BETWEEN SYSTEMS HIERARCHY AND ANARCHY

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INTRODUCTION

Serious dilemmas face all who design, manage or seek organization. Much of the trouble can be attributed to shortcomings in three areas. The first involves difficulties in how best to *design* entities that intend to be organized. The second involves uncertainties in how to *manage and maintain* organized entities. The third, and perhaps most basic, involves ambiguities in how to *select and update concepts* to aid designing and managing that which is or intends to be organized.

Design problem lie with principles that can effectively and efficiently organize parts into wholes. Managers are concerned with problems in how best to manage and redesign in the face of change. Designers, managers and students of organizations all have problems with selecting or inventing concepts sensitive enough to efficiently detect and adapt to change, yet sufficiently robust so that they can effectively negotiate with change. Organizational concepts are the prime emphasis in the paper.

Difficulties with traditional principles for designing, managing and describing organizations are presented via examples. These include companies, institutions, buildings, cities, technologies and techniques. A few examples are presented here ro suggests that some approaches and concepts of organization are incapable of their assignments, while others seem to have a great deal of largely untapped potential. Hierarchy is the focus of the first type; heterarchy exemplifies the latter.

Organizational tradition offers a simplistic choice: you accept order, of a particular type (e.g., hierarchical), or you get chaos of another type (spilled blood). The most common alternative to order, largely used as a threat to all those who ask difficult questions (e.g., Why they must endure a hierarchy?), is anarchy. Anarchy in such instances is not used in the Greek sense of individualized, self-regulation, but in the French revolutionary sense of societal turmoil and individual violence. The entire discussion and its presumptions often are humorous, except for the unfortunately consequences of restricting human potentials and well-being.

Modern organizations in action illustrate the dangerous simplicity in the choice between order, as hierarchy, and chaos, as anarchy. The chaos possible in centralized hierarchical order, and the order possible in anarchical chaos, is clear. What to do about it is not so clear. The contents of the paper are about pathologies of traditional organizational design and management. These are used as a basis to describe aspects of an alternative order, that of *heterarchical.*

This paper is about order; how to achieve it, how to maintain it, how to change it, how to evaluate it, and/or how to ignore it. Since hierarchy is the organizing principle of the modern world, most of the paper is devoted to describing and analyzing it. An analysis of the famous defense of hierarchy contained in Simon's "clockmaker example" (1962) provides the point of departure. Since this is one of the most often quoted justifications for the use of hierarchy, it seems to be an appropriate beginning. It may be one reason why both the friends and enemies of hierarchy usually fail to identify the alternatives. Cases of the negative consequences of hierarchical organizations are presented in section two. Examples of experiential signs of alternatives to hiearchy are outlined in section three, along with a minor discussion of a couple of ideological camps we are not aligned with. Alternatives principles are proposed in the fourth section. These are different form than either hierarchy or anarchy. These are the principles of heterarchy.

Valery described our concern more poetically than we shall in his summarizing comment on the dilemma of organization: "Two dangers constantly threaten the world: order and disorder." (Paul Valery, *The Nation*, January 5, 1957.)

PART I: PATHOLOGIES IN ORGANIZATIONAL PRINCIPLES

Prevalence and Permanance of Hierarchies

The virtues of hierarchical organization of matter, life, information and human institutions are mostly taken for granted. Analysts invoke the virtues without much regard for their elucidation or specification. Examples of this are found throughout the teaching literature of many disciplines. A book on organizational design, *Designing complex Organizations* (Galbraith, 1973) offers one example. It sets out to synthesize an information processing theory of organizational design around a theory of hierarchies. Hierarchical structuring is introduced as a first and fundamental way of improving the handling of information. Why it deserves such credit goes unexplained.

Another widely used text, this time in architectural education, *Architecture: Form, Space and Order* (Ching, 1979) takes a similar attitude. This is clearly seen in several key statements, e.g., "The principle of hierarchy implies that in most, if not all architectural compositions, real differences exist among there forms and spaces." (Ibid., p. 350). A great deal of important seems to rest on the concept of "real." The three possible "endowments" which allow access to "real difference", and thus "real importance" are: "exceptional size, uniqueness of shape, or strategic locational attributes."(Ibid., p.351).

The concept of hierarchy appears to bring out strong and largely untested presumptions. This holds true across diverse subject areas. Corporate hierarchies, city patterns and building designs all seem to rely on very similar "endowments" of size, shape and locational attributes; which are then arranged in a descending order. All disciplines have problems with the results of this approach, but seem trapped in the predictability.

Several authors have grappled with the issues involved in hierarchies, but normally end up giving it the blessing of being a natural phenomenon. Most architectural, and much design and management theory and literature assumes a conceptual framework that centers on hierarchies. Even such critical and reflective individuals as Ludwig von Bertalanffy, Arthur Koestler, Herbert Simon and Paul Weiss easily adopt hierarchy as fundamental in their work.

> Hierarchical organization on the one hand, and the characteristics of open systems on the other, are fundamental principles of living nature." (von Bertalanffy, *Problems of Life*, 1952)

> All complex structures and processes of a relatively stable character display hierarchic organization, and this applies regardless whether we are considering inanimate systems, living organisms, social organizations, or patterns of behavior." (Koestler, A., *Janus*, 1979, p. 290)

> Complex systems will evolve from simple systems much more rapidly if there are stable intermediate forms than if there are not. The resulting complex forms in the former case will be hierarchic. We have only to turn the argument around to explain the observed predominance of hierarchies among the complex systems Nature presents to use. Among possible complex forms, hierarchies are the ones that had the time to evolve." (Simon, Herbert, *Proceedings of American Philosophical Society*, Vol. 106, no.6, Dec., 1962.)
> (David Bohm presents an argument against this logic that is offered later in the paper.)

