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Governmentality and the history of statistical reason

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Governmentality and the History of Statistical Reason

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Governmentality is the late Michel Foucault's neologism for governmental rationality. By rationality Foucault meant the particular way in which an object or process is conceived and from this the logic by which it is acted upon. The art of government is the application of rationality in a specified way through practical techniques and principles upon objects and process constituted as political by such rationality.

I use these concepts of governmentality and the art of government to examine the history of statistical thought and practice. From this examination I illustrate the historical forms assumed by statistical reason and its interaction and relationship with the historical forms assumed by the art of government. Through this examination I show statistics to be a technology of government.

The goal of this paper is to trace, in a general way, the transformations that have occurred in governmental and statistical reason. I describe the role of statistics in the transition from an essentialist epistemology to a non-essentialist, relational or systems based formulation of objective rational knowledge. It is my thesis that the development of theories of complex dynamic systems understood explicitly as cybernetic information processing systems constitutes a fundamental shift in how process and change are understood. I argue that such theories constitute the basis of a new way of conceiving of the objects of government and hence is leading to new ways of governing them, a new art of government.

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Chapter 1: Introduction

Michel Foucault's concept of governmentality is a useful way to analyze phenomena that seem political on their face yet prove difficult to specify precisely how they produce their political effects. In the late twentieth century, information is just such a phenomena. Information is a term that elicits numerous definitions and explanations. It is widely recognized that information is somehow involved in the current political order. Names attempting to capture this new order such as "information age," "post-industrialism" or "global society" are thrown around with abandon. Such conceptions, however, tend to describe information as some sort of new commodity or the result of a new social process without attempting to delve into what this process might be or what sort of exchange system might be implied by this new commodity.

I suggest that information constitutes more than just a new commodity. It is a new way of conceiving of the dynamics of complex processes such as society. It is also a technical knowledge which allows what Foucault calls the art of government to proceed in new ways according to this new conception of society. Further, this new conception and these new political practices are intimately linked with statistics. In this paper I attempt to illustrate this link by showing the intimate relationship between the thought and practice of statistics and that of government. Through illustrating the history of this relationship I arrive at the thesis that a new mode of governing is, in fact, emerging that takes as its object a new formulation of society as a complex information processing system. This transition can be seen through an analysis of the evolution of the art of government, especially in terms of the evolution of statistical reason.

Foucault's concept of the art of government takes a wide view of what constitutes the political. This is because many different disciplines with many different objects of analysis are involved in elucidating the world and producing knowledge about it. Governing is an activity that requires knowledge and thus has a close relationship to its production. This is perhaps not so controversial. It is Foucault's particular way of conceiving the relationship between knowledge and governing, however, which has generated intense interest and criticism.

Foucault's thought is a product of the post World War II emergence of dynamic systems in which the conception of things, ideas or processes linked to unchanging and essential natures has given way to conceptions of things, ideas and processes as relational, contextual and contingent. This includes the relationship between government and the production of knowledge. For Foucault, the link between knowledge and governing is a two way street. The activity of governing is implicated in ways of knowing because ways of knowing implicate ways of governing. The production of rational knowledge, no matter the discipline, is therefore a political act.

From a critical point of view this perspective too is not so scandalous. But for Foucault, the link between governing, knowledge and rationality is not to be understood in terms of the ideological uses to which rational knowledge may be put, the idea of the illegitimate use of legitimate knowledge. The link is much deeper and more complex than that. For Foucault, there is no objective ground to judge legitimacy. Rather legitimacy is the result of an agonal contest. Not only a contest of wills, but a contest of evolution an effect of the continuous change in the art of government. For legitimacy is linked not only to individual thinkers but the larger system of thought within which individuals and their own thought processes exist.

By art of government Foucault means the application of practical techniques and principles rationally applied to rationally understood objects for the purpose of affecting this object in a specified way. It also refers to the reflection upon the specific strategies and techniques by both those who implement them and those who are the targets of them.[1]

The art of government is unique from other historical forms of rule in its interrelationship with knowledge. Government as an art began to emerge when knowledge ceased to be solely the effect of religious interpretation and became connected to investigation into and experimentation upon the material world. That is, the art of government emerged

1 Michel Foucault, "Governmentality," in Foucault Effect: Studies In Governmentality With Two Lectures By And An Interview With Michel Foucault. ed. Graham Burchell, Colin Gordon, and Peter Miller (Chicago: University of Chicago Press, 1991).

roughly simultaneously with the development of an epistemology of objectivity and the beginning of empirical scientific inquiry. From this point on the objects and objectives of government ceased to be subsumed within a divine cosmological and theological order. The principles of government, the rationality by which it operates and the knowledge of its object, became autonomous. The object of government and the principles by which they are administered, whether the state, society, or individuals, become immanent to themselves. It is through investigation into such objects of government, how they work and by what means they can be made to work better, that the principles of government, and its rationality, are determined.

Governing became linked to objectivity and rationalism not simply because these outlooks produced useful devices and techniques for manipulating and affecting things and processes. It also became linked to objectivity and rationalism precisely because objectivity and rationalism became imbued with moral and ethical overtones or capacities especially in terms of the struggle over legitimacy. Objectivity replaced divine and cosmological capacities for judgment. Moral concerns did not disappear, they became invested in rationality, governmental rationality in particular.

Governmental practices and activities based on objective knowledge were not only effective, they were the morally right way to do things. Good government became rational government - government that reflected in an objective manor upon its goals and methods for achieving these goals. And rational government became good government - government which had as its goal the enhancement of what is good and proper, the right order of things, within its domain.

Government is a broad and complex topic. There is one particular facet to the art of government that is particularly interesting and provides a degree of coherence to my story. That is statistics. Statistics emerged as one of the primary investigative activities to discover the objective facts about the state and to establish what the right order was. In 1615 Antoine de Montchrestien in his treatise on political economy remarked "One thing alone is lacking to you O great State, the knowledge of yourself, and the image of your strength."[2] By 1778 the demand for such knowledge had become common: "There can be no well-ordered political machine, nor enlightenment administration in a country where the state of population is unknown." M. Moheah stated.[3] He pointed out further that "kings and their ministers are not the only ones who may draw knowledge from the table of population...The progress or loss of population presents a host of truths from which Physics, Medicine and

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2 Antoine de Montchrestien L'Economie politique patronale. Traite de l'oeconomie politique, dedie en 1615 au roy (Paris, 1889), 34. Quoted in Pasquale Pasquino "Theatrum Politicum: The Genealogy of capital - Police and the State of Prosperity," in Burchell, Gordon, and Miller eds. Foucault Effect, 114.

3 M. Moheau, Recherches et considerations sur le population de France (Paris, 1778), 20. Quoted in Pasquino, "Theatrum Politicum," 115.

all the sciences which have for their object the health, conservation, protection or succor of humanity may profit."[4]

Statistics and the modern state system in Europe emerge together in the seventeenth century. Since its inception in the seventeenth century statistics has been at the center of the effort to know the makeup and composition of these new states. The general goal of the art of government is prosperity or the right order of the state. Prosperity and the right order of society are familiar themes in the late twentieth century. This concern is not unique to the modern art of government. Foucault and others refer to this concern as the pastoral responsibilities of the state. Such pastoral conceptions of the role of political rule goes back at least to the Greeks. Through the middle ages this pastoral responsibility assumed by political leadership was invested with Christianity and religious or cosmological conceptions of what constituted the right order of the kingdom.

What distinguishes the art of government from earlier forms of rule is the derivation from within the object of government itself of knowledge about this object. From this knowledge emerges the particular form by which the right order of the state is understood and the governments pastoral responsibilities are carried out. Governing requires that the reality of individuals and groups, their relationships with each other and with the processes of life, be made thinkable and intelligible. The art of government encompasses the "strategies, techniques and procedures through which

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4 Ibid.

different forces seek to render operable" the various rational knowledges of the social relationships of and between individuals and groups as well as their interface with material resources for the sake of production.[5] Governmental knowledge, in other words, elucidates its object in such a way that renders it thinkable, manipulable and amenable to government.

The various techniques and principles constituting statistics since the seventeenth century have been the primary means of obtaining rational objective knowledge about the object of government. However, statistical thought and practice themselves have a history. They have not been stable but have evolved. The need by the emerging states for knowledge about themselves provided the impetus for the first statistical practices. These practices were themselves informed by the emerging conceptions of rational scientific method. As the first statistical activities began to produce knowledge about the state the perceptions of it began to change. As the perceptions of the object of government evolved, so did the governmental activities aimed at it.

The history of statistics is unique in its peculiar relationship not only to the art of government but also to the very conceptions of rationality and objectivity upon which the art of government depends. What are the implications of rationality having a history? In terms of government it means the evolution of the right order of the

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5 Nikolas Rose and Peter Miller "Power Beyond the State," British Journal of Sociology 42, no. 2 (June 1992): 183.

object of government and hence how it is governed. Though statistics began as an explicitly political activity, its techniques and methodologies quickly found applications in all the disciplines producing rational, scientific knowledge. More and more techniques were developed in many different disciplines.

By the beginning of the nineteenth century statistics had ceased to be understood as political at all. Where once statistics had been guarded as secrets of the state, vital information about its strength, they became, and remain, eminently ubiquitous, dispersed throughout society open to all who care to look. This has obscured the political role of statistics but has not decreased this role. Statistics has been fundamentally involved since its inception in the production and definition of rational governmental knowledge. It may be that the political value of statistical practices has been increased with this spread and ubiquity. In any case, the evolution of statistical thought and practice, what I shall call statistical reason, has been closely linked to the evolution of the art of government. The first discovery of statistics was the population, the first object of government for the new states in Europe. Continued transformations in conceptions of the object of government, partly as a result of continuous statistical examination of the population led to a reformulation of the object of government into society.

By World War II rational knowledge had undergone a dramatic yet subtle reformulation, a reformulation that is beginning to manifest itself as the modern art of government. Statistics played a significant role in this transformation. When society began to be conceived as a complex system by the turn of the century, techniques for governing it began to reflect this reformulation. With the development and spread of information theory throughout all knowledge producing disciplines, this conception of society as a system became much more formal and practical. A new form of governmental intervention began to be imagined based upon new conceptions of the dynamic processes of society.

We are just now beginning to feel the effects of this reformulation. They are, I believe, connected to a range of new technologies which have statistical monitoring and recording capacities built directly into them. These new techniques and technologies with their new capacities and potentials are in turn altering our perception of what society is composed of, what its right order is, and what the proper objectives of government should be.

I do not assume that essentialist epistemology has disappeared or that practices emanating from this position are no longer effective. They are. Analysis of such practices are still important to render visible and analyzable such practices especially when they take the form of exclusion and marginalization documented so well in feminist and cultural studies. I believe, however, that the emerging form of government does not revolve around the identity/different nexus in quite the same way. The difference between these forms of analysis and the one presented here are related in an obscure way but are not the subject of this paper.

The goal of this paper is to trace, in a general way, the transformations that have occurred in statistical reason and to link these with the emerging transformations in the art of government. Nikolas Rose and Peter Miller describe the art of government as composed of three mutually constitutive aspects; the moral, the discursive, and the epistemological.[6] I focus particular attention upon the epistemological aspect. The focus on the epistemological aspect of the art of government clearly illustrates the political context of the production of knowledge and the evolution of ways of knowing the object of government. To understand and participate in the politics of the current period it is vital that the way the object of government is understood and managed itself be understood.

Part One begins with a description and explanation of Foucault's concept of governmentality and the art of government setting the analytical stage for the subsequent narrative of the effects of the transformations in statistical reason. The art of government can be usefully analyzed by distinguishing between the form taken by political practices and thought on the one hand and the object of these practices and thought on the other. The two are mutually constitutive and irreducible. How the object of government is understood affects how it is governed and at the same time the practice of governing this object leads to

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6 Rose and Miller, "Power Beyond the State," 178.

the same time the practice of governing this object leads to changes in how it is understood.

Part One continues with a description of the historical emergence of the art of government as a form of political rule and statistics as a form of rational knowledge production. Together they were known as *raison d'etat* or reason of state. Reason of state corresponded with an object of government known as a population. Statistics emerged in the effort to describe and understand the population. The subsequent developments of reason of state leading up to the beginning of a new art of government are then described. This is characterized by the transformation of the population into a new object of government known as society and the new art of government known as liberalism.

Part Two explores the continuous developments of early modern liberal government and statistics. Liberal government is characterized by the refinement of what Foucault calls the disciplines. Statistics provided the knowledge of the normal that made the disciplines possible. Particular attention in Part Two is given to the role of statistical reason in the development of various disciplines producing knowledge about society. The growth and refinement of knowledge about society leads to yet further transformations in how this object of government is understood. At the epistemological level, this transformation is played out in the decline of essentialist determinism and the search for a new principle of order centered on functionalism.

Part Three describes the continued transformations in statistical reason, and the development of equilibrium and structure as concepts to accompany functionalism, and the replacement of the norm as a determining force. While short lived, equilibrium was fundamental for the further development of concepts of complex processes and their ordering in terms of dominance and hierarchy.

Part four describes the continued transformations in the conception of society since World War II. Dominance and hierarchy as principles of order quickly gave way to the principle of control during what became known as operations research during world War II. These transformations led to the current state of transition in the liberal art of government and, I suggest, is the beginning of a radical change in the way the object of government is understood and hence how it is governed. Control is intimately linked with several concepts such as information, cybernetics and complex systems. The conception of society that is emerging, I suggest, is one of a cybernetic information processing system.

The concluding discussion focuses primarily upon the tentative ramifications of the emergence of cybernetic information processing systems for how the object of government is understood. The development of complex dynamic systems as a rational explanation for how many aspects of the world works implies a dramatic reformulation of the right order of modern society and how its prosperity can be enhanced. Dramatic shifts in the art of government are accompanying this reformulation giving rise to a new form of government that Gilles Deleuze has simply called control.[7] I speculate only briefly on how the actual practices carried out upon this new object of government might operate. I believe it is necessary to first understand the epistemological basis of this new society of control - where it came from and how it emerged - before attempting to understand the specific activities of government by control. A comprehensive analysis of the practices of modern government will have to wait.

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7 Gilles Deleuze, "Postscript on the Societies of Control," October 59 (1992): 3-7.

Chapter 2:
Governmentality
and the Art of Government

According to Michel Foucault current political theory pays too much attention to institutions and not enough attention to the practices and activities by which governing is carried out. This focus on institutions is based upon a reification of categories and constructs such as the *true nature* or *essential characteristics* of politics, the State, Government or Civil Society. The identification of the essential characteristics or true nature of these categories have long been the mainstays of political theory. For Foucault, however, the production and deployment of these categories themselves constitute political practices and that "[t]he nature of the institutions of the state... [are] a function of changes in the practices of government."[1] The distinction between theory and practice is not as clear cut as traditional political theory assumes.

Foucault's project had been an attempt to "sketch a history of the different ways in our culture that humans

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1 Colin Gordon "Governmental Rationality: An Introduction," in Burchell, Gordon, and Miller eds., Foucault Effect, 4.

develop knowledge about themselves."[8] This historical sketch treats knowledge and reason as "truth games" rather than truth as universal and fundamental, what George Lakoff calls objectivist truth. Lakoff defines objectivism as the assumption that "rational thought consists of the manipulation of abstract symbols and that these symbols get their meaning via a correspondence with the world, *objectively construed*, that is, independent of the understanding of any organism."[9] The world "objectively construed" is understood to be composed, at least partially, by things that possess essential properties. These essential properties "are those properties that make a thing what it is, and without which it would not be that *kind* of thing."[10] Objectivist assumptions of essential properties are the basis of traditional categorization and classification schemes.

Foucault rejects such objectivist theoretical attempts to deduce the modern activities of government that begin with

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8 Michel Foucault, Technology Of The Self: A Seminar with Michel Foucault, ed. Luther H. Martin, Huck Gutman, and Patrick H. Hutton (Amherst: University of Massachusetts Press, 1988), p 17-18. Foucault has been charged by some of anti-humanism and even conservatism for this rejection of universal and essential qualities. The rejection of universalisms however does not simply imply relativity where anything goes or a rejection of standards of judgment. Foucault's conception of modern political reason and forms of governing understood as contingent and contextual means it is a domain to be participated in and acted upon. Foucault presents a vision of politics that allows full participation. It demands recognition of our participation in the construction of governmental categories rather than simply the rearrangement of already established "essential identities."

9 George Lakoff, Women, Fire, And Dangerous Things: What Categories Reveal About The Mind (Chicago: The Chicago University press, 1987; paperback edition 1990), XII. Italics in original.

