119] the foundation is laid for a distinctive approach to the epistemology of science, based on the holistic nature of systems. This is the book’s major contribution to scholarship. The more rigorous account had already appeared in the prestigious journal *Nature* [No. 4968, Jan. 16, 1965] presented as the Stephenson for 1964, under the title *The World, the Flesh and the Metal*.

1972 – Brain of the Firm

First Edition: Allan Lane the Penguin Press, London; Herder and Herder, USA. Translated into German, Italian, Swedish and French.

Second Edition -- much extended: John Wiley, London and New York -- 1981. Reprinted 1986, 1988, etc. Translated into Russian. **1994 - paperback.**

This book is an account of the firm -- or any other cohesive organization -- based on insights derived from the study of the human nervous system. Such understanding of neurophysiology as is required, is explained in the text. Brain and management structures are elucidated and continuously compared, and a theory of effective organization is thereby evolved. This process should not be thought of as providing an "analogy", but as the pursuit of fundamental principles whereby self-regulatory viable systems are necessarily constructed.

The model distinguishes five subsystems that have particular systemic roles, and can be measured according to a particular protocol that assesses numbers of relative potential states. The five subsystems continuously interact to maintain an overall balance, known to biology as homeostasis, whereby we customarily say that the total organization is "in control". This means that the flux of significant variables achieving the balance are all maintained within limits that do not stress any one of them. The entire regulatory process is intended to ensure survival in both the short and long-term, through processes of learning, adaptation and evolution. The five subsystems cannot be isolated from each other, and attempts in the literature to identify them separately with managerial names are ill-conceived.

Brain of the Firm is the first of a trilogy of books devoted to explaining what is now known as **The Viable System Model -- or VSM**. Using the epistemology described in *Decision and Control*, the VSM was newly investigated on the basis of the necessary and sufficient conditions that would account for viability in any system. The second book, then, entitled *The Heart of Enterprise*, presents an enriched version of the Model shorned of neurophysiology.

In the meantime, the Second Edition of *Brain* included five new chapters that constitute a case study of truly massive importance. The First Edition was still with the printers when the author was invited by President Salvador Allende to apply cybernetic thinking to the whole social economy of Chile. He took with him the manuscript of the First Edition, which became the project's "Bible". As the Project Director, Stafford Beer was directly responsible to Dr. Allende, until the coup of 1973 and the murder of the President.

The story, called The Course of History, recounts how managerial cybernetics transformed some two-thirds of the social economy in a few short years. The VSM was of course deployed as the framework for the project. The whole premise of this work is novel, and nothing should be taken for granted. Orthodox information systems were totally supplanted by a real-time computerized system, based on Kalman filters and Bayesian probability theory. It used microwave link [covering the 4000 miles extent of the country], automatic statistical filtration of information, and operation rooms as ergonomically designed environments for decision. Economic information, at every level of organization from the plant through industrial sectors to the cabinet and President himself, was filtered to highlight matters of importance -- and none of this information was more than 24 hours late. Even so, the computing system was organized to **decentralize authority**.

Despite the evident complexity of all this, *Brain of the Firm* in its extended edition, is written to be understood by managers. There is little mathematical content, only descriptions and diagrams. The book should be read in its entirety, and in the order presented, or the argument will not be followed, and the Chilean story at the end will make little sense.

1968 – Management Science: The Business Use of Operational Research

Aldous Books UK and USA, hardcover and paperback.

Translated into German, French, Swedish, Japanese, Finish, Dutch and Norwegian.

Decision and Control was a weighty tome, although every effort had been made to make the work digestible. Other publishers thought that there was a serious need to convey the underlying message in a more readily accessible form -- in a book limited to 200 pages, and decorated with plenty of diagrams and pictures. The book was to be published simultaneously in many languages, based on a text of uniform layout in them all.

The standpoint of *Management Science* is expressed like this. To say that there can be a science of management is not to deny that management is an art. At the time, controversies raged in the business press over this issue. It is still true today that heavily intuitive entrepreneurs tend to disregard the scientific possibilities of systemic synthesis. But the man with the genius for designing buildings is not less of an artist because he is a competent architect. It is a good thing for us all that he is.