> The phenomenon of hierarchic structure is a real one, presented to use by the biological object, and not the fiction of a speculative mind." (Weiss, Paul, in Koestler's *Janus*, 1979, p. 290)

Why all this homage towards hierarchy? Is it an archetypal form, intrinsic to nature and man, or is it an artificial construction of limited utility and steming from limited vision? One rationale for the human tendency towards hierarchy is that both the implied and explicit proponents of hierarchy have considerable difficulty formulating any alternatives to it. The world seems filled with hierarchical constructions, although most clearly have human origins. The form and content of our governments, churches, educational institutions, scientific establishments, buildings, cities, farms, and economic organizations appear hierarchical. If so, the questions should turn to the sponsoring rationale. From this we need to then establish the conditions under which hierarchy is a prevalent and effective organizing principle.

Identifying of reasons and setting the limits forces greater precision of meaning, which may be why it is so avoided. Another reason may be that the most generally, and widely, quoted definitions of hierarchy are indeed tautological. Statements about its existence, based on these definitions, are largely empty and unassailable. Koestler, one of the most often referenced defenders of hierarchy, hints at that possibility but finally takes the view that hierarchical structures have a relevance beyond the language used to define them (Ibid, p._?_).

Given previous analysts' difficulties of attacking the concept of hierarchy in a "deductively hierarchical" fashion, we proceed in a different way. We begin with semi-autonomous examples. Each may at first seem like a fragment, but the collection illustrates how the underlying substance of each points to common limits between all hierarchies, and, potentiality, in the alternatives. The ideas in this paper are arranged in a non-hierarchical organization, but this should not be taken as a general oppsition to form through organization. We seek form, but forms that are dynamically aesthetic and that can accommodate more variety than hierarchies. Witold Gombrowicz points out the dilemma of those who take the route of opposition, be it against hierarchies, ideologies or form in general:

> Man is made in such a way that he continually has to define himself and continually escape his own definitions. Reality is not about to let itself be completely enclosed in form. Form for its part does not agree with the essence of life. Yet all thought that tries to define the inadequacy of form becomes form in its turn and thus only confirms our tendency towards form."
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> (Ehrmann, Jacques, ed., Structuralism, New York:Doubleday Anchor, 1966, p.vii.)

Hierarchies claim to effectively order great variety over long periods of time. Not only does the long tradition of the Catholic church rests upon this belief, but so do most major social sytems upon which our contemporary well being relies. In the next section this claim will be examined via a few institutions and artifacts designed around the hierarchical principle. Prior to looking at those examples, we should look at some of the conceptual problems on which their hierarchical organization is based.

Theoretical Justifications of Hierarchy: Was Tempus Really so Stupid?

Since we are primarily interested in systems that in some way involve human beings and their endless efforts to improve their knowledge level, a natural starting point is Herbert Simon's work. Simon is rather alone among social scientists who grapple with fundamental questions considering hierarhical organizations. He has also managed to constructively inform the debate among biologists and other natural scientists. We will confine our discussion to the relevance of Simon's ideas to social systems and leave biology and physics aside for the most part.

It is interesting how difficult it is for all writers to define hierarchy in terms of more primitive concepts.[1] Simon (1962) says that a hierarchy is a system that is composed of

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1. We refrain here from summarizing the views of the original inventor of hierarchy,

subsystems, each of which is in turn hierarchically organized. This is obviously a circular definition. Simon seems to perceive the need for its further delimitation. Rather than leave the definition abstract, he gives a number of examples: human authority structures, the composition of matter, computer programs, etc. A beginning definition example is:

> "Hierarchy" simply means a set of Chinese boxes of a particular kind...Opening any given box in a hierarchy discloses not just one box within, but a whole small set of boxes; and opening any one of these compound boxes discloses a next set in turn...A hierarchy is a partial ordering...specifically, a tree. (Simon, 1973, p. 5)

The reference to boxes and trees is significant. More formal definitions are felt to lack meaning. Simon is very conscious of the possibility that hierarchy is partly a reflection of the mind of the analyst. In the discussion of "nearly decomparable systems" (p. 108), he notices:

> The fact, then, than many complex systems have a nearly decomparable, hierarchic structure is a major facilitating factor enabling us to understand, to describe, and even to "see" such systems and their parts. Or perhaps the proposition should be put the other way round.
>
> If there are important systems in the world that are complex without being hierarchic, they may to a considerable extent escape our observation and understanding.