10 Ibid., 161. Italics in original.

a priori assumptions of essential properties and propensities of the State, Civil Society or Government etc.[11] Such theories, however, are instructive - not for their description of the actual workings of government or society per se but rather as representations of the theoretical practices that form past and present modes of the art of government. Foucault does not focus upon the truth or falsity of how Government, the State or Civil Society have been conceived at any given point in history. Instead he asks how such conceptions and their associated practices became possible. "These forms of knowledge and these apparatuses of power are linked in a constitutive interdependence."[12]

In Plato's allegory of the cave the philosopher produces truth in his pretense to revelation of the good and the just by the light of reason and philosophy.[13] For Foucault the truth whose shadow is cast on the cave walls is not revealed by the sun's light during the philosophical ascent out of the caves darkness. Even in the sunlight (reason) the truth remains enigmatic. We have no privileged access to, or god's eye view of, the really real or objectively real that characterizes the Platonic ideal of the philosopher king.

Foucault's analysis is not prescriptive. Foucault explicitly refrained from constructing a theory of the state

11 Colin Gordon, "Governmental Rationality: An Introduction," in Burchell, Gordon and Miller eds., Foucault Effect, 4.

12 Colin Gordon, "Afterword," in Power/knowledge: Selected Interviews And Other Writings 1972-1977 (New York: Pantheon Books, 1980), 239.

13 Plato, Republic, Translated with an introduction by Francis MacDonald Cornford (New York: Oxford University Press, 1941; Twenty seventh printing, 1965), book VII.

or good government. He is more interested in how ideas and practices came about, what made them possible and what they in turn make possible than whether they are "right" or "wrong." He prefers to to analyze the development and functioning of truth and knowledge rather than engage in pronouncements as to the degree of correspondence the object of a theory has with the "really real." The governmentality critique tries to destabilize the traditional categories of political theory and show them to be the effects of, as much as the basis for, political theory. Through this destabilization governmentality tries to illustrate how our essential political truths produce and are produced by political reason and political practices in an intimately interwoven process.

Foucault refers to this mutually constitutive character of theory and practice as an ensemble. It is an "ensemble formed by the institutions, procedures, analyses and reflections, the calculations and tactics, that allow the exercise of this very specific albeit complex form of power."[14] The ensemble comprising the art of government is not to be thought of as hierarchical with a fixed structure. Rather, the relationships within this ensemble are fluid or *thixatropic* in character displaying nonetheless "an overall coherence without answering to any determinative principle or

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14 Michel Foucault, "Governmentality," in Burchell, Gordon, and Miller eds. Foucault Effect, 102.

underlying logic."[15] The coherence and logic that obtains within such ensembles, as well as any fluid disturbances, arise from within the ensemble itself. The close relationship of these two dimensions leads Foucault to often use these terms interchangeably. For clarity's sake I will refer to governmentality as denoting Foucault's mode of analysis while referring to the art of government as the object of this mode of analysis, the practices of governing.

Nikolas Rose and Peter Miller have developed a schematic for breaking down Foucault's governmental ensemble into a form useful for this paper.[16] This schematic, or "conceptual tool" breaks the art of government into three aspects, again, understood as mutually constitutive: the moral, the idiomatic and the epistemological.

The moral or ethical aspect refers to the ideals and values to which government is thought to be properly directed such as freedom, justice, citizenship, etc. This includes the relations that are considered proper between ruler and ruled, the distribution of tasks and authority whether political, spiritual, military, familial, pedagogic etc.

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15 Mitchell Dean, Critical and Effective Histories: Foucault's Methods and historical Sociology (New York: Routledge, 1994), 223. Thixotropy is "the property of certain gels and emulsions of becoming fluid when agitated and then setting again when left at rest." Webster's New World Dictionary 2nd college ed. (1980), s.v. "Thixotropy."

16 Rose and Miller, "Power beyond the state," 178. Rose and Miller's delineation is slightly different from the one I use here. They use the term political rationality where I use the term art of government. This is because they do not distinguish between governmentality and art of government in the same way that I do. These two formulations are compatible however. They are simply derived from different narrative goals.

The idiomatic or linguistic aspect refers to the distinctive language with which governing is articulated. The language that constitutes political discourse is more than rhetoric, at least in that terms common usage. "It should be seen, rather, as a kind of intellectual machinery or apparatus for the rendering [of] reality thinkable in such a way that it is amenable to political deliberations."[17]

The epistemological aspect refers to the truth or knowledge component of political reason and practice. Each historical form of the art of government conceives its object in a relatively distinct way. These distinct epistemological conceptions of what the object of government is in its actuality gives rise to distinct ways of governing them. As the epistemological conceptions of society, the state, or the individual citizen change there is a corresponding change in how they are governed.

These three aspects are identified with the whole ensemble of the art of government. They apply to both the political reason and political practice dimensions. Just as in the latter analytical differentiation between governmentality and the art of government, these three aspects also can not be arranged hierarchically. They interact and mutually constitute one another.

I have utilized this delineation of the art of government in this way in order to isolate a narrow and more manageable field of inquiry. I focus my attention throughout this paper on the epistemological aspect of the art of government. Within this relatively narrow confine I shall

17 Rose and Miller, "Power beyond the state," 179.

trace, in a general way, the history of statistics. I am interested primarily in how the practice of statistics, as a technology that produces knowledge, is linked to the transformations in the epistemological conception of the very objects it renders knowable.

The first object of government, which will be described in detail in the next section, is the population. The form of government exercised viv-a-vis the population became known as police. In current usage the derivation policy would be more descriptive of this governing art. It was characterized by the attempt to arrange the material and processes of the territory and the population of the state in such a way to bring out the best arrangement of things, their right and proper order necessary for a state of prosperity. Police became more commonly known as *raison d'etat* (reason of state).

The population was the first target of statistical activity, primarily in the form of tabulation of simple facts such as births and deaths and the number of inhabitants of villages. The success of these practices altered not only the perception of the population but also the very practice of statistics itself. The population became understood in more complex ways and with increasing refinement. At the same time the techniques and methodology behind statistical practices were refined and became more complex. This process of refinement and complexification of the thought and practice of statistics played an important role in the evolution of how the population was understood and in the development of new techniques for influencing it.

As the nature of the population became better understood and its interactions and exchanges traced the very conception of what constitutes its proper order and how its prosperity can be enhanced was altered. This alteration accompanied, and perhaps at times motivated, further transformations in the the techniques and methodology of statistics. Because both government and statistics have a histories and because they are so closely linked an analysis of the modern practices of government calls for an analysis of statistical reason.

In modern terms this evolving relationship between the art of government and its object is described using the concept of complex dynamic systems. The historical development of this concept is in fact one of the later themes of this paper. Complex dynamic systems represents the current rational understanding of processes of change. Statistics is of central importance to complex systems theories and modern evolution. Along with a host of other related and epistemologically inseparable theories and concepts, such as information, the object of government is being transformed once more. Or, rather, it continues to be transformed. Statistics is so profoundly involved in the reconfiguration of the object of government, and in such obscure ways, an analysis of the modern art of government, at some point, must examine the effects of statistical reason's historical change. Isolating the epistemological level of the art of government and statistical reason allows for such an examination and reveals at least some of these obscure relationships between statistics and government.

It is impossible to effect a clean distinction between the moral, idiomatic and epistemological aspects of political reason just as it is impossible to clearly distinguish political reason from political practice. The delimitation of ages or even a clean distinction between the different arts and their respective objects is also impossible. Such a clean distinction, however, is not my point. My point is rather to show their relationships. That the roots of one art may be found in the thought and practice of the one before it. It should also be mentioned that the transitions described do not take the form of a replacement but of reformulation. Their are many aspects of the early rationality of police that get ample play in the modern art of government. Even earlier forms of the rationality of sovereignty characteristic of feudal periods finds expression in our legal system with the important change that each individual citizen constitutes a sovereign rather than only the monarch. Rationalities do not disappear, they seem to remain useful and find application in a number of social processes. But the art of government, in general terms and at the epistemological level, displays a certain homogeneity that can be traced.

Displaying the impossibility of clear distinctions between historical processes is one of Foucault's recurring themes. The thixatropic and mutually constitutive nature of the ensemble making up the arts of government means even a careful description of a narrow terrain or line of thought will inevitably have some discussion of these other aspects and dimensions seeping into it. This seepage will be obvious in some places. In others it should be kept in mind that such seepage is occurring just under the surface of this narrative. My story begins with the Renaissance and the emergence of the arts of government as a new form of rule.

The Emergence of the Art of Government

The Renaissance inaugurated a transformation in European political, philosophical and spiritual thought. Knowledge began to displace faith as the criterion for judgment. In the medieval Christian conception of rule, the king served as an instrument of God. Thomas Aquinas characterized legitimate rule by the king as mirroring God's rule of nature. Political rule was linked with concern for human purpose on earth, a purpose defined in spiritual terms through various representations of God's will.[18] The King must rule his kingdom as the instrument of God on earth for he was responsible for ensuring the salvation of his subjects.

The political philosophy of Niccolo Machiavelli marks a break with this spiritual conception of rule. Proper rule for Machiavelli was not defined by the divine role of the prince. For Machiavelli the prince's power was derived from control

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18 See for example Thomas Aquinas, Summa Contra Gentiles and Summa Theologica.

of his territory and its inhabitants. Such power was, furthermore, to be focused towards the good of the republic, its physical survival and expansion. Machiavelli's advice in The Prince (1513) is characteristic of an entirely new formulation of the relationship between the ruler and his domain. Henceforth increased attention is given to rule in terms of the relationship between men and territory. Fostering what is good for the domain and preparing against what is bad - whether in the form of rival kingdoms or the caprice of "the winds of fortuna" - becomes the ruler's primary objective.[19]

The increasing attention to secular relationships between the prince and his territory was linked to a general transformation in philosophical and scientific thought since the Renaissance. Truth was becoming linked to reason and the sciences with a corresponding disassociation from spiritual knowledges. Francis Bacon for example, wrote that "truth therefore and utility are here the very same things."[20] Rule became an activity linked to perpetual inquiry: What was the thing to be ruled? How did it work? How can it be made to work better? To quote Bacon further: "the glory of God is to conceal a thing; the glory of the king is to search it out."[21]

19 Niccolo Machiavelli, The Prince, Chapter XVIII.

20 Ian Hacking, Representing and Intervening: Introductory Topics in the Philosophy of Natural Science (New York: Cambridge University Press, 1983), 246.

21 Ibid., 246.

For Pierre de la Ramee, a logician and teacher at the university of Paris in the mid sixteenth century, the central problem of knowledge of any kind was its teachability.[22] If knowledge is true and if it was to be of utility it must be able to move between the minds of men. It must be communicable and teachable. The problem was to accomplish this movement and make knowledge teachable. For Ramee the spatial ordering of objects and thoughts into diagrammatic form represented the most effective pedagogical method. Regardless of the topic - whether poetry, philosophy or medicine - organization and display in diagrammatic form on the basis of contrast and dichotomization became standard pedagogical practice. Faith in reason had replaced faith in the divine. Reason became linked to knowledge as *topoi*. Rational explanation in general and scientific explanation in particular became predominantly spacio-visual in form.[23] Knowledge as topoi was knowledge manifested in earthly form.

The emergence of secular philosophies of rule did not produce a simple wholesale rejection of God's will and divine guidance. God ruled the universe and often intervened, through miracles, in the affairs of men. But the link between

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22 Johannes Fabian, Time and the Other: How Anthropology Makes Its Object (New York: Columbia University Press, 1983), 114. Fabian notes that Ramee's theories of knowledge and pedagogical method "were published in many languages and countless editions...The fact that his theories soon became anonymous (precisely because they were thought to be synonymous with pedagogical method) only underlines" his importance. Ramism has, in other words, achieved the status of Kuhnian Normal Science according to Fabian. Ramee's theories of teaching were formulated at the same time that Gutenberg began the printing revolution. His theories were surely linked to this invention, for mass printing required and reinforced the displayability of knowledge.

23 Ibid.

the sovereign and God became more complex. The secularization of political authority and of knowledge emerged together. The right order of things was no longer revealed in scripture but through investigation of the object of rule itself.

Rational knowledge of the right order and things was to be discovered by reading the "Book of Nature," Galileo Galilei's theistic concept of God as the 'Author' of nature. For Galileo, God wrote down the equations and set the fundamental laws of the universe in motion. Investigation into the working of the world, God's world, rather than devotion and scriptural faith, revealed God's will and the right order of things. The right order of things in this conception was still God's order but investigation replaced faith as the proper mode of divination.

Machiavelli marks the transition in the understanding of the proper objectives of rule from those revealed in scripture to those revealed in observation of the states activities themselves. After Machiavelli much more attention was given to the objective nature of the kingdom. A secular objective of "national interest" replaced the spiritual objective of salvation. Reason of state emerged as the predominant political reason. Reason of state was simply the rationality by which the state conducted its affairs, that is a rationality derived form the actual functioning and the requirements for this functioning of the state. This political reason was thus linked to the practical activity of the king expanding his income and strength.

This was a period in European history when one of the central concerns was war and all that war entails. The State became an object of increasing material needs - soldiers, food and money. These material needs, however, brought with them the need for new organizational arrangements which would fulfill these needs - household, barracks and agricultural practices which would increase production and participation. One could not expect the treasury to be continually replenished without some measures designed to increase the production of wealth and its collection.

The concern for the nature and actuality of that which is ruled marks the beginning of a transformation in the very concept of rule. The epistemological, moral and even the descriptive language of rule changes. The objectives of rule and governmental knowledge of its object become linked in a new way. Governing becomes understood as an art - in the sense that it pertains to specific techniques which correspond to specific rules as part of a rational knowledge. The art of government has as its goal the assurance and promotion of the right order of things. Government "is rational," Foucault observes, "on the condition that it observes the nature of what is governed."[24]

The rationality behind the sovereign's pastoral responsibility under reason of state, represented a relatively smooth transition from the earlier spiritual responsibilities of the sovereign to lead his subjects to salvation. God's will revealed by scripture was replaced by

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24 Foucault, Technology of the Self, 149.

the needs of the State. The art of government thus arose from the new relationships between authorities "constituted as 'political' and the projects, plans, and practices of those authorities which attempt to administer individuals and society in terms of a prevailing conception of what is good healthy right normal, virtuous, profitable, efficient etc."[25]

George Obrecht, an official in Strassburg, was the first to speak of the *population* - a neologism he invented.[26] The population is a new social entity, a new concept and a new object of government. Previously there had been *Stande* - groups, orders, or estates. These were much smaller organizations of people with only loose ties binding them together and encouraging cooperation. Along with this new object of government there emerges a new concept of authority *Obrigkeit*, which means government or public authority that is cognizant of its object. Obrecht called for the gathering of information about the resources and capacities of the population and territory. He called for the implementation of a set of public policies designed to augment these capacities and resources. These activities Obrecht summarized by the Latin words *census* and *censura*.[27] Census referred to the knowledge on the part of every individual of their

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25 Rose and Miller, Power Beyond the State, 175.

26 Pasquale Pasquino, "Theatrum Polititicum: The Genealogy of Capital - Police and the State of Prosperity," in Burchell, Gordon, and Miller eds., Foucault Effect, 114. The full title is actually Eine Sondere Policy Ordnung, und Constitution, durch welch ein jeder Magistratus, vermittels besonderen angestelten Deputaten, jederzeit in seiner Regierung, eine gewisse Nachrichtung haben mag.

27 Ibid., 113.

responsibility towards the State while censura referred to the obligation on the part of the public authority to take charge of the public's welfare, gather information and educate the population.

Government has not only "to deal with a territory, with a domain, and with its subjects, but...it also has to deal with a complex and independent reality that has its own laws and mechanisms of reaction, its regulations as well as its possibilities of disturbance."[28] Chemnitz, a German author, in De Ratione Status (1647) wrote that rule according to reason must "ascertain political consideration required for all public matters, councils, and projects, whose only aim is the state's preservation, expansion, and felicity to which end, the easiest and promptest means are to be employed."[29] The transition from scripture to observation as the basis of political knowledge was nearly complete. By the end of the Thirty Years War the emergence of secular territorial organization was codified by the treaty of Westphalia in 1648, inaugurating the state system in Europe. The observation and production of knowledge about this new secular territory emerged as a critical topic for natural and political philosophy as well as practical administration.

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28 Michel Foucault, "Space, Knowledge, Power" interview by Paul Rabinow, Trans. Chritian Hubert, The Foucault Reader ed. Paul Rabinow (New York: Pantheon Books, 1984), 242.

29 Foucault, "Governmentality," 90.

This was the impetus for statistics. "Statistics began as the systematic study of quantitative facts about the state."[30]

Various records had been kept throughout history. Births, baptisms and deaths had long been recorded with enthusiasm by churches in Europe and Scandinavia. The city of London in 1603 began recording weekly tallies of plague victims noting age location and other contextual information. But it was not until the mid-seventeenth century that such record keeping began to be carried out in a systematic way. In articles on "political arithmetic" and later in Natural and Political Observations (1662), John Graunt first tabulated statistics in a systematic form.[31] These works were not mere records of facts as the earlier church records had been. These were facts linked and tabulated with other facts. Graunt and co-author William Petty drew up tables of facts that were linked together in various way. "Signs of probability" were tabulated together such as Fracastoro's "signs of contagion": the air, the presence of insects and the alignment of planets.[32]

Graunt's statistical tabulations were displayed in proper Ramist schematic form which had by then become simply a matter of "undisputed practice of normal science," to use

30 Ian Hacking, The Emergence of Probability: A philosophical Study of the Early Ideas About Probability, Induction and Statistical Inference (New York: Cambridge University Press, 1975), 102.