Secondly, we should not confuse the contention that there can be a systematic knowledge of management, based on systems theory, with the notion that there are particular techniques used by managers which can be taught and applied to situations like a poultice. This is an argument already familiar to readers of *Decision and Control*, and annoyance with the way in which problem solving was already giving way to an obsession with pre-packaged technique is evident. "This is a mistake which is sometimes made in very high quarters", declares the dust jacket of *Management Science*.

Once again, as we saw in *Decision and Control*, there is an emphasis on the nature of models, and the idea that models can be made larger or smaller -- by analogy with optical resolution -- does not invalidate their utility.

Another preoccupation of *Management Science* was the virtually total ignorance of the theory of probability at the time the book was written. Managers considered that figures were either right or wrong, influenced no doubt by accountancy and especially bookkeeping. Estimates were at best inadequate figures that ought to be "put right", and probabilities were treated as equivalent to guesses. The whole scientific domain of likelihood was [and unhappily largely remains] a closed book to managers.

Therefore an attempt was made to introduce some basic statistical theory in an interesting way. For example, over many years the author mystified audiences by considering the probabilities that two people in the room shared the same birthday. In fact, the odds are even when only 23 people are present. In a sizable audience of say 90 people, the chance of a shared birthdays is not one-in-four, as most people think, but 99.99 percent -- virtual certainty.

We know that managers ought to be able to read a balance sheet, to understand costings, to consider personnel factors, to peruse market research, to offer leadership and so forth, and obviously these are particular skills which can be communicated about all such matters. But the claim that there is a management science cannot be justified as if it were simply a collection of topics in that way. The issue is about **complex, probabilistic systems**, considered as a whole. The science of a subject is always about its very nature, not about virtuosity.

1974 – Designing Freedom

CBC Learning Systems, Toronto, 1974, and John Wiley, London and New York 1975. 1993 transferred to House of Anansi, Toronto 1994 -- **Wiley paperback** Translated into Spanish, Italian and Japanese.

Following the author's extensive applications of cybernetics across Canada in major organizations and government departments during the 60s and onward, the Canadian Broadcasting Corporation invited him to deliver the Massey Lectures for 1973. This was the thirteenth in the annual series, which had included Noam Chomsky, Northrop Frye, Carlos Fuentes, R. D. Laing, Doris Lessing and George Steiner.

The Lectures consisted of a series of six broadcasts transmitted coast-to-coast on consecutive Wednesdays. The objective was to explain some key concepts of cybernetics to the general public -- although the audience was likely to have attended a university. The Lectures were set in a context of discussions and seminars at York University near Toronto, promoted and broadcast by the *Ideas* programme of CBC under the direction of James Anderson. The programme was transmitted and repeated in many countries of the world, and the Lectures themselves are available in audio tape. The published book was embellished with the author's own sketches -- intended to add to understanding rather than merely to decorate.

Canada has a special copyright arrangement for the Massey Lectures, which remain in print at a cheap price for a book of only a hundred pages. The Wiley publications, both in hardcover and later in paperback, were published in keeping with its overall pricing policy for this author, and the international retail cost was about five times the Canadian version it was unsuccessful on each occasion, but sales in the Canadian version continue to this day.

The Lectures had to be prepared during 1973. This was during the final year of Project Cybersyn in Chile, while Stafford Beer was reporting to President Salvador Allende. The project ended with the assassination of the President in September. For sometime during the

summer the political situation was highly volatile. Beer continued as scientific director, but left Santiago to live incognito in the small village of Las Cruces on the Pacific Coast. Political associates visited there, or he went to the capital, covertly during the night. That was how the first of the Massey Lectures came to choose the ocean location to make its first points, and the third Lecture entitled 'A Liberty Machine in Prototype' draws obliquely on Project Cybersyn itself. By the time of writing the final Lecture, Beer was back in London having said goodbye to the President -- and three weeks after that Allende was dead. The use of the oxymoron in the title of *Designing Freedom* was the more poignant given that the despot General Pinochet seized power, and plunged Chile into long years of torture, murder and repression.

Producer James Anderson responded to the stress he detected in Stafford Beer's situation, and discovered that the cybernetician is also a poet. He therefore commissioned a further programme to follow the Massey Lectures -- on the night of the seventh week -- for a full hour's programme of his poetry. The occasion, following a dinner party at his home in England, involved Stafford Beer and a close friend -- the prominent British actor Barrie Ingham, who had a penchant for his poetry. These two men had an informal interchange of readings: the programme itself was unplanned and unscripted. Although the Lectures were greeted with critical acclaim, far more letters were received at CBC from the public about the poetry ...