Also Koestler (197__) introduces the idea that hierarchy may be in the eye of the beholder rather than in the object beholden, but, as with Simon, he finds support for a less solipistic view. Simon's important argument is that hierarchy is important in the architecture of complexity because hierarchical systems have an advantage in evolution due to their construction arising from stable subsystems. The conclusion is somehow reached and illustrated through the widely referenced example of two watchmakers, Hera and Tempus:

> There were two watchmakers, named Hora and Tempus, who manufactured very fine watches. Both of them were highly remarkable, and the phones in their workshops rang frequently--new customers were constantly calling them. However, Hora prospered, while Tempus became poorer and poorer. What was the reason?
>
> The watches the men made consisted of about 1,000 parts each. Tempus had so constructed his that if he had one partly assembled and had to put it down--to answer the phone, say--it immediately fell to pieces and had to be reassembled from the elements. The better the customers liked his watches, the more they phoned him and the more difficult it became for him to find enough uninterrupted time to finish a watch.
>
> The watches that Hora made were no less complex than those of Tempus. But he had designed them so that he could put together subassemblies of about ten elements each. Ten of these subassemblies, again, could be put together into a larger subassembly; and a system of ten of the latter subassemblies constituted a whole watch. Hence, when Hora had to put down a small part of his work, and he assembled his watches in only a fraction of the man-hours it too Tempus. (Simon, 1962, pp. 90-91)

Dionysius the Areopagite. His theory is dicussed in Hedlund, 1988.

After the parable Simon offers a mathematical demonstration of the fact that Tempus practically never manages to produce a watch. Now, we would like to discuss the assumptions made in the example and their consequences for understanding complex social or social/technical/physical systems. There are problems in each of these assumptions. Our points will be further elaborated by the examples in the next section of the paper.

Problem 1-The System

The System (watch) is a mechanical system and cannot easily be used as a parallel to human systems. The parts have no "meaning" outside the clock, no projects of their own. Compare the situation in a group of individuals, where the parts cannot be shifted around just like that, and where they have other things to do than hang around an assembly line waiting for their further processing. Humans like to sometimes change their mind.

Another characteristic of the watch is that its behavior is completely and uniquely determined by the structure and configuration of the parts. The former can be derived from the latter. There is no "novelty through combination." In human groups, as well as in art and architecture, it is well known that there are systemic results from team efforts, surprises through combination, symbiotic phenomena, etc.

These mechanical, deterministic characteristics hint at different classes or systems, for which hierarchy can have different meanings. It is beyond the scope of this paper to engage in such taxonomical work, but Schoff and Emery (1972) provide classifications in line with these ideas. Suffice it to note that the relation between component and system is entirely different in the case of both components and systems which have ends of their own and an ability to generate new qualities by association on the one hand, and in the instrumental and "addictive" components on the other.[2] Much of Simon's discussion hinges on the specific type of system presented in his example.

Problem 2-The Parts

The Parts--the inputs to the production process--are viable over time. Simon's example seems to come from a belief that a watch consists of certain parts that are constant over time. As the Swiss watchmakers were saying when the Japanese were introducing batteries into watches: "That is not a watch--eine Uhr ist enine Uhr." Hierarchical breakdown of a process into "stable intermediate forms" illustrates a need to conserve the original system, make it resistant to change. This would be more obvious if the example included a watchmaking factory with many people rather than one single master. We will examine this attribute in later examples.

Problem 3-The Product

The Product--the output of the process--is a given: the watch. Compare Simon's example with where exactly what to produce has to be first discovered, or invented. When the final product is known, it is possible to break it down into parts. This will, however, unavoidably create obstacles to later change, if we assume some inertia of "sunk costs" in the system.

Hora would in fact not be able to set up his hierarchy of parts (i.e., design the product and its production) if he had not already worked like Tempus for some time. You have to understand the whole system and the function of every part in it before you can efficiently break it down into components. Hora would never have figured out how to make a watch if he had started by making a series of parts. This means that, at least for the kind of system that the example is about, the stable intermediate forms follow, not precede, the more complex system. The example therefore does not support a view of

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2. See the discussion of "nested hierarchies" on the one hand and those of "independent activities" on the other in Depew and Weber, 1985.

evolution as experimentation and mutation on the basis of given components. Of course, biological evolution may still be like that, but industrial development certainly is not, other than in the most general sense of everything has to come from something.

Problem 4-Coordination

In Simon's example there are no problems of coordination between parts and processes of manufacturing the parts (the throughput process is given and stable). The only disturbance is noise, that comes from the outside in the form of telephone calls. Internally, there is a picture of perfect harmony. No fights between the manufacturers of springs and those of pendulums emerge concerning how they fit together. In fact, all parts are assumed to arrive from perfect situations and fit together perfectly. Also, is it feasible to store components and have them around waiting for assembly without deterioration. Hora has not been pushed by his competitors into just-in-time production systems. If he was a cook rather than a watchmaker, he would have had to consider issues such as food spoilage, sour milk and product fermentation.

Systems which evolve without mutual coordination through interaction tend not to fit together easily. Thus, there is a big jump from Simon's example--which assures perfect fit--and the conclusion originating building blocks. If we assume that contiguity in space and time facilitates mutual accommodation, which certainly is the case in social systems, the architecture of complexity rather involves unstable, jointly developed components.[3]

In the case of Hora, the parts "know" where they are headed, since their role and structure is specified in his drawings or memory. But, did the primal cell know about tissue and organism? In fact, the watchmaker analogy is a very interesting one in that it pictures a world with a maker with perfect knowledge, a sort of omniscient god. His creation is frictionless and everything has its perfect place in it. Simon argues (p. 93) that his theory assumes no teleological mechanism, "in spite of the overtones of the watchmaker parable." He claims that "complex forms can arise from the simple ones by purely random processes." He provides another example as support (p. 96):

> Suppose that the task is to open a safe whose lock has 10 dials, each with 100 possible settings, numbered from 0 to 99. How long will it take to open the safe by a blind trial-and-error search for the correct setting? Since there are 100 to the tenth possible settings, we may expect to examine about one-half of these, on the average, before finding the correct one--that is, 50 billion settings. Support however comes from the fact that the safe is defective, so that a click can be heard when any one dial is turned to the correct setting. Now each dial can be adjusted independently and does not need to be touched again while the others are being set. The total number of settings that have to be tried is only 10x50, or 500. The task of opening the safe has been altered, by the cues the clicks provide, from a practically impossible one to a trivial one.