31 Ibid. Shortly thereafter, in 1667, Paris also began keeping official statistics.

32 Ibid., 28.

the term Kuhn would later popularize.[33] Statistics became the basic factual units of knowledge about the nature of the state and its proper order. These practices of counting and gathering information are intimately interconnected with the practices of rational government. The increased complexity of government and the expansion of bureaucracy emerged together with the increasing detail and sheer amount of information about the state.

The linkage between increasingly elaborate governmental practices and increasingly detailed statistical information is complex. Political authority's desire to know the facts about the State intimately influenced what was counted and how the counts were tabulated. Where once the counting of hearths, for example, was sufficient for tax collection purposes it later became necessary to count the number of rooms in a dwelling and the number of animals husbanded by a family. Which "signs of probability" were to be linked together was itself a form of governmental practice. The mere existence of a family evidenced by its hearth preceded the assessment of a "flat tax." It was not enough to know of the family's existence but. Its state of existence - as indicated by the signs of room number and animals husbanded - also became necessary and useful knowledge.

Statistical thinking emerges along with a general transformation in scientific theory - specifically its epistemological aspect. During the plague of 1603, for example, swarms of rats, mice or other such creatures were understood as both signs as well as causes of contagion or

33 Fabian, Time And The Other, 114.

corrupt air. Whether or not something acted as a sign or cause was part of the theory itself. There was no independent epistemological criteria for judging between signs and causes and the theory in which they were embedded. Without viewing such an epistemological criteria separate from causal theory the mass of tabulated facts could only reveal what the prevailing theory specified.

Graunt and Petty, however, began to look at their data not as signs or causes, dependent upon theory, but as data epistemologically independent of theory. Graunt and Petty began to look at the tables and see "epistemological relationship independent of the particular subject matter."[34] The tables of mortality ceased to be the "signature of the plague" and became merely data from which many conclusions could be drawn.[35] Only after such a separation between sign and explanatory theory do controlled experiments become part of the scientist's repertoire. This distinction between sign and theory made modern inference possible.

The amount of statistical information gathered by national governments grew immensely by the end of the seventeenth century. All the Western European states had by then set up some sort of ministry to collect and tabulate statistical data. What appeared in these statistical tables was knowledge about Obrecht's newly conceptualized population. The pursuit of rational knowledge was not without its effects. Population statistics soon revealed an object of

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34 Hacking, Emergence Of Probability, 105.

35 Ibid., 106.

government much more complex than even Graunt or Petty imagined. The population emerged as an entity consisting of processes and activities with an order all its own - an order that seemed to emanate from the population itself. The population, according to Foucault, "is the subject of needs, of aspirations, but it is also the object in the hands of the government, aware, vis-a-vis the government, of what it wants."[36] The population, with its own needs and desires, was an active entity. The State as a whole came to be understood as constituted by the activities of its population and the general processes within its territory with the king at its head responsible for directing its affairs.

The right order of the State, towards which the art of government was directed, came to be understood in terms of the *Oikos*. Oikos was taken from the Greek concept of the relations proper to a family and the relationships between its members and its resources as overseen by the head of the house.[37] The family and the population was an object of needs. The household was understood to involve a set of interwoven processes that had to be carefully managed in order to function properly. The family and the population thus had needs not only for specific material resources but certain general arrangements that had to be continually maintained. The king (the head of the house), according to this model, was responsible for directing these processes and providing for the needs natural to the population. Prosperity

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36 Foucault, "Governmentality," 100.

37 Mitchell Dean, Critical and Effective Histories: Foucault's Methods and historical Sociology 9New York: Routledge, 1994), 184.

or destitution, within the bounds of fate and God's will, was in the hands of the head of the state. For Samuel Von Pufendorf "sovereign authority is conferred upon them [the rulers] only in order to allow them to use it to attain or conserve what is of public utility."[38]

The Oikos model therefore represented a relatively smooth transition from medieval to classic forms of rule. To run a household one must know of what it is made as well as its propensities and tendencies. The Oikos model provided both an impetus for the production of statistical knowledge (facts about the state) and a framework (the sovereign's pastoral responsibilities under *raison d'etat*) in which to utilize this knowledge. The initial form taken by the art of government was directed at the assurance and promotion of the orderly activity observed in the familial economy transferred to the larger domain of the entire State with the figure of the sovereign occupying the familial position of the father.

The early reason of state based on the model of the Oikos was not to last however. Preserving and enhancing the state proved to be problematic. The population was an unstable and shifting entity for which the conservative model of the Oikos provided a viable conceptual framework for only a short time. Governmental practices based on the sovereign's pastoral responsibility failed to deliver the order and

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38 Foucault, "Governmentality," 94. The metaphor that became common in these treaties was that of a ship-the ship of state. As with a ship, it was not the material making it up that was the object of the captain's (i.e. the sovereign) power, as would be under the medieval conception of power, but the whole operation of the crew, the stores and the ship itself including its timbre, tar and hemp.

prosperity that was supposed to result from such rule. By the end of the seventeenth century confidence in the sovereign's ability to produce the right order of the State had begun to erode.[39]

The processes and needs of the population soon became differentiated from the managerial figure of the sovereign. It became increasingly understood that even the beneficial processes within the State proceeded despite the activities of the sovereign. There were of course many contributing factors to these transformations, both practical and theoretical. The political travails in England surrounding the attempts at Stuart restoration and the competition between rival oligarchic groups after William of Orange's death for example, or in France, Louis the XIV's involvement in several wars. The peasant uprisings in Quercy and Perigord France at the end of the seventeenth century challenged the existing order by contesting the payment of taxes to the king, tithe to the church, or the provision of free labor for the upkeep of roads.[40] Such events seemed to call into question the notion of the sovereign as in some way responsible for what little order did obtained in the processes of the state.

The scope of rational scientific knowledge began to expand to include not only the idea of reading the "book of nature" but also Galileo's conception of constant natural

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39 Denis Meuret, "A political genealogy of political economy," Economy and Society 17, no. 2 (May 1988): 234.

40 George Rude, The Crowd in History, 1730-1848 (New York: John Wiley & Sons, Inc., 1964), 19.

laws operating without the direct guidance of an orderer. Galileo, and his friend Thomas Hobbes, both received threats from the church and the aristocracy on grounds of heresy. The aristocracy eventually warmed to Hobbes' views and later to Galileo's. Charles II, who was tutored by Hobbes while in exile in Paris, invited him into his court upon the restoration of the monarchy in 1660. The new king described Hobbes as "a bear, against whom the Church played their young dogs, in order to exercise them."[41]

Isaac Newton expanded Galileo's theory of fundamental constants, stating that even 'perturbations' in planetary motions were due to specific causes that followed from an as yet unrecognized natural law. Order and what appeared to be disorderly, and thus the realm of chance, Machiavelli's *fortuna*, had both come to be understood as in fact determined by specific causes. Natural law and determinism was the immutable cause of order. Knowledge, if it was to count as reasonable, eventually reflected this understanding. The conception of the right order as the direct consequence of an active orderer, a sovereign or God in effect lost its rationality.

Statistics revealed the order and processes that obtained in the state. This gave rise to the new object of the population, an object wholly contained within the state.

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41 Isaac Disraeli, Quarrels of Authors (London: John Muray, 1814), 24. Quoted in George Dyson Darwin Among the Machines: The Evolution of Global Intelligence (Massachusetts: Addison-Wesley Publishing Co. Inc., 1997), 4. n. 12. The Church, in fact, labeled the heresy of Hobbes as the cause of the great fires and plague of 1660. The Church evidently did not notice the discovery of inferential statistics by Graunt and Petty.

The pastoral responsibility of the sovereign carried over from medieval formulas of rule made rational thought the model of the Oikos. But the order and processes of the population revealed by statistics did not allow this holdover from earlier forms of rule without substantial renovation. The sovereign's importance declined and gave way to a much more bureaucratic form of rule. As the object of government became more complex - composed of its own forces of regulation, as revealed by statistics in line with the emerging rationality of natural law - the art of government also took on a more complex form.

Paul-Henri Holbach was the first to mount an "unmitigated defense of atheistic materialism."[42] Combining Hobbes and Newton, Holbach held that the material universe is self-controlled and that nature was the sum of matter and motion. The sole role of the state, for Holbach, was to "nurture, in every possible way, the virtues of cooperation" on which the good of the population and good government depends.[43] Political reason begins to reflect this emerging conception which displays its object in terms making it amenable to intervention and government.

The concept of the State as constituted by an Oikos with the sovereign at its head begins to change with these transformations in the concepts of nature, natural law and causal determinism. By the early eighteenth century the Oikos

42 Paul Edwards, ed. The Encyclopedia of Philosophy (New York: Macmillan Publishing Co., Inc. & The Free Press, 1967), s.v. "Holbach, Paul-Henri Thiry, Baron D'" by Aram Vartanian.

43 Ibid.

model was breaking down. The population and its order became separated from the figure of the sovereign as the source of order. As causes of order move from a sovereign pastoral figure, God, king or father, to internal natural laws, the process of the population become differentiated from the institutions of political authority. Foucault notes that by the mid eighteenth century the "menace" of death in the form of plagues and famines had been mitigated and a knowledge of and power over life emerged. "Western man was gradually learning what it meant to be a living species in a living world, to have a body, conditions of existence, probabilities of life, an individual and collective welfare, forces that could be modified, and a space in which they could be distributed in an optimal manner."[44] After a hundred years of increasing collection of statistical data along with the inferential possibilities of the epistemological separation of cause and sign within theory there emerged new formulations of the object of government.

The Physiocrats and the End of Reason of State

The transformations in how the population was linked to the sovereign and the state was dependent on the transformations in the epistemological basis of rational

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44 Michel Foucault, The History of Sexuality Volume 1: An Introduction trans. Robert Hurley (New York: Random House, Pantheon Books 1978; reprint, vintage Books, 1990), 142.

knowledge itself. Early critics of reason of state, such as the Physiocrats, emerge with the differentiation of the orderly propensities of the population and the figure of the sovereign. With this differentiation the economy emerges as a distinct object of knowledge constitutive of and yet, at the same time, constituted by a new form of political reason. The sovereign's direct intervention in the economy actually becomes the source of disruption and dysfunction rather than order and prosperity.

John Locke (1632-1704) and later David Hume believed the inner workings of nature to be unknowable. Abraham De Moivre in The Doctrine of Chances (1711) had said that fundamental chance was the result of equally possible outcomes of some kind of physical set-up.[45] Newton's mechanics led to unprecedented precision in astronomical measurement yet the implication was that gravity in itself is unknowable. Pierre-Simon Laplace in Philosophical Essay on Probability (1795) built upon this idea and stated categorically that chance and probability was merely the result of ignorance of true causes.[46]

The Physiocrat's texts are explicit that it is not through laws and decrees that the right order of things are to be achieved.[47] Francois Quesnay suggested that good

45 Ian Hacking, The Taming of Chance (New York: Cambridge University Press, 1990, reprint, 1991, 1992), 12.

46 Ibid., 11.

47 Foucault, "Governmentality," 92.

government simply *was* economic government.[48] That is, good government, government according to reason, had to be cognizant of the natural laws that determined the economy. The slogan "laissez Faire et laissez passer, le monde va de lui-meme" may be loosely translated as "Don't interfere, the world will take care of itself."[49] But this also meant actively guarding against the disruption of the world's taking care of itself through its natural processes. That is, it was an active non-interference. Quesnay's Tableau Economique, a three columned table of expenditures and receipts, displayed money in a whole new light. Money and wealth were conceived in terms of a self contained circulatory process within the population. The blood within the body politic. Wealth was the product of exchange rather than the zero-sum conception of surplus characteristic of the Oikos model.[50] This constituted the invention of what is today called the national economy.[51]

The Physiocrats' critiques of sovereign intervention into the economy were modern in terms of their distinction between political authority and the processes of the economy. However, their formulations were also consistent with another distinction that has since been erased. What we today call

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48 Ibid.

49 George Soule, Ideas of the Great Economists (New York: Mentor Books, 1955), 36.

50 Susan Buck-Morss "Envisioning Capital: Political Economy on Display," Critical Inquiry 21 (Winter 1995): 442-3.

51 Soule, Ideas of the Great Economists, 36.

"the economy" had been distinguished, until the late eighteenth century, between national processes and international processes.[52] Internal national processes corresponded to the reformulated Oikos model - the economy, newly differentiated from the ordering figure of the sovereign. The international corresponded generally to what is now referred to as commerce or capitalism. Commerce was the domain of the market, characterized by free exchange and competition. It was the domain of chance and caprice, Machiavelli's fortuna, where causal laws were of the unknowable Humian type. Commerce was understood as distinct from the economy precisely because the model of the Oikos could not be applied. There was no providential figure of a sovereign to exercise authority to protect the natural process of the population.

Quesney and the Physiocrats dismissed the conception of orderly economic processes dependent on an orderer but maintained the distinction between the economy within the State and commerce without. The right order of the economy was to be ensured through the sovereign's refraining from direct intervention in the economy yet the sovereign was also responsible for ensuring that such internationalperturbations and other events of unknowable cause characteristic of commerce did not disrupt the State's economic processes. Thus was the economic logic that propelled imperialism and colonialism. The sovereign responsibility was distanced from the economy, in other words, but not divorced from it.

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52 Meuret, Political Genealogy, 232-3.

Sovereign authority for the Physiocrats thus remained the foundation of rational government - either through the sovereign's active intervention on the one hand or inaction on the other. Physiocratic theory constituted the beginning of a general recognition, however, that, in Foucault's words, "if one governed too much, one did not govern at all - that one provoked results contrary to those one desired."[53] The Physiocrat's doctrine of laissez faire proposed a limitation on the legitimate exercise of political authority on the grounds that the population functioned better - followed its natural propensities - if left to its own devices. That is, with minimal expense by governing more by governing less - providing for the welfare of the population by allowing the population to govern itself.[54] This positive justification for market freedom would, the Physiocrats declared, make the State richer and more powerful. The laissez faire criticism of the authority and rationality of the sovereign's interventionary practices was the beginning of a new political rationality.

This new rationality presented new problems however. If the natural processes of the economy were disruptable, care must be given to protecting and fostering them. This was to be the new goal of government. Physiocratic criticisms of the rationality of reason of state, however, did not offer an alternative knowledge upon which the practice of governing

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53 Michel Foucault, Foucault Live ed. Sylvere Lotringer, Trans. John Johnston (New York: Semiotext(E): 1989), 260.

54 Burchell, "Liberal Government and Techniques of the Self," in Foucault And Political Reason, eds. Barry, Osborne, and Rose, 22.

could consistently operate. Good government, government according to reason, required a tighter link between the emerging epistemological conceptions of the population and knowledge that could produce rational techniques for acting on this object. Quesney and the Physiocrats can be seen as a phase in the transition from the political rationality of reason of state to a new political reason of liberalism. The question of how to arrange and manage all the parts of the Oikos gave way to the question of how to govern a natural self regulating process. "What is the principle of limitation that applies to governmental actions such that things will occur for the best, in conformity with the rationality of government, and without intervention."[55]

The State emerged as a dream of an homogeneous entity knowable in its earthly reality distinct from the revelations of scripture. It sooncame to be conceived in terms of the Greek Oikos, an object requiring direct guidance from the sovereign lest it fall to the whims of fortuna. The Physiocrats then articulated the first major critique of this dream by emphasizing the distinction between the population and political authority over it. Thus the state had become understood as composed of two spheres. The classical economists performed yet a further distinction. Building on the criticism of the Physiocrats they dividing the population into two distinct, yet mutually constitutive spheres; the economy and civil community. Taken together these formed the new object of a liberal art of government known as society.

55 Foucault, "Space Knowledge Power," 242.

By the end of the eighteenth century it was the responsibility of rational government to know its society in order to govern it rationally according to its nature.

Chapter 3:
Know Your Society

The responsibility of rational government to know its society had profound effects. Statistics effected the very epistemological level of political rationality. Once the impetus to read the book of nature produced the massive archiving of facts about the Oikos, the emergent political formation that arose from this archive could only be understood from within a rationality of statistical reason.