1975 – Platform for Change

John Wiley, London and New York. Reprinted 1978, etc.
1994 - paperback

The year 1970 saw a commitment to make an unprecedented number of major speeches to specialized audiences at a very high-level. There was to be a keynote address for an international assembly of the Pierre Teilhard de Chardin Association in London. Following the authors election as President of the Operational Research Society, there had to be an inaugural address. There was to be a major address in London on the management of health, a report for UNESCO, a plenary address to the International Cybernetics Congress, and a presidential address for the Institute of Management Science. An annual memorial lecture for the police would soon have to be followed by an appearance in Washington D.C. to talk about complexity to a U.S. House committee. Obviously, immense significance attached to that.

Meanwhile, there was an important article to fit in, and a radio broadcast, before major addresses began again. A dinner address for the British Institute of Management would be followed by a second visit to Washington to talk about ecological systems. Following election as President for the Society for General Systems Research in the United States, there would have to be another presidential address, this time in Philadelphia. There was a big statement to celebrate the Five Hundredth public lecture, and the original idea was to conclude Platform *for Change* with that address in that same year of 1970. However, the SGSR meeting moved into another year. Finally, just edging into the following year of 1973, another memorial lecture was chosen to make the first public announcement in Britain about the Chilean work, while President Allende was making his own announcement in Santiago simultaneously. These two writings were so germane to the whole thesis of the book that they were included in the final plan.

The commitments of 1970 were daunting indeed. It was an option to write one basic piece, and then tailor it for 15 different audiences ... Instead, the whole year

was devoted to designing different statements, specific to their audiences, which between them would be a vehicle of more encompassing intention. That was to express the relevance of the new science of cybernetics to holism, and to propose it as a new worldview. Insofar as key cybernetic insights were concerned, to illustrate them in all those different contexts should buttress the thinking.

The work in Chile pre-empted the preparation of the book, which therefore took until 1975 to achieve its consolidated basis, although the over-arching plan had to be in place from the start. This consists of a thesis called **the total system**, which represents a philosophy about the world written as a single systems diagram. The integral thesis comprises six statements, each with an appropriate explanatory systems diagram, which are developed during the course of the book, and printed on blue pages. Meantime, the fifteen Arguments of Change, as the individual public statements were called, proceeded in ordinary printed format on white paper.

Each Argument of Change is prefaced by a personal statement, presented on yellow pages, explaining what the author was thinking about the occasion. This is followed by a more formal explanation of the intention underlying the statement -- these are the gold pages. The yellow and gold pages, like the thesis in blue, are presented in a format that breaks sentences down, and arranges the words in groups -- thereby replacing most punctuation. This is an experiment in communication, which clearly distinguishes the text of the Arguments from the metasystems in which they are embedded. The result gives the appearance of free verse, but it is by no means intended as poetry ["I do write poetry and this isn't it" says Stafford Beer].

1979 – The Heart of Enterprise

John Wiley, London and New York. Reprinted with corrections 1988.

1994 - paperback

This is the second in the trilogy dealing with the VSM -- **The Viable System Model**. After the first book *Brain of the Firm* had become well-known, it became clear that people could not handle the theory of models for which it called -- an epistemology elucidated in *Decision and Control* and many papers. It was often said that the book was a treatise on neurophysiology, to which other kinds of organizational might be extended "by analogy". According to this position, the "analogy" might prove to be useful or not depending on circumstances. In fact, the book postulated cybernetic principles that were supposed to be independent of context.

This was a much stronger position altogether. In the 1970s when *Brain* was written, Stafford Beer had thought that -- since people knew about their own bodies -- they could be helped to perceive underegulation well enough, *Brain of the Firm* would help them to learn about the central nervous system, and prescribed course work accordingly!