In our view, the problem with this example is the click. It is sort of obvious that it is easier to open a defective safe. But where is the "click" of the cell, telling it that now it had better stop evolving, since it was designed so as to fit well well into tissue? Or, in a hierarchically symbolic system, where was the click for Beethoven when he decided to make the second movement of the string quartet, opus 13, so short? We would say that the click came only after Ludwig had "seen" the whole structure of the quartet. We may also have had a hunch about the total combination of the safe.

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3. If Simon's view of evolution is erred, we should observe many independent components floating about. Protons without neutrons, brains without heads, alligators outside swamps, accounting departments without firms. The relative absence of independent intermediate firms, rather than the existence of complex systems, iw what the theory fails to explain.

Simon argues that the safe example shows the "savings due to hierarchization" are greater in situations involving "random search for correct combination" than in situations where the parts immediately "come together in the right order," as in the watchmaker's smithy. He puts biological evolution somewhere in between the two, because not all combinations are equally likely in evolution, whereas they are in the safe example.

Our argument is different. We argue that hierarchy does not work well in situations of search when there are no signals indicating when a part of the total system has been found. Such a signal requires foreknowledge of the total system, and implies a goal-directed evolution, contrary to Simon's argument. It is true that hierarchization a la the safe is very important in solving problems of a type previously successfully solved, but these may not be the important or interesting problems.

Then, there is the coordination problem of partial results that "represent recognizable progress toward the goal" (P. 96). Our only argument with this is the extension of the system in his example to a wider range of systems, and particularly to the notion that hierarchy is inevitable because of an evolutionary advantage, absent goal-directed development.

Problem 5-Singularity of Producer

Simon uses a system that contains one producer. Partly for this reason, there is no loss of control and coordination when the process is broken down into parts. Problems and possibilities of multiple producers can be ignored. In a multi-maker situation, the relevant comparison would be between specialized teams making components on the one hand, and multi-function teams putting together whole watches on the other. Then the telephone calls would not necessarily discriminate between the two.

The example also fails to elucidate on advantage of hierarchy; namely, specialization and consequent learning. Adam Smith's pin factory supports proponents of hierarchy. However, a very limited division of work would protect Tempus from the torment of customers in interrupting his work. A receptionists or an answering machine would suffice. The example shows the importance of being protected from the environment rather than the advantages of hierarchical organization of work.

Even without a receptionist, it is not obvious that Tempus fares worse than Hora, depending on the product. Assume a crisis in the Swiss watch industry forces our two heroes to go over to building outdoor sculptures (e.g., houses of cards) for tourists. They must of course be built to show the traditional elaborate Swiss style, for the enjoyment of tourist, and for maximum effect they must be on top of the windy Alps.

Hora follows his tried-and-true method of building the parts first, leaving 10 chimneys, 10 balconies, 10 roofs, etc. for later assembly. To his disappointment, he finds that, by the time he has finished making all components, the unpredictable gusts of win on the mountain top have destroyed or blown away almost all of the previous work on parts.

Tempus, on the other hand, finds that he can protect his sculpture by protecting it with his body as it gradually evolves. He can reinforce each and every part of the house's stability by incrementally creating and combining parts into a solid structure. When he is finished with one creation, it stays up just long enough to collect money from the admiring Japanese tourists with digital watches. Tempus thus thrives where as Hora gradually becomes crazy, not understanding why houses of cards are fundamentally different from watches.

Entrepreneurs and good managers know that they can rarely leave any part of the organization alone for very long. Every nook and corner has to be nurtured and encouraged to work for the totality, be protected from the wind and gain support from the rest of the organization.

Problem 6-The Environment

The environment can interrupt and destroy a system being worked on, but only discretely and only on a single part. The important aspect of the first point about the influence of the environment is that it is shown to be a discrete interruption, not a continuous set of challenges (like a wind). If the latter were the case, it does not follow that Hora would be more effective; in fact, neither of them would get anything done. Or, if we allow for simultaneous work on the watch and for talking to customers, there is no reason to suspect that Tempus would do more work than Hora. Both would be somewhat distracted.

The second point is more important. In most real systems, environmental shock cannot be confined to a specific part or a specific actor. Watch-eating monsters would also eat Hora's parts. Competition would make the parts as useless as the watch. the case can be made even stronger. It is often not even desirable to concentrate the shock. A tree stands up because it bends with the wind as a totality, rather than taking the full blow at one point (which would be the case for a rigid tree). In military strategy, the principle of concentration of force is important as an aggressive strategy. For defense, scattering the enemy's forces is equally important.

A more realistic rendering of the impact of environmental disturbance would be to let Hora's part be almost completely destroyed, and Tempus's watch only marginally damaged. The question then becomes one of costs of repair, not one of the starting price. The Sisyphus metaphor which works against Tempus in Simon's treatment could be replaced by the metaphor of the weakest link in the chain. A 50% reduction in the efficiency of the totality.