The relationship between statistics, society and early liberal political rationality is subtle. The transformation from population to society accompanying the transition from physiocratic to classical political economic formulations was closely linked to the development of statistics. Statistics transformed the way the population was understood and at the same time was fundamental in the transformation of the very perception and practice of rationality itself. It was through the technology of statistics that the spaces and processes of society were first observed and made legible. The development of statistics into a rational mode of analysis and the consequent exercise of this form of reason arose from and was directed at a new domain that frustrated direct control. Or to put it another way, society emerged because of the inability of the sovereign to order the population. Such was the lesson of the failures of the policies arising from the rationality reason of state.

The new liberal rationality of government was aimed at a new set of processes - the private, atomistic and egoistic exchanges that classical political economists spoke of. The individual to be governed was not only a rational, interest-motivated economic ego but also part of a biological population, a natural member of society. These processes of individuals and society were understood as rational because they arose from nature itself - the natural and historic milieu made up of personal ties, associations and communitarian bonds.

Statistics had been understood from the beginning as a window into the vital heart of the state, a measure of its vital power. This information about the Oikos was thus guarded and kept secret. By the late eighteenth century information about the state was explicitly made public. The United States, in article 1 section 2 of the Constitution, was the first to legally mandate the counting of people and public access to the results. It was only natural, so to speak, that a society governing itself have access to the facts about itself. Statistics was no longer a tool for the king. It became a tool for self government - a tool for knowing the proper order of nature so that one could conduct oneself in accordance with this order.

Statistics had emerged in response to the tables drawn up of plague victims. Eventually it turned to health matters of all kinds, making life itself in all its forms and processes inherently political. The rational knowledges produced through statistical inquiries such as census, medical and police reports on sickness, crime or suicide, rendered intelligible and manipulable the political object of society that liberal (self) government had to know in order to govern (itself) properly. "For the first time in history," Foucault notes, "biological existence was reflected in political existence....[Life] passed into knowledge's field of control and power's sphere of intervention."[56]

In the cases of disease and society - problems requiring some form of collective response - liberal political intervention did not take the form of direction from above, as did interventions from within the rationality of reason of state. Rather, governmental intervention took the form of a sort of investment of political rationality into society. That is, an instillment, at the local level within the processes of society itself, of the necessity to know the proper order of oneself and ones community in order for the community to conduct itself correctly.

In England in 1793, for example, "friendly societies" were encouraged by an act of Parliament as a means for workers to alleviate some of the negative effects of the industrialization process then emerging. These organizations begun by the workers themselves and paid for by weekly contributions were aimed at providing a certain degree of self-insurance against disease, death and support for widows.[57] They societies also kept records of their activities and tables of vital statistics. From these the government, the first insurance companies and the individual

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56 Foucault, History of Sexuality, 142.

57 Ian Hacking, "Biopower And The Avalanch of Printed Numbers," Humanities In Society 5, no. 304 (Summer & Fall 1982): 282.

"friendly societies" themselves determined how to best conduct their affairs. By 1815 there were 925,429 of these "friendly societies".[58]

A New Art of Government: The Beginning of Liberalism

By the end of the eighteenth century a new conception of the object of government was emerging. This new object was characterized as self-organizating and possessing internal drives. Yet statistics also revealed a living species - a species with specific conditions of existence. The problem became one of reconciling the requirement for a space of freedom for the play of natural process on the one hand and the fact of specific conditions of existence that must be protected and even fostered on the other. If government was to rule properly and bring about the right order of things, it would have to be cognizant of these newly understood conditions of life including the need for freedom. Only through such knowledge would government be able to foster and protect the natural functioning of the population. The practice of government becomes linked in a new way to its object - through its freedom. For only proper government could ensure this freedom. The outlines of this new art of government began to emerge with the classical economists. It is a liberal art of government with a society as its object.

58 Ibid.

Adam Smith started from a new generalized conception of human nature rather than the physiocratic distinction between commerce and the economy. Smith's The Wealth of Nations (1776) marks the emergence of a conception of the economy that integrates the previously distinct internal domestic economic order and the external disruptive realm of commerce. By combining commerce and the economy the responsibility for ensuring order is taken from the sovereign and placed into the (invisible) hand of the market and the natural laws of the economy. Commerce became understood as a competitive and dynamic process *within* the economy of the State rather than the fearsome realm external to it where, in the absence of the sovereign, disorder prevailed. The perturbations and chance characteristic of commerce are now understood to be checked by forces internal to it: the propensity to exchange and market competition.

With Smith and the classical economists the separation between the sovereign and the population was widened even further by distinguishing between the economy of the population and civil society. Thus with the synthesis of the economy and commerce emerges the wholly new object of society, an object which encompasses the economy and civil community but taken together form more than the old population. As Foucault puts it "What was discovered at that time - and this was one of the great discoveries of political thought at the end of the eighteenth century - was the idea of society."[59]

59 Foucault, "Space, Knowledge, Power," 242.

Governing was, for Smith, not a question of producing a good but of "the prevention of so great a public evil."[60] The natural functioning of a capitalist economy was not understood to promote social good per se but merely productivity. By this criterion the "society can demand that the state account for itself."[61] Adam Smith and classic political economy in general provided a criterion for judging political authority and the reasonableness of governmental practices that had eluded earlier critics of reason of state. Rational government and the right order of a liberal State, in other words, was ensured by the natural processes within the State itself. This is the culmination of a long process resulting in a new form of rule.

By the end of the eighteenth century the "meticulous observation of detail, and at the same time a political awareness of theses small things, for the control and use of men, emerge through the classical age bearing with them a whole set of techniques, a whole corpus of methods and knowledge, descriptions, plans and data" came together to form a "general formula" of managing the self-actuated collective of society.[62] This mode of knowing and governing the new object of society Foucault calls discipline. The emergence of discipline was not sudden but rather the effect of many minute movements and events. As a kind of political

60 Adam Smith, The Wealth of Nations, (Oxford, 1976), 342-3. Quoted in Meuret, "Political Genealogy," 244.

61 Meuret, "Political Genealogy," 246.

62 Michel Foucault, Discipline and Punish: The Birth of the Prison trans. Alan Sheridan (London: Pantheon, 1977; reprint, New York: Vintage Books, 1995), 141.

anatomy, discipline grew out of multiple and continuous observations and investigations into the body politic.

Beginning with Petty's and Graunt's "political arithmetic" statistics quickly generated massive amounts of information about the new states of Europe. But statistics also generated new ways of interpreting this information and it soon became the primary means by which the early states produced the knowledge used to rule the population. Interpretation of scripture was replaced by interpretation of the book of nature. As the techniques and methods of statistics were refined, they became more and more important to all other disciplines of inquiry. The very act of inquiry became linked to government in a new and intimate way by virtue of the various disciplines' power to make visible the proper or natural state of things.

Foucault notes that the successful emergence of the disciplinary form of political rule was due to three simple instruments or characteristic modes of operation.[63] These are: 1) hierarchical observation; 2) Normalizing judgment; and 3) examination.[64]

1) Hierarchical observation - which took specific forms such as the military camp, the prison or the school - was observation in which the figures of authority watched over their charges and recorded their observed movements and behaviors. The general form of hierarchical observation was of course objective scientific inquiry which sat above its

63 Ibid., 170.

64 Ibid.

object actively yet dispassionately peeling away the shrouds of ignorance and revealing the truth of its nature. It is this observation and the production of objective knowledge which renders people and things calculable.

2) Normalizing judgment, also known as surveillance, takes the knowledge of the natural and proper order of things and compares these with the successive observations of individual events, phenomena or behavior produced through hierarchical observation. The particular instance of an observed behavior more or less complied with the natural law particular to it. The resulting political arithmetic gives rise to measures of correction or encouragement to bring about or sustain movement towards the proper, natural state.

3) Examination combines the techniques of the observing hierarchy and normalizing judgment. The examination is the interface, so to speak, of those in possession of knowledge of the natural order produced through hierarchical observation and the individual or collective entity - defined of course by this very knowledge - to be evaluated and treated. Observation provides the basis for classification and qualification while the examination carries it out in the form of normalizing judgments.

This disciplinary form of government is not uniformly hierarchical in the same way that feudal kingdoms or even early sovereign states were with their strictly guarded lines of authority from God, via the church and/or the sovereign, down to the individual peasant. This form of production of knowledge was restricted to the few in the privileged institutions of the court and the church. Conflict within this form of rule generally occurred over ones place in this singular line of descent. The hierarchies of liberal government, by contrast, are multiple. Knowledge is available to anyone following the rules of objectivity. The natural and human sciences, the professions and disciplines, the business groups and workers societies and on down to the individual all assume the responsibility for observing, producing normalizing judgments and examinations within their respective spheres of influence. Power was dispersed, spread out in the vastness of objective knowledge itself.

The openness of knowledge and the multiplicity of hierarchies of knowledge/power characteristic of society emerged together with liberal government. In this process the intimate link between disciplinary rule and reason was strengthened. Indeed liberal society and the disciplinary art of government mutually constitute one another. The power brought to play by the disciplines, Foucault notes "is one of analysis."[65] The liberal institutions of government that arise at the end of the eighteenth century begin to take the form of one - albeit perhaps the largest and most extensive - observational hierarchy among many. The achievement of self government was thus ironically accompanied by the dramatic expansion of the institutions of political authority.

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65 Ibid., 197.

The Moral Sciences and the Natural Laws of Society

Adam Smith understood the object he was describing to be a moral one. He himself thought of his ideas as moral philosophy. Indeed, the moral encompassed the political, which in turn came to encompass the biological once power over it was taken from God's hands and given to science. The natural order was, after all, the proper order and therefore moral. By the end of the eighteenth century a new discipline intimately linked with statistics had emerged to formulate knowledge in this way: the moral sciences. Through the moral sciences statistics became both an expression of and at the same time a necessary condition for reason and liberal government.

The moral sciences, the precursor of today's social sciences, were the first disciplines specifically concerned with the study of the phenomena and processes of society. It was the moral sciences that were to identify the laws of society and provide liberal government with the rational knowledge necessary to bring its right order. Antoine de Caritat, Marquis de Condorcet was the preeminent spokesman of the moral sciences. He was a friend and student of Anne-Robert-Jacques Turgot, the last of the Physiocrats. Condorcet understand the moral science to be "all those sciences that have as their object either the human mind itself, or the relations of men one to another."[66]

For Condorcet "the moral sciences are founded upon facts and reasoning; their certainty will therefore be the same as the physical sciences....It is from the more or less constant order of facts observed in moral and physical phenomena that the kind of certainty that pertains to reality is derived."[67] For Condorcet the natural laws of society were not statistical in themselves. Statistics merely revealed the social phenomenon ruled by natural laws.

The "friendly societies" did not fare very well for the most part. Poor organization and poor information were partly to blame. The Select Committee of the House of Commons' first meeting in 1825 gave the reason for their failure thus: "Until a very few years ago no data were collected whereon a calculation of the average occurrence of sickness at the several ages of men could be formed with tolerable accuracy."[68] The Committee inquired whether any "tables of sickness formed upon actual observation" were available.[69] England's chief actuary, John Finlaison, and the administrators of other European states all answered no.

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66 Antoine Condorcet "Eloge de M. Buquet" Euvres de Condorcet ed. Antoine Condorcet - O'Conner and F. Arago, (Paris, 1847): 2, 410. Quoted in Hacking, Chance, 38.

67 Ibid. Condorcet distinguished five categories of moral science: 1) The study of compound interests and other time series; 2) Permutations and combinations; 3) induction; 4) the calculus of probabilities; 5) the theory of mean values.

68 Report of the Select Committee to Consider the Laws respecting friendly societies. Quoted in Hacking, "Biopower," 282.

69 Ibid.

Finlaison's response represented the common rational belief that no conclusions could be drawn from the reports of the "friendly societies." This was not merely because of bad record keeping, although this was also the case. It was simply thought impossible. Sickness and most undesirable things (including heathens and savages) were commonly understood to be the result of the absence of order, the absence of a determining principle or the breakdown of natural law. How could there exist an "average occurrence," that is, a regular and orderly appearance of a phenomena which was by definition the result of the absence of the very source of order and regularity? Sickness and disease could not possibly have a discernible regularity of their own from which their occurrence could be perceived with any accuracy. Disorder could not be rationally linked to an orderly process. The problem of sickness was not merely the lack of data. The very idea of regularity and order to an unlawful, pathological and abnormal phenomena simply made no sense.

Learned opinion in the late eighteenth century held that chance and luck were vulgar, even the work of the devil. Dicing, games of chance and probability were the domain of gamblers and the sure path to atheism and damnation. Chance, accident and fortune were, after all, phenomena dangerous to the old order of the Oikos. Fortune, since Machiavelli, constituted the preeminent antagonistic condition against which the sovereign was supposed to guard his population. Probability could be useful however. And rational men, by this time, did not believe probability to be evil. It was merely a subjective frame of mind. While the universe was necessarily determined through the operation of natural laws, these laws may not always be known directly as in the case of gravity.

John Locke, for example, in his Essay Concerning Human Understanding (1671-89) proposed that the true essence of a thing was in their "inner constitution." But this inner constitution was inaccessible to man. Natural laws were understood to operate upon this essence in order to perform their work. But this seemed to produce an impasse between the governing according to reason (that is - the rationality of reason) and the rationality of natural law - the very foundation of reason itself. Government needed to know the functioning of the irrational - the pathological and the abnormal - in order to govern according to reason. But the irrational - the chaotic and disorderly - by definition defied reason.

The moral sciences and statistics were rapidly evolving disciplines. They soon developed the necessary techniques to render even the irrational and disorderly visible and open to governmental intervention. The existence and operation of natural laws was (and remains) the necessary condition for reason itself. There was thus no question that there must be laws governing society similar to those governing the rest of creation. The problem for the moral sciences was to discover these laws of society. This was accomplished by rationalizing probability and making the normal visible and measurable.

Statistics become natural I: The Rationalization of Probability

The physicist and mathematician Pierre-Simmon, marquis de Laplace, Like Condorcet before him, was interested in questions of jurisprudence. There was great concern among reform minded men such as Condorcet and Laplace to limit irrationality - bias, superstition etc. - from judicial proceedings. A rational society, they thought, must have a fair and just judicial system. The empirical question in jurisprudence was whether or not witnesses could be trusted and what majority of jurors would produce a verdict closest to the truth.[70] Democracy called for equality and jury by peers but superstition was widespread. Probability applied to the design of the judicial system was, for Laplace, the best way of protecting the public from their own unreason.

Laplace, like most educated men of the period, held that probability was subjective. Chance was simply the absence of knowledge of true causes and the natural law by which they operated. Probability at the end of the eighteenth century thus meant two things at once. It referred to the subjective reasons one may have for thinking that an event will or will not take place and, at the same time, probability meant what Laplace called *facilite*, the chance or likelihood that various outcomes will obtain in situations where the causes are unknown. One was purely of the subjective mind the other

70 According to Laplace's calculations, a tribunal split of 3:2 has a probability of 0.59 of deciding correctly, while a jury split of 7:5 has a probability of 0.71 of being correct. Hacking, Chance, 230.

was lack of knowledge of the object and thus still subjective.

Laplace articulated the classic rational explanation that there existed "petty little causes" for all phenomena. Every fact in the universe, according to Laplace, was determined by law. He began his Philosophical Essay on Probabilities (1814) with the words "[a]ll events, even those which on account of their insignificance do not seem to follow the great laws of nature, are a result of it just as necessarily as the revolutions of the sun."[71] Probabilistic statements where merely a means of coping with the lack of knowledge of these causes. It was a concept that provided a means to aid sound judgment in the absence of direct access to the inner constitution and natural law of things. Each observation of an objective event was more or less correct or incorrect. The problem was to calculate the probability (likelihood) that an observation was correct. Laplace calculated the conditions of observation by combining many linear equations and aggregating the results. From these calculations he obtained his probability of the accuracy that the observations accorded with the event itself and thus to the true causes of the phenomena.

To be sure there were other opinions. Marie-Francois-Xaviar Bichat (1771-1802), lecturing in Paris at the same time as Laplace, postulated that "there are in nature two classes of beings, two classes of properties, and two classes

71 Pierre-Simon Laplace, A Philosophical Essay on Probabilities (Paris, 1814) trans. F. W. Truscott and F. L. Emory (New York, 1951). Quoted in Hacking, Chance, 11.

of sciences. The beings are either organic of inorganic, the properties vital or non-vital, and the sciences either physiological or physical."[72] Both of these conceptions, the vitalism of Bichat and the mechanism of Laplace, were deterministic and reductionist. But there was no room for probability in the teleology of Bichat. Arising as it did in mathematics probability readily lent itself to the mechanistic concepts of Laplace and it soon began to creep in at the margins of rational thought.