The second book in the trilogy was written to assert the stronger position. It does not mention neurophysiology. It proceeds from a basic discussion erlying cybernetics principles by referring to them. However, several universities and a leading teaching hospital took a reverse position. They said that because people could understand about as to the very meaning of the word system, and its essentially subjective and relativistic nature, through modes of measurement, to the discovery of the five subsystems deemed essential to support any viable system. Two regulatory aphorisms, four principles of organization, and three axioms of management, are put forward, together with a theorem of recursion and an associated law of cohesion. All of these are inferred from first principles. Part Four of the book contains notes on implementation, and includes a full-scale case study of the evolution of a management cybernetic process, based on a mutual life insurance company.

The reference to *heart* in the title was meant to deal with another criticism -- that the cybernetic approach, because it invokes scientific rigour, is basically positivistic, and fails altogether to deal with human factors. Some contend that it is in fact inhuman. *The Heart of Enterprise* tried to deal with this second major issue too. It set out to discover the necessary and sufficient conditions that must apply to any viable system; and this was explicitly to include *human* systems. This did not satisfy those who feel that nothing human can be said that does not involve sentimentally pious sentiments expressed in gouts of emotive language. On the other hand, the fact that each chapter of *Heart* ends with a conversation in a bar was widely tut-tutted as "inappropriate" in a serious work ...

The real meaning about the interchanges called "Later in the Bar ..." has everything to do with humanity after all. On page 562 a systems diagram is described specifying the layout for the whole book. The episodes in the Bar are shown as attempts to foresee the misunderstandings that might predictably arise from the previous chapter, and to correct them through the medium of provocative conversation -- in which humour is not disdained.

No review has yet commented on this structural innovation. In the expectation, that none of this would be understood, Appendix Three draws attention to the 'bar problem' by providing an alleged review of the book. The language of this is completely meaningless, but no one has ever commented about that fact either. The review is signed by the initials C.W.R.W., writing from Wales. Someone may be interested to know that *cwrw* [pronounced *cooroo* in Welsh] is the Welsh word for beer. Between Appendix Three and the spoof review is a wholly serious select bibliography, innovatively organized as a model of a reading list -- arranged in a circle. The only comment on the bibliography, written by a distinguished reviewer, complained that there was none. It seems that neither novelty nor irony is much appreciated.

1985 – Diagnosing the System for Organizations

John Wiley, Chichester and New York. Reprinted 1988. Translated into Italian and Japanese. 1994 - **paperback**

The third in the VSM trilogy is a kind of workbook. By working through these 150 pages systematically, a particular application of any viable system may be created. This was meant to be done on the understanding that the underlying theory in *Brain and Heart* had already been studied, which would mean that the crucial cybernetic philosophy of science entailed would already be deeply embedded. The workbook, then, provides a checklist of actions, and a recapitulation of key terms, to facilitate the development of a given application.

Sadly, some people have naively plunged into *Diagnosing the System* without reading the first two books. Perhaps because it is the more recent of the three, and despite or because of its brevity, and ignoring its opening warning, it has been taken as an inclusive compendium on the viable system. Many writers have presented applications of VSM models which reference only the workshop book. If they have followed the instructions, they have rarely made monumental mistakes, but they offer little of substance beyond the pretty pictures. Most of all, they fail to make the advertised *diagnosis* -- because they have not sufficient understanding to know where to look for dangerous symptoms or how to quantify them.

In June and July 1982 a group of nine mature post-graduate students collected in Concordia University in Montreal to study the cybernetics of organization with Stafford Beer. Teams were formed to apply the VSM to a range of viable systems. The whole group would be involved throughout, so that the applicability of the same model to the diversity of topics would be appreciated. Seven systems were chosen for study. The *university* itself, and a *manufacturing* industry, were obvious starters. The *health service* of Quebec Province came next: we were meeting in Montreal after all. Next came a third world *broadcasting corporation*, covering

no less than thirteen levels of recursion. An organization for *planetary protection* was conceived and designed. The family as a viable system turned out to be an elaborate affair. Finally, the recursive embodiments of *language* led to some surprises when submitted to the VSM.

To give a full-scale account, with all its multiple recursions, of these studies would probably have taken a full year and a very large book to write. There was no time for any of this, and no particular interest in its publication anyway. The value was in testing the presentation of the VSM in highly diverse systems. The workbook *Diagnosing the System* was written following this experience. There was a significant reason for taking this much time over a small book. It concerned the core diagrams of the VSM.