Problem 7-Intermediate Pools of Stability

Simon's wider argument is that evolution, on the basis of random mutation, favors hierarchy because stable intermediate forms give time for evolution to try various combinations before their building material becomes extinct. We have touched on the problem of temporal ordering earlier. It is empirically true that the hierarchies we observe are effects of experiments with concoctions of previously existing components. An absurd counter example is the human body. Was there a soup of organs--hands, feet, livers, brains, eyes, etc.--which luckily got combined into the first human being, miraculously also supplied with the capacity for procreation? Obviously there are problems with this. We can easily define systems, and the human body with its organs would fit Simon's criteria of a hierarchical system, which have not arisen in this fashion. An ecological system is also an example of "co-evolution" of organisms and environment. Alligators and swamps were not hanging were not hanging around waiting to run into each other. In physics, did the elementary particles exist before atoms, or did they arise jointly? Confessing our ignorance about biology and physics, we still would like to raise these questions.

Does nature favor hierarchy and stable intermediate forms in any other sense then the rather obvious one that evolution always has to work with what is available? Even if Simon's argument would hold for biology and physics, it may not hold in human systems. Therein, forethought and afterthought can dramatically increase the speed of evolution, and decrease the need for hierarchy. Sets of subsystems can be conceived simultaneously, and previous arrangements of components can be drastically altered as the result of learning. New complex systems often require new components. It is well known how big projects, like the Apollo mission or a war effort, lead to advances in technology at a lower level. A stable superordinate form (a drawing, or an objective) can give rise to intermediate ones, rather than the other way around.

Problem 8-Floating Subsystems

Simon discusses the virtues of loosely coupled subsystems. Problems in the accounting departments, or in the producers home-life, are not allowed to disturb the manufacturing organization (horizontal sealing off the units), and the turmoil and pollution of the shop floor must not interfere with strategic thinking at the top. Organizations

are increasingly finding that they have to intensify communication laterally, once useful dividing lines no longer are, and are sometimes dangerous (e.g., Union Carbine's Bopal).

When there is a perception of very little time to accomplish something, or a need to accomplish something that is to last a very long time, hierarchies are often relied upon, but at some point a price must be paid for short-circuiting the process or presuming infinite stability. The overnight construction of St. Petersburg exemplifies the danger of the manifestations of intentional cities lacking intention. The flaws in instant new towns in Britain illustrates other aspects of the same shortcomings.

PART II: THE CHAOS IN ORDER/PATHOLOGIES IN ORGANIZATIONS

IBM, Philadelphia, New York, governments and GM have widely accepted structural problems. Recent efforts to reorganized them around modified hierarchies are still unsuccessful. Corporate design, city building, redesign and rebuilding illustrates the basic dilemma of intentional building when intentions are finite yet aspirations aren't. The experiential disadvantages of attempts to create a highly ordered hierarchy can be seen in the chaos they seem to generate by their presence.

Example 1-The Multinational Corporation[4]

The multinational corporation (MNC), particularly the diversified MNC, is a crucial arena for testing the viability of hierarchies. The complexity and size of such firms challenges hierarchical forms. They cannot deliver on promises of efficient handling of complex tasks. In organization theory, the MNC is often seen as the latest, most complex stage in an evolution of structures, logically related to the strategy of the firm. This can be seen in the important research initiated by Chandler (1962), and given more significance through work of Stopford and Wells (1972), Franko (1976), Galbraith and Natanson (1978), Teece (____), Caves (____), and Williamson (19__). Four observations from the practice of MNC management seem pertinent.

a) Firms are finding that clean, streamlined organization structures are difficult to design and make workable. The debate in theory as well as practice is mostly phrased in terms of what dimensions of structure should be primary--the most common candidates are three: function, geography or product. More and more MNCs are frustrated by such discussion. They need to coordinate along product lines and geographical lines and functional lines simultaneously. At one point in time, integration between R&D and marketing for a single product are critically important. At the the next moment it may be global netting of financial flows for the total corporation is the most critical issue. Later, implementing an overall strategy in a region, like Southeast Asia, that involves all product lines and functions is the central challenge. Ongoing research illustrates how the environment as well as the action of the firm itself is too dynamic and multifaceted to allow permanent superiority based on any one issue, dimension of focus or operating structure. Davidson and Hasperlagh (1982) show how the supposedly unavoidable step to "global product divisions" in practice may lead to lack of dynamism in the firm. Logical steps are not necessarily praxio-logical.

The matrix structure, which has become a way of justification of fixed ambiguity, was first proposed and tried as a remedy for hierarchical ills. There is significant evidence that the result of this structure is fairly negative. The matrix easily becomes a bureaucracy of coordination, a rigidifying mechanism rather than a means for flexibility. Living in two or three universal and overlapping domains, that retain hierarchical structure, with double or triple reporting relationships, is no panacea for shortcomings of living in one hierarchy.

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4. The arguments in this section are further elaborated in Hedlund (1986) and Hedlund and Rolander (1988).

MNCs have responded to this experience by increasing their willingness to live with "messy" organizational structures, happily blending dimensions and tolerating "inconsistencies," overlaps, and non-institutionalized ambiguities. The organizational chart--a favorite example for most theoreticians of hierarchy--becomes distinctly unwieldy, non-hierarchical, and unhelpful. Something besides a chart is needed.

b) Partly as a consequence of the demise of pure structures, other control systems than the favored structure of the firm have gained in importance. Two aspects stand out: the design of systems for genuine information flows (as distinct from stacks of unread computer print-out in the corner of offices), and mechanisms to encourage shared goals, consensus on strategies, and continual interaction between people, which is the same as a strong corporate culture. Organizational memory, informal interaction and capacity for rapid transfer of information between units is helped by encouraging long careers within the same firm and systematic rotation of personnel.