Statistics become natural II: Revealing the Norm

Government requires an object that can be known in manipulable terms. The problem of probability and natural law for the conduct of science and government preceded a transformation in the entire domain of reason. At about the same time Laplace was rationalizing probability, a much more subtle transformation was underway. Carl Friedrich Gauss, a German astronomer, had worked out his "law of errors" for measurement in observational astronomy by 1807. Gauss produced a graphical representation of the distribution of error in measurement. The Gaussian bell shaped curve vividly illustrated the two quantities of mean and dispersion about the mean. Dispersion has since become fundamental for all methods of measurement. A normal distribution is defined by

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72 Xaviar Bichat, Anatomie generale appliquee a la medecine (Paris, 1801). Quoted in Hacking, Chance, 14.

its mean and standard deviation. When the number of measurements (or any kind of data) is large enough, and plotted graphically, a bell shaped curve, peeked at the mean results. Measurements that cluster about the mean, the top of the bell shaped curve, are thought to be reliable. That is, they have a high probability (likelihood) of being correct. Combined with the more popular work of Laplace, the very foundations of reason, governmental or otherwise, were to be changed for ever.

Gauss focused his calculations and attention on measurement as opposed to Laplace's focus on observation. Gauss, interested as he was in the position of celestial bodies, did not assume each measurement to represent an actual quantity or that each measurement had a corresponding object. Gauss was concerned with calculating the accuracy of multiple measurements of the same entity. For him the curve itself was nothing more than a collection of measurements. Gauss was essentially calculating the accuracy of the astronomers' instruments and the conditions of observation. The true position of the star or planet in question was understood to lie somewhere within the multiple measurements arranged in a curve of error. The curve of error thus revealed the most probable location of the celestial object to be somewhere in the concentration of points representing the majority of individual measurements at the top of the curve.

Calculation of the curve of error allowed statistical inferences to be made with a high degree of certainty and therefore reduced subjective speculation.[73] Gauss' distribution of error was striking for its representation of regularity and order where none had previously been visible but merely assumed a priori. Orderly processes, after all, should, in principle, be measurable. Being orderly and measurable, they must be objective. The orderly and calculable had for a long time been associated with the normal in terms of the good, the lawful and morally right. This sense of the normal remains today. But the objectivity of the normal, and thus the proof of its lawfulness, rationality and, above all, its usefulness, achieved new heights with the invention of Gauss' distribution. Statistics - with the addition of the Gaussian curve - became not only a lens for viewing the order of things but a lens for viewing the right order of things, the things as they should be normally. Gauss' bell shaped curve quickly came to be called the normal distribution or normal curve.

The Select Committee in England reviewing the "friendly societies" reconvened in 1827, the year of Laplace's death. One set of reports did show a regularity. Moreover, it came from one of the few successful "friendly societies," the Highland Society of Scotland. There were a number of reasons for the lack of faith in the tables produced by the many other societies besides the classic conception of natural

73 Since Graunt and Petty's separation of sign from cause in the seventeenth century, statistical inference had remained largely unchanged. After Gauss, however, inference was substantially transformed into two distinct aspects - estimation and hypothesis testing - giving statistics its modern form. John Mueller, Karl Schuessler, and Herbert Costner ed. Statistical Reasoning in Sociology (Boston: Houghton Mifflin Co., 1977), 383 and 413.

law. Many of the ruling elites suspected that the friendly societies were a front for combines or trade unions. In addition, if the numbers from the Highland Society were accepted the actuaries would be forced to lower their premiums by one third.[74]

The numbers and methods of the Highland Society were soon adopted by the central government however. Disorder and pathology had come under the sway of natural law. In the intervening two years it was officially acknowledged that sickness did indeed exhibit regularities which could be tracked using statistical methods. By the 1830's it was perfectly reasonable to speak of the laws of sickness.

By the early eighteenth century the obscure mathematical work of Gauss and the high profile work of Laplace came together. Probability no longer constituted a subjective frame of mind. But the admittance of probability into rational thought did not leave objectivity and reason unchanged. Laplace's calculations of probability - in terms of observation of multiple real events - joined with Gauss' calculations - which revealed the normal distribution in a graphical way - together combined to make the bell curve an actual quantity with objective characteristics.

The Gauss Laplace synthesis, as it has been called, had further profound effects.[75] Objectivity was, and remains, the touchstone of rational thought. The rationalization of

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74 Hacking, Chance, 51.

75 Stephen Stigler, The History of Statistics: The measurement of Uncertainty Before 1900 (Cambridge: Harvard University Press, Belknap Press, 1986), 158.

probability and the reification of the normal curve made the laws of society accessible in a way Locke and Smith, for example, could not have imagined. The normal curve was believed to be the revelation of natural law itself - the functioning of natural law made visible in the requisite Ramist topological form. It was an objective display of the actual functioning of the natural laws governing whatever phenomenon the statistical methods were applied to - such as sickness or crime of a given community.

Natural Laws Become Statistical

The search for Laplacian petty little causes of social phenomena and the gathering of information within the administrative framework established by Farr led not to final unveiling of an obscure and intricate causal mechanical process but to the transformation of the conception of natural law itself. What emerged from this transformation was a statistical natural law. The Belgian astronomer Adolphe Quetelet was the first practitioner of the mathematical methods associated with modern statistics.[76] The statistical regularity that presented itself in the reams of data suggested to Quetelet the operation of a natural law. Turning to social matters and the mass of data collected on crime Quetelet proposed that the number of criminals was constant and that the relative proportion of different sorts of crime

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76 Mueller, Schuessler, and Costner eds., Statistical Reasoning, 5.

remained the same.[77] The regularity and order that Quetelet observed in the tables of social data he likened to the motion and measurement of the heavens.

The Gaussian distribution curve, according to Quetelet, represented precisely the type of law regulating the distribution of human social behavior and biological traits. By virtue of the norm, statistical natural law preserved the taxonomic order based on essentialism and universalism. In the course of applying the normal curve to social phenomenon in the early 1830's through the 1840's, Quetelet came to the conclusion that, in social matters, the mean was, in fact, an actual quantity, a real entity, a concrete characteristic of society. Statistical methods began as descriptive of large scale regularities, Quetelet turned them into laws of nature with causal power and truth.[78]

Once the normal distribution became objective and measurable the norm took on a fundamental role in government. Liberal political rationality, according to Foucault "has to qualify, measure, appraise, and hierarchize.... [I]t affects distributions around the norm."[79] For it is the identification of the normal that allows one to judge whether ones conduct and the conduct of society is in accordance with its natural law. That is, in accordance with the right and proper order of things. The delineation of normality became a fundamental technology for social management.

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77 Hacking, Chance, 105.

78 Ibid., 108-9.

79 Foucault, History of Sexuality, 144.

Quetelet was not the only influence on the early development of the social sciences to be sure. The father of positivism, Auguste Comte, vehemently disagreed with Quetelet's social mathematics. Both Quetelet and Comte were the heirs of Condorcet's moral science but they differed sharply over the statistical treatment of social phenomena. Comte came to a radically different conclusion than Quetelet over the concept of normality. Quetelet took normality to be the mean, the cluster of data points at the top of the bell curve, the prevalent and the common. Comte, on the other hand, derived a conception of the normal from the physician Francois-Joseph-Victor Broussais. For Comte normality had nothing to do with probability. Normality was a matter of degrees, a sliding scale so to speak. In his System de Politique Positive (1851) Comte wrote "Until Braoussais, the pathological state obeyed laws completely different from those governing the normal state, so that observation of one could decide nothing for the other. Broussais established that the phenomena of disease are of essentially the same kind as those of health, from which they differ only in intensity."[80]

For Comte the normal could not be linked to a distinct statistical law governing the clustering about the top of the bell curve. The normal was the ideal, the good, the best possible arrangement. Society was to be studied in terms of its progress through history towards its ideal full development. It was to be judged judged by its progress

80 Auguste Comte, System de politique posetive, (Paris, 1851), 1, 651, 652f. Quoted in Hacking, Chance, 160.

towards ideal. He was furious over Quetelet's appropriation of the terms "social mathematics" and "social physics" for his brand of moral science. Comte eventual coined the term "sociology" for his historical epistemological approach.[81]

When Comte applied his normal/pathological distinctions to the political and social sphere the normal ceased to be a conception of the normal in terms of ordinary or common. Instead normality became inextricably linked with the concept of progress. "progress is nothing but the development of order: it is an analysis of the normal state."[82] The normal is what society should strive for. The normal as what was essential and therefore the good, the Aristotelian telos, rather than what is extrapolated from data revealing an average or mean.[83]

Despite Comte's influence, statistical reason remained central to social science and liberal political rationality. Charles Babbage, often referred to as the father of the computer for his invention of the Analytic Engine, noted that "it is the science of calculation - which becomes continually more necessary at each step of our progress and must ultimately govern the whole of the application of science to

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81 Hacking, Chance, 39.

82 Ibid., 168.

83 The normal, to this day, continues to stand for both the typical, banal average at the same time as it stands for the healthy ideal as in the use of the Latin norma and the Greek ortho so common to the corrective and restorative disciplines. The normal still lingers between the is and the ought.

the arts of life."[84] In the mid-1800's statistical reason and the new concept of statistical law retained the classic deterministic quality of natural laws characteristic of Newton and Laplace. The large scale assignment of numbers to all of nature and their subsequent calculation was fundamental to the later emergence of the concept of energy in physics and biology.[85]

With the introduction of probability into rational thought, however, the natural link between counting and classification became problematic. Babbage was aware that computation and classification were intimately linked. He developed a technique of using punch cards as a classification system. He never completed his analytic engine however.[86] Classification on the basis of essential properties or universal constants was becoming more and more suspect. Classification was beginning to be seen as probabilistic just as precision measurement was - a high probability of accuracy relative to the distribution of error rather than an a priori essential quality. The relationship between the real world and mathematical symbols continued to become more complex.

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84 Charles Babbage, Econonomy of machinery and manufactures, In Charles Babbage: Collected Works, V 8, M. Campbell ed. (London, William Pickering, 1989), 266; quoted in Andrew Barry, "Lines of communication and spaces of rule" in Barry, Osborne, and Rose eds., Foucault and Political Reason, 132.

85 Francois Jacob, The Logic of Life: A History of Heredity (New York: Pantheon Books, 1973), 194.

86 F. H. George, Automation Cybernetics and Society (New York: Philosophical Library, 1959), 47.

But Babbage was also of historical importance as one of the earliest and most strident advocates for establishing the "Constants of Nature and of Art" to be put into tables that "ought to contain all those facts which can be expressed by numbers in various sciences and arts."[87] These should be undertaken, Babbage thought, by the eminent scientific institutions of the day such as the Royal Society, the Institute of France, and the Academy of Berlin. Everything had a constant associated with it, it was thought, by which it could be calculated and measured. He had a list of nineteen categories of constants that should be the initial focus of such an effort. These included constants of interest to theoretical scientists such as those of the solar system and atomic weights to those of interest to industry and government such as cultivated crops, their production rates, geographical distribution and profitability or the quantity of oak or Portland stone a "man laboring ten hours a day will saw" and the lengths of rivers, populations, buildings, etc. Babbage was a witness for the Select Committee which vindicated the numbers of the Highland Society in 1827. He along with Quetelet and others, founded the British Association's Section F for statistics in 1833.

Statistical facts by the mid-nineteenth century simply revealed statistical laws, laws as sure as gravity and the movement of the stars. The transformation of statistical laws into real objective causes gave rise to a new form of teleology: Statistical determinism (or what we might now call

87 Babbage in letter to David Brewster February 22, 1832. Quoted in Hacking Chance, 55.

pre-determinism). The conceptual link of probability to contingency and relativism was not made for several more decades. When data showed, for example, that 200 to 250 people committed suicide each year by drowning in the Seine this became a fact that was thought unalterable. It was, in other words, predetermined by the natural laws of society. "Society prepares the crimes and the guilty person is only the instrument" wrote Quetelet in 1832.[88]

Two general consequences of the emergence of statistical natural law can be identified: optimistic utilitarianism and statistical fatalism. Jean-Pierre Falret for example, compiled a list of predisposing, direct and indirect general causes of suicide: heredity, temperament, and age; sex, education, and reading novels; music, theatrical performances, and climate; as well as the seasons, masturbation, and idleness.[89]

If enough information was collected and if the mechanics of social laws was discovered, influences upon society could be changed. The optimistic utilitarian determinism of statistical natural law maintained the enlightenment conception of free will and the dream of human betterment and perfection. The optimistic statistical determinism of Quetelet and Farr held individual acts of free will to themselves constitute petty little causes. These minute free causal acts, taken together, balanced each other out. "The

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88 Quetelet in letter to vellerme published in 1836. Quoted in Hacking, Chance, 116.

89 Hacking, Chance, 68.

larger the number of individuals, the more individual will fades out, and allows the series of general facts to predominate, the facts which depend on general causes, and in virtue of which society exists and is conserved."[90] Human progress was to be achieved through altering the conditions of mortality and morality. William Farr, compiler of abstracts and effective head of the Registrar-General of England and Wales wrote in 1860:

> Despite the accidents or conflagrations, the unstableness of winds, the uncertainties of life and the variations in men's minds and circumstances, on which fires, wrecks and deaths depend, they are subject to laws as invariable as gravitation and fluctuate within certain limits, which the calculus of probabilities can determine beforehand. This holds for crimes, and other acts of will, so that violation itself is subject to law. Shall a system of fatalism be built upon this foundation? No, for statistics has revealed also a law of variation. Introduce a system of ventilation into unventilated mines, and you substitute one law of accidents for another. These events are under control. Some races, however, commit crimes of violence in greater proportion to others races. Some classes are more dangerous. [But] as men have the power to modify their race, they have the power to change the current of human actions within definite limits, which statistics can determine.[91]

Farr conceived of the physical infrastructure of ventilation systems in mines or the sewage systems in London, for example, as "artificial agencies" acting on an individuals free will to alter the material conditions

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90 Adolphe Quetelet, Recherches ssur le penchant au crime aux differents ages, Nouveaux memoires de l'academie Royale des Sciences et Belles-Lettres de Bruxelles 7 (1832), 81. Quoted in Hacking, Chance, 123.

91 Hacking, Chance, 115.

influencing moral life.[92] The link between probability and normality within statistical reason meant that morals, in a general way, could be mapped creating a moral geography. The disease ridden areas of the Victorian urban landscape were easily identified by looking at a map of the city water supply. Despite the official historical status of laissez faire as the shibboleth of Victorian political values, state intervention into the moral boundary conditions of society were not only compatible with but required by early liberal political rationality. The Health of Town Commission, convened in 1837, heard evidence from various sources including engineers, commissioners of sewers, parish registrars and doctors.[93] The general goal of this hearing was the improvement of cleanliness and good moral habits. All were quite sincere in their faith to affect positive moral change. Cleanliness, after all, was (and remains) next to Godliness. Governmental intervention, in the form of the establishment of specific rational forms of infrastructure by experts and professionals, provided a space for and at the same time an inducement to the observance of the moral laws of health at the individual and societal levels. Furthermore, these sewers and drains affected their moral transformations and reinforcing the sanitary integrity of the home without direct intervention. The effectiveness of scientific and

92 Report into the sanitary conditions of the labouring population of greAt Britain, XXVI; quoted in Thomas Osborne, "Security and Vitality" in Barry, Osborne, and Rose eds., Foucault and Political Rationality, 113.

93 Osborne, "Security and Vitality", 102.

engineering advances within the framework of the Moral Sciences lead many to believe society's ills could one day be solved.

Statistical Autonomy:
The Derationalization of Determinism

Condorcet's enlightenment dream of rational moral science was short lived however. Optimistic utilitarianism gave way more and more to deterministic fatalism. In 1857, the year Comte died, Henry Thomas Buckle became instantly famous in Britain with the publication of History of Civilization in England. Buckle quickly became famous throughout Europe though to varying degrees of enthusiasm.[94] Buckle founded his history on Quetelet's statistical determinism. Starting from the mass of studies on crime and the ever popular topic of suicide he made the conceptual leap and applied the same logic to the entire movement of history. For Buckle the climate and other environmental factors rather than free will determined the course of society and civilization.

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94 Karl Marx read the same statistical tables of Quetelet and Farr that Buckle did but deduced an entirely nonstatistical necessary progress. German intellectual thought rejected, for the most part, the 'French school' of statistical reason or *Queteletismus* as it was called. George Friedrich Knapp (1842-1926) in a lecture just after the Franco-Prussion war noted that Buckle's Queteletismus amounted to "nihilistic rejection of the state and its duties, and the release of the individual from all bonds of society." Hacking, Chance, 125.

The identification of constants useful for industry also contributed to the air of pessimistic fatalism gaining popularity in Europe by mid-century. Inspired by Nicolas Leonard Sadi Carnot's study of the efficiency of heat engines, Rudolph Clausius began writing of "the new kind of motion we call heat."[95] Clausius discovered that the performance of mechanical work by an engine powered by heat was accompanied by a degradation, or lowering of the temperature of the initially inputted heat. The conversion of heat into energy requiring continual additions of heat was not surprising in itself. Arriving at a constant to measure this transformation was, however, very suprising and would change the way processes were understood forever. The new constant was a whole new quality of the universe called energy. This new thing called energy was never created or destroyed. But the question was how to measure the changes that occurred in the world given this new quantity.