The Viable System Model had its origins in a mathematical model of the brain, first published in 1960. This set-theoretic model [reprinted in *How Many Grapes Went into the Wine*] was not accessible to the general reader. Moreover, the notion of recursivity which became central to the VSM is also a difficult mathematical concept. Stafford Beer took the decision to represent the mathematics in terms of rigorous diagrams. The diagrammatic rigour meant that the mathematics itself would maintain its validity. This is the reason why the author has made so many attempts to preserve the accuracy of the diagrams -- with little success, as so many writers have felt free to 'improve' the drawings to make them 'more comprehensible' -- and have destroyed the theoretical validity in the process.

The first attempt to do this, in *Brain*, correctly depicted the structure of a single recursion. Every attempt to build into that structure the full recursivity of the VSM failed. In *Brain*, therefore, icons were used to indicate that a diagram repeated itself. In *Heart*, considerable diagrammatic advances were made, and the rigour was achieved -- but without much artistic elegance. In *Diagnosing*, however, the problem was finally solved by depicting a level of recursion below the VSM in focus at an angle of 45 degrees. Since then, the formal depiction has been adopted and insisted upon -- not out of obstinacy, but because no alternative diagram has ever been presented that preserved the mathematical basis correctly.

1994 – Beyond Dispute: The Invention of Team Syntegrity

John Wiley, Chichester and New York.

A reader who studies the VSM diagrams in any one of the trilogy *Brain, Heart, or Diagnosing* that discusses the **viable system model**, will have noticed the 'fat arrows'. These are uniquely used to designate one feature of the VSM -- the homeostat connecting System Three and System Four. The fat arrows are an attempt to emphasize the importance of the balancing device that provides homeostasis between [Three] energies devoted to maintaining the profitability of the status quo, and [Four] energies devoted to creating the future. **Team Syntegrity** was an invention designed to create a process that would facilitate the homeostasis marked by the fat arrows. It is directed to normative, directional, and strategic planning -- and other creative decision processes.

The underlying model is a regular icosahedron. This can be thought of as a sphere with twenty flat faces. The resulting solid object has 20 equal triangular sides. It also has 30 equivalent edges, each of which represents a **person**. An internal network of interactions is created by a set of protocols -- 'rules of the game'. It is so arranged that each person selects a unique 'ownership' in two of the group's twelve eventual topics, and a responsibility to act as a critic towards two different groups. Group organized like this is an ultimate statement of participative democracy, since each role is structurally indistinguishable from any other. There is no hierarchy, no top, no bottom, no sideways. Stafford Beer illustrates how continued dynamic interaction between persons causes ideas and resolutions to hum around the sphere, which reverberates into a kind of group consciousness. Mathematical analysis of the structure shows how the process creates synergy by spreading information uniformly throughout.

Team Syntegrity offers managers and their advisers a new planning method that captures the native genius of the organization in a non-political and non-hierarchical way. It has been found to generate great enthusi-

asm and commitment among those involved in the team -- who after all are the sole-designers and generators of the outcome. No agenda are put before them at the start, and they settle their own priorities as they go along. Although the invention was founded on the urgent need to make Three-Four homeostasis in the VSM effective, the technique can be used in other contexts -- for example to explore conflict resolution, or to generate new products.

Part One of *Beyond Dispute* explains the origins of these ideas -- many of which antedate the VSM and the path-finding experiments that led to its eventual formulation as a model and technique. Part Two elaborates further, particularly in relation to the VSM and to governance in general. The form of the model and its icosahedral space are addressed in Part Three, and much deeply significant mathematical issues are discussed at the high-school level.

Part Four consists of a single Chapter Fourteen which explains what Stafford Beer means by the notion of "group consciousness". He traces the cybernetic development of his theory that consciousness begins with a single nerve cell, or neuron, and by a process of increasing complexification reaches the level of self-awareness. The Part concludes with a few speculative paragraphs on the notion of transcendence.

The final Part contains supporting work by a number of collaborators. One returns to the mathematics involved -- not this time at high-school level, but using graph-theory and spectral analysis. The design of the algorithm required to choose between the allocation of individuals in the way most satisfying to the participants comes later. Two chapters deal with problems of facilitation in supporting the team's activity. There are two chapters about practical concerns one in organizing and one in implementing the outcomes. Finally, there is a very brief note to introduce the VSM to those who know nothing about it.