Telecommunications information technology increasingly allows direct (rather than hierarchical) access to information on a real-time basis. A metaphor for this type of information processing is the holographic corporation,[5] in which information about the totality of the firm is shared in each and every part of the firm. The janitor in the Bulgarian joint venture knows about the overall strategy contemplated in the New York "headquarters." The growing importance of changes brought about by use of advanced communications technologies is illustrated by Pava's *Managing the Office of the Future* (1983). Eric Trist's argument in the book's afterword is consistent with the non-hierarchical theme we present.

c) An obvious implication from the first two points is that lateral communication becomes critical to the company operation. "Subsidiaries" increasingly talk directly to "subsidiaries," divisions to divisions, etc. This takes place, place in good firms, without it having to be institutionalized along regularlized lines of command. Lines of command continue to be important, but must increasingly be open to change.

Increasingly, the national subsidiaries are given global roles and are put in charge of supranational projects. The temporary, international project team becomes a basic building block of the MNC. With practice, companies learn to work in this way, which also strengthens internal cohension and culture.

An interesting structural parallel to laterality is the tendency to use interlocking directorates as a means of coordination. The head of the German subsidiary may be on the board of the U.S. company, or perhaps_____ of the French parent company. Such "uncertain organization" (Schoff, 1974), albeit only at the very "top" of firms, is a clear sign of heterarchy in MuCulloch's (194_) restricted sense.

d) The very raison d-etre of the MNC seems to be shifting. Theories of the MNC emphasize monopolistic, firm-specific advantages (Hymer, 1960; Kindleberger, 196__; Dunning, 197__) and the necessity of internalizing the exploitation of such advantages (Maggee, 197__; Teece, 197__; Rugman, 197__) is changing. The modern, established MNC is better described in terms of responding to "new" advantages having to do with scale and scope, learning, and operational flexibility (Kogut, 1983). Thus, the international reach and the organizational competence in exploiting it, becomes the source of competitiveness, rather than any narrowly conceived product/market position. The "structure" thus precedes and constrains the strategy of the firm. The strategy may in turn also constrain the real-time action of the firm. The point about the MNC is its flexibility in mobilizing resources and it becomes impossible to prespecify the crucial interdependencies. The information processing view of organization design, as well as transaction cost theory (Williamson, 1975) assumes a given task with given processing needs. The modern MNC makes its living on the absence of these givens. Both Galbraith's and Williamson's hierarchies therefore do not really fit the bill.

Example 2-Swiss and French Railroads

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5. See El Lawy (198_) for the first, as far we know, discussion of the firm as a hologram.

Switzerland offers interesting examples of the heterarchical alternative to hierarchy. The anonymity of its central bodies (It is interesting to ask who knows the name of Switzerland's president in comparison to say that of Austria.) contrasts with the vitality at the local level. Yet, nobody can accuse the Swiss of being disorganized as a nation. It is highly organized. France, on the other hand, is admirably centralized, logically planned, and highly disordered. The differences are reflected in and found throughout the social and physical infrastructure systems of the two countries.

> It (the Swiss railroad systems) is the outcome of fierce political struggles. In the 19th century, the "democratic railway movement" brought the small Swiss communities into conflict with the big towns, which had plans for centralization...And if we compare the Swiss system with the French, which, with admirable geometrical regularity, is entirely centered in Paris, so that the propensity of the decline, the life or death of whole regimes has depended on the links with the capital, we see the difference between a centralized state and a federal alliance... (Herbert Luethy, as quoted in Ward, 1966, p. 589)

Example 3-Dostoyevsky on St. Petersburg

Dostoyevsky, in 18__, made a trip to Western Europe. His experiences are reported in _____, 18____. The richness and historically-based idiosyncrasies of the great, western cities makes him lament about the deplorable contrast with St. Petersburg:

(Quote...

Dostoyevsky puts his finger on the aspect of conscious design, which often goes together with hierarchy, in human systems. The designer feels compelled to follow one theme, which is varied, in a specific way and so as not to lead the thoughts away from the basic idea. Interesting, vital spaces, as well as organizations, seem to arise in spite of, rather then because of, single-minded ideas about design. Are there ways of overcoming the limits of Dostoyevskian internationality and design heterarchy from scratch? We will consider this question later.

Example 4-Post-Modern Architectural Hierarchy

With the modern movement of the early 20th Century, there was a turn away from the dictates of Beaux Arts hierarchy in architectural organization. The importance of function, process, path, production, craft, etc. became more important than the repetition of time-honored dictates of tradition. The writings and buildings of Louis Sullivan, Frank Lloyd Wright, Mies van der Rohe, et. al. illustrated a new way that turned from the predictable hierarchies of Paladio, etc.

Example 5-Big Corporations

The accumulated evidence of limits to scale in industrial production is growing and solidifying. Small firms are contributing most of the growth in employment (Birch, 197__), are much more efficient in the use of R&D resources (_____), and are responsible for disproportionate shares of fundamental innovations (_____). In addition, they are more attractive as places to work for an increasing number of people (_____). Technical and organizational innovations tilt the balance in favor of small units and "flexible decentralization" (Piore and Sabel, 198___).