In 1854 Clausius coined the term entropy from the Greek word for "a transformation."[96] But this constant of transformation had the peculiar quality of being irreversible. Heat, Clausius discovered, only goes "downhill." The extraction of mechanical work greater in energy than the heat energy put into it was, he discovered, impossible. Put another way, performance of transformative work degrades energy from "high quality" to "low quality."

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95 Lawrence Sklar, Physics And Chance: Philosphical Issues In The Foundations Of Statistical Mechanics (New York: Cambridge University Press, 1993, paperback edition, 1995), 18.

96 Paul Edwards ed., The Encyclopedia of Philosophy V. 2 (New York: Macmillan Publishing Co., 1967), s. v. "Entropy," by G. J. Withrow, 526.

Irreversibility became a natural law. Very soon speculation arose about the fate of the universe. If entropy is irreversible and there is only a constant amount of energy in the universe how much time might be left before all the energy degrades into a uniform spread of low quality unavailable for productive work? In short, universal heat death became a new concern of the growing followers of popular science and culture in Europe.

Herbert Spencer articulated a theory of social evolution even before Darwin had published his Origin in 1859. After the publication of Origin, however, evolutionism gained the prestige of a scientifically based theory that came to be called Social Darwinism. By the mid-nineteenth century the optimistic and utopian utilitarianism of Condorcet and Quetelet had given way to two popularly intermingled forms of reductionist determinism: the pessimistic statistical fatalism characteristic of Buckle's History of Civilization on the one hand and the hopeful conception of Social Darwinism on the other. It is in this atmosphere that the transformative effects of the rationalization of probability appear. Effects that are at once hopeful in the face of this prevailing fatalism, but also terrifying in its dissolution of the comfortable absolutes provided by an iron law of determinism.

When probability became rational, through Quetelet's adaptation of Gauss and Laplace, statistical reason coexisted with taxonomy and classification methods that proceeded on the basis of identification of essential and universal characteristics. Statistical methods - the new forms of probabilistic rationality - were carried out upon data that was collected and arranged according to the classic rationality of essentialism and natural law. The two form of reason operated uneasily side by side. However the admittance of probability into the domain of reason, truth and rational thought eventually transformed the definition of cause and determinism by de-linking them from essentialism.

There had been previous explanations of the inconsistency of statistical determinism. John Venn, said to be the inventor of the frequency account of regularity in statistical phenomena, noted that probability has no meaning except in terms of a series "which combines individual irregularity with aggregate regularity."[97] The probability of an event, in other words, was its frequency relative to the series in which it occurred. This explanation of the confusion of determinism in statistics has since become the second basic theory of probability after Gauss's distribution. Venn's frequency was not enough to refute the committed determinist accounts of the world however.

The theory of heat as internal energy put forth by Clausius arose within the dominant scientific consensus around the substantive-caloric theory of physical change. Considerable speculation arose over just what kind of motion energy in the form of heat actually exhibited.[98] Early work

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97 John Venn, The Logic of Chance (London, 1866), 4. Quoted in Hacking, Chance, 126. There were even earlier hints of frequency but none spelled out as clearly as Venn's account.

98 Sklar, Physics and Chance, 28.

in kinetic theory was rejected by the Royal Society. Clausius and others eventually won out, however, with the growing realization that heat and mechanical work are related and that energy is the proper way to conceive of this relationship. This led to the emergence of thermodynamics.

Two key concepts emerge with the development of thermodynamics and further refined with statistical mechanics; that of system and that of equilibrium. These concepts have continued to evolve ever since. The idea of a system was not new but the centrality of processes and their relationships within thermodynamics gave a new meaning to the term. Simply put, the notion of a system was vital for understanding the kind of change the new concept of energy gave rise to. Thermodynamics allowed the identification of systems - arrangements of particles say- and their parameters, which further enabled one to accurately characterize the transformation from one form of matter to another such as ice to liquid to gas through the application of energy in the form of heat. The distinction was made between systems that came into contact with one another or with an indeterminate environment and those energetically isolated from one another (adiabatic systems). The concept of Conservation of energy and the First Law of Thermodynamics arises by rationalizing the definition of heat flow. Heat flow is understood to be simply the total energy flow into or out of the system divided into those parts of the flow that results in directly observable mechanical work as well as the remaining (flow of) heat. That is energy is neither created or destroyed but merely changes form - that is causes systems to change form. Change caused by heat, hence the name thermodynamics.

This leads to the second key concept of thermodynamics: equilibrium. Since energy can neither be created or destroyed nor can it "go uphill," as Clausius showed. The macroscopic state of a system can be simply described by three parameters; energy, mass and volume (and magnetization for magnets). Quantities such as temperature and pressure can only be defined for systems in equilibrium. The question becomes how to measure the transformation from one equilibrial state, with, say, one specific pressure and temperature, to another.

Objectivity, by the 1830's, had already required testing the validity of beginning assumptions, measurements and theories. In physics statistical mechanics emerged to fulfil this requirement for the new field of thermodynamics.[99] Maxwell's kinetic theory of gases published in 1860 was the first important use of statistical reasoning in physics.[100] He may have been heavily influenced by the recently published

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99 It is the addition of field theory and statistical mechanics which progressively expanded traditional equilibrial thermodynamics to account for non-equilibrium. Any system undergoing transformation. that is doing work and transforming energy is said to be increasing in entropy eventually, in theory, reaching a state of maximum entropy. Maximum entropy is complete equilibrium of the system. Stable equilibrial entropy is a system in a state of maximum disorder where no work can be done by energy and thus no transformations are possible unless the conditions of the system, its fundamental structure, is altered.

100 Paul Edwards ed., The Encyclopedia of Philosophy V. 5 (New York: Macmillan Publishing Co., 1967), s. v. "Maxwell, James Clerk," by Woodruff, Arthur, 225.

theory of errors of Gauss and Quetelet.[101] Maxwell posited that molecular collisions must be equally likely, that is equally distributed, throughout an equilibrial system. The trick was to discover precisely what kind of distribution this was.[102]

For Maxwell the statistical method was a technique, simply a tool. For Ludwig Boltzmann and Josiah Gibbs however "statistical analysis and the theory of probability supplied the rules for the logic of the whole world."[103] Theirs was a new kind of statistical law from that of Quetelet or even Maxwell. The differentiation between the how and the why was a direct result of the possibility of deriving practical laws to explain phenomena for which determinate causes were unknown. These laws were themselves statistical in nature rather than causal. In the process, essentialist causation became at worst a metaphysical concept and at best merely uninteresting. The focus of rational explanation became how things occur rather than why. This constituted the end of determinism's link to statistics and represented the "perfection of the mathematical tool that made it possible to investigate the structure and evolution of any system involving large numbers."[104]

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101 Sklar, Chance, 30.

102 This led to the Maxwell Law but even Maxwell considered it suspect and it was later revised. Sklar, Chance, 31.

103 Jacob, Logic of Life, 196.

104 Ibid., 199.

A radical shift occurred in the conception of complex objects and processes in the course of the development of statistical mechanics. The "concept of the electromagnetic field was the decisive turning point."[105] The mechanistic notion that every whole was the sum of its parts began to change. A field is not a concept of things but a concept of relationships forming a system. A field is a subset of a system and, generally speaking, systems are composed of numerous fields. Large numbers were studied not merely because it was impractical to study individual particles but because it was understood that the individual particles themselves could not reveal the behavior of the whole system.[106] Effective theorizing and exploitable discoveries, in other words, could not be gained from analysis of individual units.

The structures and behaviors of thermodynamic systems that statistical mechanics analyzed, and from which it arose, could not be perceived by the senses or grasped intuitively. The inability to know the precise characteristics of the constituent parts of a system was considered a characteristic of the statistical techniques themselves not of the object

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105 Ernst Cassirer, The Logic Of The Humanities (New Haven: Yale University Press, 1960, fifth printing, 1974), 166. Field theory and statistical mechanics basically arose from the expansion of thermodynamic theory.

106 Jacob, Logic Of Life, 196.

under investigation.[107] It was assumed that each particle had a definite and determinable state and conditions. Explicit probability in the form of statistical techniques was implicitly thought to be underwritten by some form of necessity or efficient cause. It was simply the sheer magnitude of all the particles, in even the simplest systems, that limited their detailed study.[108]

Eventually the development of thermodynamics and statistical mechanics in the second half of the century completely upset the traditional notions of rigid separation between process and nature, the transitory and the real. Put another way, the concept of the real as process became natural and rational. The association of truth and reason with the old taxonomic epistemology of essentialism and determinism began to erode. Theory formed on the basis of essential qualities and universal attributes became

107 Boltzmann suggested that the laws of classical mechanics and perhaps even the laws of nature themselves "might be approximate expressions for average values, and not differentiable in any strict sense." It was not until Erwin Schrodinger, Albert Einstein and John Von Neumann in the first half of the twentieth century that it became plausible to rationally conceive of individual particles of a system as having indefinite properties. The early pioneers of modern physics assumed the existence of some sort of deterministic deep structure. Boltzmann's H-theorem was in fact an attempt to mathematically retain determinism. Paul Edwards ed., The Encyclopedia of Philosophy V. 1 (New York: Macmillan Publishing Co., 1967), s. v. "Boltzmann, Ludwig" by Paul Feyerabend, 335.

108 Paul Edwards ed., The Encyclopedia of Philosophy V 7 (New York: Macmillan Publishing Co., 1967), s. v. "Quantum Mechanics: Philosophical Implications of," by Norwood R Hanson, 44.

increasingly understood as subjective beliefs rather than objective knowledge.[109]

> Statistical mechanics introduced into physics the idea that the aim of a physical theory could be not to provide an account of what must happen, but of what might happen. Phenomena were now to be accounted for in probabilistic terms, events being accounted for as 'overwhelmingly probable' or even 'as predictable to occur with some probability' and macroscopic phenomena as being reflections of what happens 'most probably,' or sometimes 'on average,' at the microscopic level.[110]

By 1870 the congenial link between statistics and determinism had been severed. Determinism became probabilistic in terms we would recognize today.[111] The increasing sophistication of statistics since the rationalization of probability brought about a new form of taxonomy based not on essential characteristics but a taxonomy of calculation itself.

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109 The relationship between statistical mechanics and thermodynamics is complex. This reduction continues to be the source of debate and discovery. One of the origins of quantum mechanics, in fact, lies in Max Planck's studies of the thermodynamic and statistical mechanics of radiation. Some of this complexity is captured in the philosophy of science concept of the reduction of laws by subsequent theories. There are two general forms of such reduction: Homogeneous and deductive subsumption. Galileo's law was reduced to the later principles of Newtonian mechanics is an example of Homogeneous subsumption. Deductive subsumption refers to to the "subsumption of a law by a theory which lacks some of the concepts in which the law is expressed." Thermodynamics was subsumed by statistical mechanics in just such a process. Temperature and entropy are concepts central to thermodynamics but are not included among the concepts of statistical mechanics. Maxwell and Boltzmann were able to deduce the laws of thermodynamics concerning the motion of molecules through statistical mechanics. John Losee, A Historical Introduction tothe Philosophy of Science (New York: Oxford University Press, 1972, reprinted 1988), 185.

110 Sklar, Physics and Chance, 347.

111 Determinism has never had a canonical definition. The Oxford English Dictionary gives 1876 as the first English use of "determinism" in the modern sense of doctrine of necessity. Hacking, chance, 153.

Any event, object or property that could be enumerated and classified in a discontinuous system could be analyzed using statistical methods. But the derationalization of essentialist determinism had the effect of bringing statistical methods to bear on the process of classification itself. With the end of determinism, statistics became the means of identifying discontinuous units previously accomplished through identification of essential properties in terms of natural law. The ability to produce discrete countable units ceased to be the ability to distinguish essential or universal characteristics of a phenomena or object and became the ability to apply statistical methods.

To affect the required production or enumeration of discontinuous units for the application of statistical methods the traditional techniques of observation, classification and calculation were carried out. However, classification was accomplished through the analysis of relationship rather than identities, processes rather than traits. These relationships, furthermore, were themselves statistical in nature, the function of probabilistic calculations. The transformations brought about by statistical mechanics constitute what Kuhn called a "change in paradigm" of a kind "somewhat smaller, because more exclusively professional" than the shifts brought about by Copernicus, Newton or later Einstein.[112]

What was being measured and calculated at the end of the nineteenth century was no longer things and their qualities

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112 Thomas Kuhn, The Structure of Scientific Revolutions (Chicago: The University of Chicago Press, 1962, Pheonix Books, 1965), 66.

but relationships between probabilities and correlations. Things not understood as representative of themselves but things in terms of certainty of observation and measurement. By 1889 British physicist Sir William Thomson (Lord) Kelvin could say that "when you can measure what you are speaking about, you know something about it; when you cannot measure it...your knowledge is of meager and unsatisfactory kind".[113] According to Thomas Kuhn such sentiments were fairly new at the time. The physical sciences gave a central place to measurement only after the experimentation within "Baconian science" had become mathematicized in the nineteenth century.[114]

The mathematization furthered by thermodynamics and statistical mechanics directly transformed the focus of both physics and biology and eventually all other rational knowledges. The emphasis on "force" in classic Newtonian mechanics gave way to "energy." Until the second half of the nineteenth century, phenomena were analyzed in terms of space, time, mass and force. "Force was introduced as the cause of motion, preexisting and independent of it."[115] In biology the external cause acting on life was vitalism. At

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113 Ian Hacking, "How Shouild We Do the History of Statistics?," in Burchell, Gordon, and Miller eds., Foucault Effect, 186. The facade of the University of Chicago Social Science Research Building bears part of this inscription: "If you cannot measure, you're knowledge is of a meager and unsatisfactory."

114 Thomas Kuhn, The Essential Tension (Chicago: Chicago Universtiy Press, 1977), 219-220.

115 Jacob, Logic of Life, 192.

the start of the nineteenth century, "an organism expended its vital force in order to perform its work of synthesis and morphogenesis; at the end of the nineteenth century, it consumed energy."[116]

Vital Correlations and Functionalism

Thermodynamics and statistical mechanics did not represent the simple triumph of mechanism and measurement. The effects of these emerging concepts of physics upon those within the social and biological sciences is complex. The rationalization of probability freed these disciplines from the fatalism of Buckle but it created new problems for the conceptualization of society and its pathologies. Vitalism, a theoretical/spiritual mode of thought gained prominence in this atmosphere of receding determinism and emerging energetic relational systems. A central aspect of vitalism, or holism as it was called, was the necessary interrelation of all the parts of an organism which, taken together, formed a whole much more intricate than a simple sum of parts. The preeminent complex whole was a living organism or population of organisms. It is the beginning of what today are called complex systems though the term system does not get used in this context until the next century.

In 1866 with the publication of Generalle Morphologie der Organismen Ernst Haeckel, coined the term ecology also

116 Ibid., 194-5. The replacement of force with the discovery of energy according to Kuhn "offers no more striking instance of the phenomena known as simultaneous discovery." Kuhn, Essential Tension, 69.

from the Greek Oikos.[117] A German zoologist and Monist philosopher, founder of the Monist League, Haeckel used the term ecology to refer to "the web that linked organisms and their surrounding environment."[118] The development of the concept of equilibrial systems and energy in physics gave credibility to the vitalist or, strictly speaking Monist, focus on wholes and dynamic relationships. Holism and fields or systems emerged together as rational scientific concepts. But the introduction of systems of relations was made rational in the form of thermodynamics and its central principle of entropy directly contradicted the central problem in biology and social science; that of evolution - the growth of complex organisms from simple ones in the closed system of the world. It provided a measurement of systems and thus made them objective but at the same time it made the principle feature of the systems biology and the social sciences had to explain fundamentally paradoxical. Negative entropy was not a rational option in physics yet it was essentially what the vitalist insisted upon. Negative entropy could be theorized only in vitalist terms verging on the mystical.

However, the vitalist life forces were not a concept affording government a means of rational management. Point mechanics may have been on the way out but government

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117 Bramwell, Ecology, pg 39. Darwin gave Haeckel the credit for spreading the acceptance of his theory of evolution in Germany. Paul Edwards ed., The Encyclopedia of Philosophy V. 3 (New York: Macmillan Publishing Co., 1967), s. v. "Haeckel, Ernst Heinrich" by Rollo Handy, 399.

119 Bramwell, Ecology, 39.

required specifics. In the 1860's acquired traits were thought to be inheritable. Darwin had postulated the theory of "pangenesis" to explain the phenomenon of heredity suggesting that characteristics were passed on by "gamules" circulating in the blood.[119] Darwin's cousin, Francis Galton, was an anthropometrist and pioneer of eugenics. He sought to explain the phenomena of human heredity using his cousins theory of gamules. Instead of finding gamules however Galton discovered statistical correlation. At the same moment that physics was discovering the field Galton in biology was discovering correlation. The petty little causes of Laplace, Galton found, could not account for the dispersion about the mean of human traits plotted on a normal curve.