1994 – How Many Grapes Went into the Wine

Stafford Beer on the art and science of holistic management

edited by Roger Harnden and Allenna Leonard

John Wiley, Chichester and New York.

This collection of Stafford Beer's writings covers important early work which is difficult to find, and publishes some which has never been printed before. The editors included a few poems and cartoons as light relief in tracing the historical and intellectual progress of someone who considers that rigorous methods and goal alignment may coexist with artistic achievements and a concern for human beings. The title itself is a quotation from a poem that mocks the technique of cost benefit analysis.

After an introduction by the editors, Stafford Beer's own writing opens with a relatively recent [1987] address given as President to the triennial conference of the World Organization of Systems and Cybernetics, which summarizes the holistic position. This is immediately followed by way of juxtaposition with an account of empirical research undertaken in the 50s, seeking systems that could be inherently self-organizing.

Only then does Part One of *Grapes* begin with selections on interdisciplinary applications. Of operational research to tangible problems. These writings all date from the 1950s, and all are concerned with industrial production and its organization. Throughout this decade, Stafford Beer was Head of management science for the largest steel company in Britain. For much of the time he also held the managerial position of production controller. With a scientific staff that grew to seventy, and the world's first computer [1956] dedicated to management science [a Ferranti

Pegasus], major increases in productivity were recorded. The department's holistic and problem-solving approaches dominated the purely analytic enquiries of orthodox O.R. Before the computer arrived, completely innovative techniques were invented: massed batteries of controlled charts were designed by nomography, and simulations of stochastic processes were undertaken on a mechanical machine called SAM. Both are described here.

Part Two consists of a number of addresses introducing cybernetics -- considered as a new world view. These date from the late 50s to the early 60s, and feature a number of seminal writings. They include a plenary address at the second world conference on cybernetics in Belgium, and the Stevenson Lecture in Newcastle which laid the foundations for the author's epistemology. This was followed in 1960 by the inaugural address for the new Institute of systems founded at the Case Institute in Cleveland. The speech made here was regarded as revolutionary. Many other events of a six-week intensive visit were recorded in a long forgotten diary, which is printed here for the first time. It adds retrospective comments noted in 1992. These point to the fact that much of the advanced and well-funded work on cybernetics, welcomed with such enthusiasm in 1960 has been virtually forgotten since. It is slowly and hesitantly being rediscovered today.

The editors entitle Part Three as dealing with complexity in human and social affairs. It contains four major writings. In India, the government founded an Institute in honour of the country's illustrious scientist, Dr. Zaheer. Stafford Beer was asked to give the inaugural address. He was also invited to write a critical essay as the Preface to Maturana's seminal work on autopoiesis. Finally, there are two Memorial Lectures -- strangely enough commissioned on the same day. The first was in honour of the founder of General Systems Theory, Ludwig von Bertalanffy. The second honoured Teilhard de Chardin, the Jesuit paleontologist and mystic. Stafford Beer took a full year to write these two papers which, otherwise apparently unconnected, both ended in the recital of the eighty-second Psalm ...

Perhaps the most influential paper in the whole book, which is also the most difficult to read and understand, is Chapter 10 in Part Two. This presents a model of the brain, couched in Bourbakian set theory, which Stafford Beer was working on throughout the 1950s. This may well have been the earliest formal model to take the position that the brain is a closed

system. It also argued that the vast complexity of the brain must necessarily be attenuated by a conditional probability process -- and postulated a possible neuro-mathematical mechanism that would make learning possible. The contentious theorem **on the indeterminacy of configuration structure** belongs here.

The chapter concludes by displaying a picture of the operation of a cybernetic factory which was actually being implemented in a steel rolling mill. This includes a printout of an "electroencephalograph" of the company's "brain". The occasion of this presentation was a small closed conference on self-organizing systems called by Heinz von Foerster, and attended by both Warren McCulloch and Ross Ashby who were Stafford Beers mentors. Their confirmation of his work was crucial to his support, as was that of Joel Elkes, a leading authority on the brain, when he came across the 1960 paper in 1982 [pp. 226/7]. From these origins were developed the Viable System Model.

Chapter 10 ends: "A self-organizing system must always be alive and incomplete. For completion is another name for death."