The inefficiencies of corporate hierarchies are explicitly discussed by leiberstein (1987). Earlier work by Williamson (196__), for example, on control loss in hierarchies, and the large literature on bureaucratization in general, show that this is no new concern. The novelty lies in the empirical indications of huge waste of resources in large firms.

Also, the tendency in economics and organizational theory has been to find a rationale for the existence of giant firms, emphasizing market failures and the coordinative and monitoring advantages that go with large enterprises. The "small is beautiful" argument, and the suspicion that the world does not automatically produce firms of the "right" size, have not been part of mainstream analysis until quite recently.

With some exceptions, the critique of bigness has not addressed the issue of hierarchy directly, other than as an opposite of a market. Indeed, it would be to go too far to take the evidence referred to as evidence against a hierarchical principle of organization. As we tried to show in the MNC example, there are ways for large firms to adopt, or happen to fall into, other patterns. The problem may be that large firms feel compelled to structure themselves more tidily than experience justifies. In MNCs, the heterogenecity and complexity is so great that the firms have given up, whereas in the giant national firms, the temptation to deviate from the norm is not as great.

Example 6-Small Entrapreneurs

We are sympathetic, yet unaligned with those who have a fervent bias towards the opposite of large organizations, the "beauty of smallness"[6],
there are instances where small is not particularly beautiful, perhaps even downright ugly. Our argument is not directly at all the underpaid, reduced benefits jobs initiated by the widely aclaimed resurgence of many small firms; although subject certainly deserves some attention. Our concern here is with another class of problems associated with the downside of smallness in a world defined by oppositions (this simply means that the following problems are not the result of being small, they just get ignored because they are small).

Several researchers passionately spread the word that small is quite pretty, even beautiful, even when it isn't. There is a great deal of talk about the importance of small firms, how nice, productive and friendly they are. This includes the discussion about small Italian residence-based workshop firms that are attempting to band together in a hierarchy to get the advantages of being a big firm. Evidence points out how these firms are small versions of big privately held firms, but choose to stay small so they can escape the labor and government regulations that govern firms with greater than fifty employees. This is sometimes called the Italian model, but is actually a German model. These firms do tend to be more innovative than the large U.S. firms, but that does not necessarily relate to their size. The Japanese firms in related product lines are even more successful, yet are quite large. Japan firms gained flexibility, not through being small, but from developing

> "...from continuous production innovation, often with internal design of equipment and a skilled work force about to understand and implement the continuous changes. Advanced production technologies are not an alternative to skilled workers. It is the capacity to manage the continuous evolution of the production system, and not merely the ability to operate an automated factory, that is the competitive meaning of post-industrial manufacturing." (Science, 1988, p. 1112.)

But this is not the central point as to why smallness may not solve hierarchical problems. It is possible to argue that the world would be better off if large companies sought the advantages of being small, non-hierarchical, and a bit chaotic, instead of creating a lot of small firms seeking to hierarchically behave as if they were large. The importance of this can be seen clearly in the area of environmental pollution control.

We have long concentrated pollution control activities on a few large concerns in Europe and North America. Members of the public support this approach because it somehow seems obvious that big companies are big polluters. Government officials that

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6. These are the individuals that take great pride in having a copy of E.F. Schumacher's Small is Beautiful

have to do the monitoring and control also prefer a few large locations to monitor instead of an infinite group of large. They know that it is feasible to police a few large sources, but impossible to keep track of numerous small, high mobile sources of pollution. One reason is that there are many more of them, but they may well generate more pollution per a given quantity of output than large facilities. In addition, they may do practically nothing to manage the pollution generated. This results in a serious cumulative problem. The small companies tend to use labor efficiently, but only so long as it is measured in terms of wages per task, but when material and energy resources are included their efficiency drops.

An example of this can be seen in the home building sector. The small firm approach to on-site, wood frame construction often generates 10 to 15% waste material, which has to be hauled away to solid wastes disposal sites. The costs for removing construction wastes has climbed 1,150% in the last year in some dense urban locations. The factory built approach to using the same resources to make a similar product often generates only 1.5% wastes, of which most of it is used for fuel in plant boilers.

Similar comparisons can be made for small high-tech chemical and electronics firms. The pollution from these type of organizations can be especially dangerous due to the toxic and hazardous type materials used in their processes. The drains and backlots become too convenient. The organizing principle behind this type of firm is one of "Its so little, does it really matter where we pour it?" Perhaps this should be called the disorganizing principle. The activities in this area may prove to set the most important socioeconomic agenda items for the future.

Example 7-Another Misinterpreation of Non-Hierarchy in Action

There are serious dilemmas with the behavior of small entrepreneurial firms the last example. One presented here is especially dangerous in that it is setting a paradigm for influencing considerable international development in poor countries. It is being sponsored under Schumacher's banner of "smallness as beauty". Over the past three years work has been undertaken by the U.S. AID to establish a demonstration project that claims to be flexible, non-hierarhical, beautiful small and a boon to employment. It has been set up to help Peruvian people to overcome unemployment and poverty. It is espoused as a method that is unusually successful in providing thousands of jobs with low (appropriate?) technology.