In a paper read to the Royal Society in 1888 titled "Co-relations and their measurement, chiefly from anthropometric data" Galton illustrated that if the same statistical scale was used on the measurements of two symmetrical lines of regression the two lines formed by these regressions had the same slope.[120] Galton separated statistics forever from deterministic epistemology. Karl Pearson, a physicist,

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119 Darwin did not include this theory in his book On the Origin of Species (1859). Michael Ruse speculates that Darwin may not have been very enthusiastic about pangenesis. he did not accord it level of importance given to natural selection. Before causal determinism was overturned however any self respecting philosopher had to explain the causal mechanism behind their theory, hence the idea of gamules. Michael Ruse, The Darwinian Revolution: Science Red in Tooth and Claw (Chicago: The University of Chicago Press, 1979), 212-3.

120 Stigler, History of Statistics, 297. Stigler notes that Galton is credited for the discovery of correlation but that he never developed it fully and that the full idea of correlation remained on the periphery of his work.

historian and in later life a statistician, said that "it was Galton who first freed me from the prejudice that sound mathematics could only be applied to natural phenomena under the category of causation."[121] Correlation, like a field, is a probabilistic concept. They are concepts of relationships rather than identities. Causal determinism was becoming less rational in more and more disciplines.

Galton was motivated by the widely held hope that the underlying deterministic causes of the Queteletian statistically determined traits could be found. Galton was a humanist and utilitarian. Finding these, he hoped, would lead to techniques for increasing or decreasing the occurrence of these traits. Following Quetelet's and Farr's statistical determinism Galton sought the keys to human nature by measuring the physical characteristics of individuals such as foot size and arm length relative to overall height, etc. The identification and differentiation of human physical characteristics, Galton hoped, would reveal the precise operation of the natural laws governing the individual with a given set of physical characteristics. In this way Galton thought the statistically mapped central tendency of the phenomenon in question as well as exceptions could be explained.

Galton's approach was unique however. The Gaussian normal curve, since Quetelet, was understood as the product of many Laplacian "petty little causes." It was thought, outside the obscure world of avant garde physics, that the

121 Ibid., 305.

characteristics of things followed some sort of natural law and that this law acted upon the essence of things. Essence and law necessarily operated together providing direction and order to the processes of the universe. Galton, however, observed that "the reason for their doing so is totally unexplained."[122]

For Galton it was the reason for this law-like regularity (revealed by statistical methods) that had to be explained. Only then could statistical law serve as explanations for phenomena. Galton was not satisfied to assume statistical laws *caused* statistical regularity. Galton focused on exceptional individuals rather than the mean, the central cluster of traits at the apex of the normal curve. He focused on geniuses and criminals, the exceptions to the norm, the tails of the Gaussian distribution curve produced from social statistics.

Galton was the first person to find serious problems with the determinist theory of petty little causes to explain statistical dispersion.[123] Galton's efforts to account for exceptions to central tendencies in heredity and his focus on the dispersion lead to his formulating correlation coefficients and the theory of regression. Galton's theory of regression fundamentally transformed the popular conception of natural law.[124]

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122 Hacking, Chance, 185.

123 Ibid., 185-6.

124 Ibid., 181-5.

Galton found that reversion towards the mean in the distribution of a large sample of traits was a mathematical consequence of the Gaussian curve itself and not the thing being measured. That is he explained the dispersion of traits without resort to petty little causes. In his example read to the Royal Society in 1888 he stated that if the measurement of forearms and head lengths "were expressed in units of their probable errors, then both regression lines had the same slope (r). Hence this number could be taken unambiguously as an expression of the "closeness of co-relation."[125] This along with the developments in thermodynamics and statistical mechanics constituted the end of essentialist causal teleology defined in terms of natural law. After Galton, determinism and necessity no longer referred to explicit causal relations but to correlations, to statistically probable relationships. Correlations became as real as causes had been.[126]

The real-ization of correlation did not simply bring about an unproblematic acceptance of probability. Even in the physical sciences differences of opinion concerning just what probability entailed persisted. And they continue to persist to this day. One interpretation is that probability applies only to collections of unites, aggregates or ensembles forming systems. In this view probability does not pertain to

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125 Stigler, History Of Statistics, 297.

126 Hacking, Chance, 188.

the units making up the system themselves.[127] The other interpretation, initially less widely accepted but increasingly difficult to ignore was that probability was not simply a feature that came into being when ensembles of units were aggregated together but that probability was a real feature of every state of systems and their components. That probability (non-essentialism) was, so to speak, an essential aspect of reality.

Charles Sanders Peirce, father of modern pragmatism, was perhaps the most outspoken proponent of this view. Peirce denied determinism in all its forms and believed the world to be ruled completely by chance. In an intellectual environment presided over by the attempt to discover Babbage's constants of nature, Peirce insisted there were none. For Peirce there were no constants over and above the ones agreed upon for the sake of consistancy. It was the statistical stability of the highly probable that made inductive learning and rationality possible. For Peirce the universe was irreducibly stochastic - one state of affairs led to the next most probable state of affairs.

Peirce developed these ideas in the course of his work for the U.S. Government in the Coast Survey. His attention was focused upon measurement and measuring devices for the nearly twenty years he worked in the Coast Survey. Peirce respected the work of his predecessors in the development of measurement noting that the "law of distribution of errors

127 This is of course the view which became especially troublesome in the development of quantum mechanics as "individual units" were discovered to themselves be systems or points in phase space and probability functions within relationships with other systems.

which Quetelet, Galton, and others, have applied with so much success to the study of biological and social matters" but he was interested in the relationship between statistics and observation.[128] For Peirce the distribution of errors was about judgment and the operation of the senses rather than the object of the senses as was the concern of biology, sociology and physics.

Probability as a matter of judgment did not mean that beyond judgment there lay a realm of true facts, universal and essential objects whose constants, when found, would reveal their truth to the enlightened observer. as it had been supposed by the moral scientists in the early part of the century. For Peirce, since the universe itself was fundamentally chancy, judgments were also explainable in statistical terms. The focus on judgment and the senses lead to a fundamental innovation in experimental method: randomization. Randomization has since become a standard practice in experimental science.

Randomization was introduced into the experiment to gain a new level of control, not through the elimination of chance events but by including them. In 1884 Peirce and the Psychology student Joseph Jastrow conducted the first experiment in which an artificial randomizer was used to decide the sequence of trials and also used in the analysis of the data. This experiment was conducted in order to determine if the normal distribution applied to judgments made about sense perceptions so small that they may be considered below the threshold of conscious perception. It

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128 Hacking, Chance, 203.

was commonly held in psychophysics that the curve did not apply to the realm beyond consciousness.[129] Peirce believed that it did, that the observer will make subliminal distinctions whose accuracy will decrease according to the curve of error.

One can see the importance of randomization in the construction of such an experiment. But the subject of the experiment was also taken very seriously. Telepathy was a popular subject and the late nineteenth century. The term had been coined in 1880 and in 1882 The society for Psychical research had been founded with the goal of replacing mediums and seances with scientific study.[130] In 1884 the American Society for Psychical research was established in Boston with the same goal. It was believed that below the minimum threshold of conscious sensation there occurred the phenomena of thought transference between people rather than a mystical realm where the dead spoke to the living.

The existence of a threshold below which the curve of errors did not operate was necessary for the theory of thought transference. Peirce insisted that he had proven there to be no minimum threshold. For Peirce this “gives reason for believing that we gather what is passing in one another’s minds in large measure from the sensations so faint that we are not fully aware of them, and can give no account of how we reach our conclusions from such matters.”[131] Peirce

129 Ibid., 204.

130 Ibid., 206.

131 Ibid., 206.

was in no way a spiritually oriented person. His linking of probability with subliminal sensations was grounds for his rejection of various strains of religion he considered deterministic. He refuted the Vatican Council's 1870 sanctioning of the doctrine of papal infallibility and in a 1893 paper titled "Reply to the Necessitarians" Peirce noted that only Dr. Paul Carus, editor of the Monist, a journal of general science published in Chicago linked to the work of haeckel, had agreed to respond to his challenge.

For Carus, the validity of ethics and morals were their universality, based on the truth of the unity of the creation, and their objectivity, based on the truth of natural laws.[132] The spiritual strain of holism derived in part from the replacement of belief in God and the rule of Gods law to belief in the oneness of nature and the rule of natural laws. Carus, and Monists in general, could not imagine a world without determinism and the necessity of natural laws. Universalism and determinism were linked at the heart of Europeanholistic faith.

In Peirce's pragmatics the indeterminateness of reality meant that activity, whether organic or inorganic, human or non-human was not the result of the will of a unified world enforced by natural law but a probabilistic occurrence. Peirce was sometimes unclear but generally action could be divided between the dynamic processes between two subjects, "or at any rate is the result of such actions between pairs" and the processes occurring as a result of three subjects; a

132 Bramwell, Ecology, 47-8.

sign, its object and its interpretant, a process he called semiosis.[133]

Peirce's theories and concepts remained obscure. His experimental methods were rejected by mainstream psychiatry. His theory of signs found little initial application. But if the particulars of his work had to wait until after his death to receive widespread attention, his position on determinism was not completely out of the ordinary. The end of the nineteenth century was a period of transformation in many disciplines in the way objects of rational analysis were defined. It is a period in which a new form of classification and identification emerges. Through statistical mechanics, the discovery of correlation and general statistical methods, activities initially embarked upon the quest to identify the determining natural laws, produced a transformation in reason itself. Probability had become a central rational concept in the physical, natural and human sciences. The identification and classification that preceded any rational analysis was no longer conducted in terms of categorizing the essential properties of things linked to their universal natural laws. In all enterprises producing rational knowledge identity became a product not of what something was but of what something does in relation to other things. Rational knowledge began to take the form of functionalism.

By the end of the nineteenth century functional analysis of one form or another had replaced evolutionism and natural law, in the social as well as physical sciences. Franz Boas,

133 Charles Morris, Sign, Language and Behavior (New York: Prentice Hall, 1946), 289.

"the father of modern anthropology," studied physics and geography. He read Galton and integrated it into his work, making biometrics a standard procedure of anthropological field work. For Boas and those who followed him, evolutionist causal natural law was idealistic and romantic at best and unscientific, not to mention racist, at worst. In refuting evolutionist concepts of progress and the separation of the races Boas pointed out that what appeared to civilized people as the irrational behavior of primitive cultures was merely the result of a difference in classificatory schema. Simpler cultures, according to Boas, merely classified concepts differently.[134]

Boas insisted on a "thoroughgoing description of all cultural data as the sole warrantable scientific attitude."[135] Every detail was to be carefully recorded and tabulated. How this data fit together to form the whole of the social system in question would guide the science of anthropology. It was not a matter of identifying which aspects were right or wrong, normal or pathological by European culture's standards, but how they fit together. Assumptions of progress lain on top of the facts would only reveal a distorted picture of the truth good, perhaps, for supporting dogma but not science. To judge social processes and phenomena on the basis of an idealistic concept of higher and lower races and

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135 Robert H. Lowie, The History of Ethnological Theory (New York: Rinehart & Co., Inc., 1937), 142. Boas and his students have thus been called "historical particularists" Marvin Harris Cultural Anthropology 2nd ed. (New York: Harper and Row, Publishers, 1987), 418.

135 Ibid., 131.

normal and pathological progress precluded attention to the complex relationships actualy making up culture. Cultures became "not mere arrangements of separate elements but integrated wholes."[136] After Boas' best known book "The Mind of Man" (1911) taxonomy in anthropology and ethnology was henceforth determined through a functional analysis which attempted to focus on the whole field of culture and social relations. Comparability was first determined by context and only then were phenomena to be compared. Henceforth the truth of a society was ascertianed through some form of functional analysis that paid attention to interrelationship and context. The new object displayed by these new methodes were accompanied by a new mode of governing appropriate to this new truth. Functional analysis replaced the determinism charecteristic of Social Darwinism as the dominant Governmental rationality. This was not a simple replacement, however, for the epistemology of determinism was at the heart of nineteenth century conflict between vitalist and mechanistic conceptions of life and the body-politic. The emergence of context and relationship as objective aspects of the real requires a brief discussion of the so called "vitalist-mechanist" debate.

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136 Ibid., 142.

Vitalism, Mechanism and the New Arts of Government

Social Darwinism was a vague enough formulation to be interpreted in many different ways. While it proved to be an antidote for the fatalism of Buckle it remained firmly determinist. The determinism of Social Darwinism, however, was not simply the determinism of Quetelet. It was a determinism linked to the vitalism and holism of Haeckel and T. H. Huxley, the outspoken natural scientist who defended Darwin and his theories from attacks by the Catholic Church. It was a form of vitalism that sprang from the inability of purely physical laws, especially the second law of thermodynamics, to mesh with observed biological and social reality. The vitalist/mechanist debate by the end of the nineteenth century had to do with the concept of goal-directed progress or some form of life-energy or vital force which countered entropy and gave direction to life. Henri Bergson, for example, thought that materialist explanations of evolution utterly failed. The fact that things evolved in the direction of greater complexity, counter to the second law of thermodynamics was proof of a mysterious force of life, an elan vital as he called it. Quantifiable rationality was not enough. The natural sciences, according to Bergson, needed to be supplemented with metaphysics.[137]

137 Paul Edwards ed., The Encyclopedia of Philosophy V. 1 (New York: Macmillan Publishing Co., 1967), s. v. "Bergson, Henri" by T.A. Goudge, 292.

Statistical methods played a role in both vitalist and mechanist concepts. Though no physical scientist doubted the efficacy of statistics not all vitalists or social Darwinists were convinced of their value. In general the later vitalists and Social Darwinists can be divided into two political camps according to editorial page guidelines; the "right" and the "left."[138] Social evolutionism was deployed by the "right" by men such as John Rockefeller and Andrew Carnegie, who stated that the richest members of society achieved their wealth because they were the fittest and best adapted members of society. This was natural and this was morally correct. Welfare measures that supported "dependency" and "misfits," so it went, would weaken the health of human kind. Philanthropic charity organizations accepted Social Darwinism as scientific fact.[139]

On the "left" social reformers found in evolutionism scientific evidence for the possibility and in some cases inevitability of social change and progress. Karl Marx (1818-1883) wanted to dedicate the first volume of Das Kapital (1867) to Darwin. Reformers saw evolutionism as a demonstration that although existing social, economic and political institutions and arrangements may be natural or at least determined by, in some cases, identifiable causes, this did not preclude their eventual transformation into something

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138 Paul Edwards ed., The Encyclopedia of Philosophy V. 2 (New York: Macmillan Publishing Co., 1967), s. v. "Darwinism" by Morton O. Beckner, 304.

139 June Axinn and Herman Levin, Social Welfare: A History of the American Response To Need 2nd ed. (New York, Longman, 1982), 99.

better. Better, in Comte's terms of ideal and normal, as that which society progresses towards.

Pauperism was thought contagious owing to the theory of inheritance of acquired traits. Philanthropic responses to poverty took the form of scientific charity. Scientific charity instituted the careful development of a welfare delivery system that would protect the social worker while at the same time preventing the inducement and spread of a contagious pauperism. A report in 1874 at the first Conference of Charities and Corrections in New York advised against the then common practice of "out-of-doors" relief in the form of aid taken to the homes of those wholly unable to work. These could not be regulated sufficiently to ensure moral health. Relief, it was advised, was to be connected to work and carefully monitored as in the case of "indoors" relief which was aid given to those in exchange for various labors.

Under scientific charity trained "friendly visitors" would distribute "out-of-doors" relief and closely monitor the situation of poor families. In both situations close monitoring was enhanced for the good of the visitors and paupers alike.[140] In 1884 the U.S. Bureau of Labor Statistics was created. Its authority was to "collect information upon the subject of labor, its relations to capital, the hours of labor, and the earnings of laboring men and women, and the

140 Veterans of 'the war of rebellion' who fell on hard times constituted another class class all together. Veterans having proved their social worth were not considered susceptible to the same degenerating effects of pauperism that civilians did. Ibid., 90-2.

means of promoting their material security, individual and moral prosperity."[141]

In 1895 George Udny Yule applied Galton's correlation hypothesis to data on pauperism and declared "the rise in the mean percentage of pauperism, as the proportion of out-relief is increased, is as marked as could be desired."[142] Many had at first thought that Galton's methods applied only to the field of anthropometry. It was Yule who expanded and illustrated the applicability of Galton's discovery of correlation for all the sciences and, at the same time and by means of which, he developed the method of correlation coefficient.[143] The regression line hence forth stood as a surrogate for what is still called a causal relation.