Individuals are encouraged to go out into the mountains to mine for gold near the surface of the earth. This requires only low-tech equipment, a bit of food, and some transportation to the work site. All of this looks like the essence of "appropriateness" of technology and technique of development. Even those that are generally anti-development, often come out in open support of this project. Thousands of normally unemployed citizens are thereby employed doing important national work. They continually find small amounts of gold near the surface, which can be exported for national exchange currency. If seems that everyone gains.

Even when the *New York Times Magazine* did a feature article on this project in 1986, they failed to point out the most important feature. They did report on the vast creation of mud slopes and destruction of vegetation, but they didn't mention how the gold was actually secured. It is believed that the most efficient way for each individual "entrepreneur" to separate the small amounts of gold from the rocks is with adding small amounts of mercury to a boiling solution. After the gold distills out, the miner then throws the remaining solution down the hill side. The mercury that didn't go up in the fifteen hundred foot plume over the campsite, is simply discarded down the hillside. The initial results of set of techniques is quite damaging to the miner and his family, but the most dangerous aspect of what all these small endeavors cumulatively do is that the hillsides are at the beginning of the Amazon.

PART III: THE ORDER IN CHAOS/PROPERTIES OF A NEW ORGANIZATIONAL ARCHITECTURE

The disorganizing results of hierarchies are growing. This can be seen in a wide range of phenomena including MNCs, transportation networks, the, and cities. The advantages of hierarchies have been greatly exaggerated. In general, it has been imported, in a wrong fashion, from areas were it may have been plausible, but even there it may not have been necessary. Meanwhile, it continues to receive apologetics from those that don't see or seek a viable alternative. Herbert Simon's description of the evolutionary advantages of the hierarchy in watchmaking are blown out of proportion by he and others.

This is similar to the difference between Leonardo de Vinci's idea of life processes similar to the organization of a a candle, where "The body of anything that takes nourishment constantly dies and is constantly renewed; because nourishment can only enter into places where the former nourishment has expired, and if it has expired it no longer has life..." Rene Descartes, on the other hand believed that life was organized as an arrangement, independent from its environment.

Hierarchies probably began with the emergence of the idea of difference, with difference of levels being the critical idea. The final step towards hierarchy comes with attaching levels of importance to differences. The earliest myths imply that humans lacked many of the distinctions we now find to be of fundamental truth. this can be seen in how early civilizations believed there were such things as substance and soul, but that all substance contained souls as life forms come and went between the twos states. Anaxagorus (510-428 B.C.) was perhaps the first to clearly document this belief. Later, explanations emerged that some types of substance have a higher or lower level of soul. Aristotle was important in beginning this line of belief. He stated that the basic elements of fire, air, water and earth have different amounts of soul, with earth substance having the least concentration. According to the biologist, Edmund Samuel, this logic became the basis for ascribing hierarchies and mechanisms to biological entities, and life. This came to be known as the "clock" model.

An alternative viewpoint to this clocklike evolution of attributing differences of importance to different levels (i.e., hierarchies) was offered by Leonardo da Vinci. He proposed a candle model instead. He wrote:

> The body of anything that takes nourishment constantly dies and is constantly renewed; because nourishment can only enter into places where the former nourishment has expired, and if it has expired it no long has life. And if you do not supply nourishment equal to the nourishment which is gone, life will fail in vigor, and if you take away this nourishment, the life is entirely destroyed. But if you restore as much as is destroyed day by day, then as much of life is renewed as is consumed, just as the flame of the candle if fed by the nourishment afforded by the liquid of this candle, which continually with a rapid supply restores to it from below as much as is consumed in dying above; and this death is continuous as the smoke is continuous; and the continuance of the nourishment, and in the same instance all the flame is deal and all regenerated, simultaneously with the movement of its own nourishment.

Leonardo believe living systems had more to do with loose aggregation of part processes within a constant flow, than the regular motion of specifically-shaped gears run by a regular spring. As Samuel describes it:

> This abstract model of the soul emphasizes that life is the flow of a substance or principle from without that does maintain a delicate and dynamic equilibrium of the parts of the organism whatever they may be. This model recognizes the instability as well as the aggregating power of the soul. It also emphasizes the absolute dependence on the environment of the organisms. There is inexactness, indiscreteness, and the necessity of the continuous vibrant motions of the substance that if living, indlucing a substitution of parts.

This sounds like the characteristics of the non-hierarchical model we are seeking herein. Unfortunately, for us, the da Vinci notions got buried by Rene Decartes in the seventeenth century with his new proposition about the central importance of the watch model and its "natural" hierarchy. (Many additional examples of organizational pathologies will be presented in this section.)

In this section more examples will be presented that support the notion that something exciting is emerging in the field, and that it tends to be non-hierarhical in its form and organization. The examples will be drawn from examples of:

production plants that produce buildings
computer architectures
business organizations
building design
city design
communications networks

PART IV: ALTERNATIVE ORGANIZING PRINCIPLES/PROPOSITIONS FOR NEW ORGANIZATIONAL ARCHITECTURES

Herein are principles emerging from several theoretical areas, that begin to produce a general theory of non-hierarchical organization. It may be heterarchy, it may be something else. The areas are:

Chaos theory
Mutual aid
Negotiated Order
Parallel Processes
Virtual Systems

PART V: SUMMARY AND CONCLUSIONS/WHEN YOU CAN'T GET THERE FROM HERE

Outlines the difficulty in the gap between a new theory of non-hierarchical organizing and the world of experience that presumes its truth to such a degree that it seldom brings it to the table for discussion.

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