By the turn of the century Social Darwinism, both in the progressive and conservative variety, gave way to the Progressive era. At the height of scientific-philanthropic forms of poverty managing, the family was to be protected from the evils of indigent individuals. By the first decades of the twentieth century, however, the family was to be protected from the hostilities of the industrial environment. Scientific charity based on the science of Spencerian evolution gave way to science of a more rigorous statistical kind. Society began to be understood as a complex system of functional relationships.

141 Ibid., 97.

142 Stigler, History of Statistics, 348.

143 Ibid., 354. What is now called partial correlation coefficient Yule called "net coefficient of correlation."

The end of essentialist determinism played it self out in the private sector with the development of Taylorism. Named after Fredrick W. Taylor, Taylorism, or scientific management as he called it was a conscious effort to affect the human element of the production process. It was literally the application of engineering techniques and principles to human activity in the factory. Scientific management was basically the attempt to control the human element of production at the individual and small group level. It initially proceeded with a simple conception of "economic man" and sought to manipulate behavior through "incentive-pay" or the "shop disciplinarian" to produce the desired "voluntary" behavior.[144]

In the public domain social work took a new form. The social policy that emerged from the epistemological principles of systems or fields and functional interrelationship within society played itself out in an immense expansion of federal political authority. Theodore Roosevelt in 1901 called on every citizen to help with "reform through social work."[145] Individuals were responsible for their state of affairs and these could be improved with hard work. In 1906 the Food and Drug Act was passed. Income security and workmans compensation was enacted in many states by 1911. In 1913 the 16th Amendment to the Constitution was ratified establishing a federal income tax. This same year

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144 David F. Noble, America By Design: Science, Technology, and the Rise of Corporate Capitalism (New York, Oxford University Press, 1977, paperback ed. Alfred A. Knopf 1979), 264.

145 Axinn and Levin, Social Welfare, 137.

the Federal Reserve System was established, drastically reforming the banking industry. 1914 saw the enactment of the Clayton Anti-Trust Act leading to the Federal Trade Commission.

If this may be called a revival of pastoralism it must be characterized as a new form, an urbane form, in which the rural or village economy is superseded by the economy of the factory or industrial space in general. Industrialization and the formation of the factory as the preeminent form of production was accompanied by and, at the same time reproduced, an exceedingly rapid process of technological change. By the beginning of the twentieth century industrial machinery had become sophisticated and efficient enough that "the domestic economy of the factory replaced [this machinery] as the limiting factor of production."[146] Industrial machinery, it was discovered, could only be used at peak efficiency if the human factors of production were organized properly.

By the second decade of the twentieth century the reactions against the social engineering and management practices of Taylorism grew intense. Taylor's brand of scientific management was opposed not only by workers but eventually by engineers and managers as well. The initial incarnation of Taylorism was supposed to represent the application of scientific methods to the organization of the increasingly complex sprawling industrial empires. Scientific management utilized incentive-pay arrangements to motivate workers to cooperate and behave more efficiently. The

146 Noble, America By Design, 260.

development of time-motion studies gave Taylorism its claim to scientific status but this technique was found to be employed as often as not by engineers who knew little about the activities and processes they were accountable for. They simply guessed at the optimum rates used as base lines for their measurements.[147]

In 1916 Assistant Navy Secretary Franklin D. Roosevelt banned Taylor's methods in Navy yards and all other federally funded operations after five years of hearings into the causes of the strike at Waterton Arsenal.[148] The problems with Taylorism, from the engineering, management and government inspectors perspectives, was not the concept of human engineering itself but its actual lack of science. Taylor's brand of authoritarian scientific management simply introduced the arbitrary authority of owners and managers in a new and subtler form. The cure for the problems of industry and production understood in terms of labor and social arrangements was the application of real science and the realization that management and ownership were part of the domestic economy that had to be reformed. "The new human focus of engineering required that the discipline of engineering itself had to expand, to include the new methods of the social sciences."[149]

Magnus Alaxander an electrical engineer for Westinghouse, GE and a researcher for the National Bureau of

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147 Ibid., 272.

148 Ibid.

149 Ibid., 274.

Economic Research as well as co-founder of the National Industrial Conference Board, the largest cooperative enterprise of American employers ever undertaken, represented the post-Taylorism form of scientific management or "liberal industrial management" as it was called.[150] Before World War I Alaxander had conducted statistical research on income distribution. In 1916 he began extensive research on industrial accidents and authored the first comprehensive report on the cost of labor turnover to American industry. Joining Alexander in establishing the NBER was Malcolm Rorty, an engineer with interest and expertise in statistics and economics. In the 1920's before he became president, Secretary of Commerce Herbert Hoover, who was himself a mining engineer before entering politics, commissioned studies on "recent economic changes" and "recent social trends" from the NBER.[151]

The reformulation of scientific management by the corporate liberal reformers was consciously motivated by the desire to affect stability, understood as the the sin qua non of future profits, of the business environment.[152] But this revisionism within scientific management brought with it many changes and not only for labor. It constituted nothing less then action upon a new object of industrial governance. The transfer of the craftsman's skill to the machine was thus soon accompanied by the transfer of authority from the owner

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150 Ibid., 52.

151 Ibid., 285.

152 Ibid., 288.

and manager to the industrial processes themselves, industrial processes understood as an economy - a functional interaction of human and machine within a production system and the factory environment.

An array of governing institutions were erected that socialized the individual both as a private citizen and agent of economic activity in the name of collective security and wellbeing. This was accomplished through the deployment of political authority somewhere between liberalism and state pastoralism or nascent socialism. It was an intervention or reorganization of the space of social negotiation, the locus where production and exchange was understood to actually occur. This rearrangement maintained the classic liberal separation of the civil, economic and political realms. The privacy and sanctity of the individual enterprise was weakened, but formal autonomy of the market as a whole was preserved. This was justified and made acceptable by ensuring the security of the economic domain as a whole.

The expansion of the state's role in social work dramatically increased the size, number and complexity of social research institutions and government agencies. As a consequence systematic social surveys and investigations were refined and deployed extensively. The Pittsburgh Survey of 1907-8 was the "first major attempt to survey in depth the entire life of a single community."[153] As welfare became increasingly professionalized and bureaucratized scientific philanthropy was transformed into scientific social work. The attendants at alms houses and the friendly visitors of the

153 Axinn and Levin, Social Welfare, 146.

early aid societies and charities were replaced by paid agents of the state. The proper techniques and methods of the professional social worker were first codified in Mary Richmond's "Social Diagnosis" published in 1917.[154]

A new state pastoralism was emerging. Social work and reformed scientific management, on the one hand, and social security, on the other, constituted two axis of a new rationality of government. Social security arose from and at the same time reinforced the connections and relationships between public or civic activities and the fate of individuals in their private economic affairs and personal conduct. Social work and scientific management operated through investigation by experts who, increasingly with the aid of statistical techniques, distilled, identified and categorized the range of social norms in individual and collective conduct and administered the appropriate treatment or regime of reform.

The different forms of governmental intervention into society from the last decades of the eighteenth and the first decades of the twentieth centuries reflect a shift in the very constitution of reason and rational knowledge. This change in the constitution of rational nowledge and how it was obtained was the result of a transformation in the mutualy constitutive relationship between the methodes of knowing the object of government and the actual object revealed by these new methods. Government, in other words, precipitates a transformation in the object of government by its very effort to know this object.

154 Ibid., 156.

Social policy in the United States by the end of the last century, for example, was directed at a society no longer percieved in strictly mechanistic and unalterable terms. Change and transformation became real aspects of social reality influenced by context and relationship. This is a very different society from the one encountered by the first Select Committee investigating rates of sickness and the efficacy of "friendly societies" in England. This new society was one just beginning to be constituted by internal forces apprehendable through statistics. Soon the city planning of Farr, with his sewers and vents, marked the inception of modern attempts to attend to the needs of society and its conditions of existence. That is, to foster about the right order of society.

Statistics at this point had been reconceptualized first as a real natural phenomina then into a full fledged natural law with determinist capabilities. The development of thermodynamics and statistical mechanics by the second half of the century dispensed with determinism in the physical sciences. A little later, in the period leading up to the invention of correlation, the natural and social sciences also came to reject determinism. A reformed mechanistic outlook of field and function, one which adopted interrelationship and probability, replaced vitalism and whig history.

By the end of the nineteenth century society began to require attention on new terms. The object of government and its conditions of existence had become one of broad social relations in which poverty and efficient production became some how linked or correlated. The previous emphasis on adjusting the moral character of the individual gave way to an emphasis on the individual as part of a set of social relations. The perceived failures of early nineteenth century governing practices were articulated from within this new epistemological formation of rational knowledge. Governing had to adjust to this new conception of its object.

Government, according to this new rationality, had not provided nor fostered the wellbeing and prosperity of society that was expected of it. Instead it had allowed, and perhaps inadvertently promoted, social and economic disruption such as the increasing disturbances among workers and rising rates of suicide, employment concerns and oppressive working conditions. Philanthropic responses to such social distress in the form of altering the statistically determined circumstances under which certain behavior and morality were now seen as a failure. The reformed social work of Mary Richmond and the scientific managment of Taylor and later the National Bureau of Economic Research represent the birth of modern attempts to deal with a society composed of interacting yet also interdependent social agents.

This was the beginning of a vast effort at inducing cooperation and efficiency through socialization. This effort was still one centered on the norm and the disciplinary mode of hierarchical observation, normalizing judgement and examination. But with the normal no longer tied to an essential reality and stripped of determining influence, the disciplinary mode began to change. In the early twentieth century there was not yet a replacement for the disciplinary mode of government. But its emergence was not far off.

Chapter 4:
Decline of the Norm and the Rise of Control

The identification of the normal and pathological were the precondition but also the effect of the new professions of social work and scientific management. Just as it had been for the moral scientist and sewer engineers seventy years previously. But the normal and the pathological identified in the twentieth century began to conform to a new rationality of functional analysis of roles and relations within a system. The normal as a hard and fast point assumed to lie at the top of Gauss' curve gave way to the normal as a field, a dispersed range of possibilities in a dynamic interrelated process. The social worker and the manager-engineer relied on instrumental rational knowledge of functional interactions to devise their interventions. The norm eventualy gave way to a new principle appropriate to functioning systems - that of structural equilibrium.

Functional explanations in the life and human sciences represented an overturning of essentialist accounts that sustained the bogeymen of evolutionism and vitalism. With Boas, Taylor, Yule and Richmond the grounds were laid for the investigation of intricate whole organisms in the newly formed rational terms of interrelated functional systems. The new objects of the life and social sciences were organizations of complex whole organisms. The difference between the systems of the physical sciences and those of the life and social sciences resided mainly in the means of their coordination and transformation.

However, the objects of the life and social sciences seemed to intrinsically defy the second law of thermodynamics - energy can only "go downhill," entropy results in a decrease of constructive work in an energetically isolated system. Rational instrumental explanations were necessarily mechanistic. They took the form of a precise description of the mechanisms controlling the organization and transformation of living matter. Yet such an explanation for large scale biological and social phenomena at some point had to rely upon the the evolutionist claims of Social Darwinism or the metaphysical claims of the vitalists to explain the counter entropic phenomena of life. This was soon to change and the rational explanations that emerged solidified and extended the rationality and affectiveness of the ontology of functional systems.

As scientists began to understand these unique characteristics of life process, they began to reformulate or expand a concept that had remained more or less implicit in physics and statistical mechanics; the concept of structure. The analysis of nutrition requirements in organisms for example, based on the new biochemical knowledge of compounds and metabolism, lead to the discovery that some organisms could synthesize the compounds necessary for metabolism and growth while others could not. This was the discovery of vitamins, or rather, the discovery of the presence or absence of substances which allowed for certain metabolic processes, substances later called vitamins. Mammals, biologists discovered, do not produce these necessary substances on their own. Such discoveries solidified the belief that the functioning of living organisms was unique but also that its composition and structure was fundamental to this uniqueness.[155] The secrets of life's processes had to be sought in its structure as well as its functioning.

Jacques Loeb a German born physiologist who immigrated to the United states to occupy academic posts at the University of Chicago from 1892 to 1902 and later the University California from 1902 to 1910 gained an international reputation for his experimental skills and originality. But he was best known for his insistence on mechanistic explanations for living phenomena.[156] In his The Dynamics of Living Matter (1906) Loeb describes the role of biological chemistry as "distinguishing the functions which depend on chemical constitution from those that also require a particular physical structure of the living substance."[157]

Structures were no longer understood as completely stable material entities but entities whose stability was directly linked with its functioning. An important element in any system became its structural equilibrium. The particular phase or state of an organic structure at any given point in time was thus governed by a calculus of probability relative to its future equilibrial state. Organic structure in biochemistry were born as statements of probability of the

155 Jacob, Logic of Life, 241.

156 Paul Edwards ed., The Encyclopedia of Philosophy V. 4 (New York: Macmillan Publishing Co., 1967), s. v. "Bergson, Henri" by T.A. Goudge, 503.

157 Jacques Loeb, The Dynamics of Living Matter (1906), 29. Quoted in Jacob Logic of Life, 236.

formation, arrangement and reproduction of specific organic structures necessary for life sustaining functions. Biological chemistry and genetics fundamentally changed the understanding of the very nature of living bodies. Organisms could now be conceived in a way that did not simply array structures and functions around a mysterious life giving force.

This new emphasis on quantitative rigor and the focus on composition and structure of living systems had a radical effect upon the life sciences, and eventually the social sciences. Complex organisms ceased to be understood as layers of organs and functional processes surrounding a mysterious source of life and form. The uniqueness of life no longer resided in the functioning of organisms in defiance of the second law of thermodynamics. The secrets of life came to reside in the specific material arrangements of organisms and unique functions and processes arising from them.

Biological phenomena at the turn of the century were understood by scientists to emerge from the storing, releasing and exchanging of energy through the formation, synthesis and transfer of "energy rich bonds" of specific phosphorous compounds.[158] Biologists found that a single compound, adenosine triphosphate, was common to all living things and constituted the energy storage process in all organisms. In both bacteria and mammals, whether in respiration or fermentation, the breakdown of sugars lead to the same energy rich phosphorous compound. However, the

158 Jacob, Logic of Life, 241.

rigorous clinical methods used to identify these processes strengthened the conceptualization of the unity of function or holismin the living world.[159]

Most other branches of biology and the human sciences focused on living organisms at a much larger scale. Earlier concepts in the human sciences, formulated by such theorists as Hobbes or Spencer, treated the organism as a large version of a single body transferring analogically the functions of individual organs to parts of the collective mass of society. Where biological chemistry and genetics sought answers in the minute mechanisms of tissues and cells other branches of biology reformulated their objects in terms of the importance of structure on a much larger scale.

Fredric Clements, an American botanist and researcher at the Carnegie Institution had read the work of Herbert Spencer, whose use of the organism metaphor to describe human society may have prompted Clements to respond by using the community concept in biology.[160] Clements was not alone in this tendency. Anton Kernor Von Marilaun, a professor of botany at the University of Vienna also used the community concept analogicaly from the social realm in the 1890's.[161] Another naturalist influenced by Spencer was Stephen Alfred

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159 Ibid.

160 Frank Benjamin Golly, A History of The Ecosystem Concept In Ecology: ore Than the Sum if the Parts (New Haven, Yale University Press, 1993), 18-25.

161 Ibid., 17.

Forbes, founder of the Illinois State Laboratory of Natural History. In 1887 he described a lake as:

> an old and relatively primitive system, isolated from its surroundings. Within it matter circulates, and controls operate to produce an equilibrium comparable with that in a similar area of land. In this microcosm nothing can be fully understood until its relationship to the whole is clearly seen... The lake appears as an organic system, a balance between building up and breaking down in which the struggle for existence and natural selection have produced an equilibrium, a 'community of interest,' between predator and prey.[162]

For Clements the community, with its complex of relations, *was* the organism. Every region had a characteristic pattern of vegetation that he called a climax. Climax communities of plants were the result of selection by the specific climate and other factors within a region. Every region was made up of a variety of communities each with a different trajectory of development or ecological succession as he called it. In some communities in the region succession was slow and in others it was fast. Clements applied the organisms analogy to these climax communities noting that they exhibited a kind of social structure. In part this distinguished organic communities from the individual organism commonly focused on in biology.[163] These communities, Clements postulated, went through a cycle of birth, growth and death each characterized by a stage of development culminating in what he called climax states. The focus for Clements' studies of biological communities and

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162 Ibid., 36.

163 Ibid., 24.

their various stages of development was the interactions between the biological elements, or biotic components, and the processes controlling community development.[164]

British botanist Alfred George Tansley was a colleague and friend of Clements. It was Tansley who expanded Forbes' and Clements' concept of organism giving them a larger audience. The spread of these concepts is linked to Tansley's efforts to bring greater scientific rigor and quantitative methods to botany in particular and biology in general. Tansley was made a fellow of the Royal Society in 1915 and appointed Sherardian Chair of Botany at Oxford in 1927 where he remained until his retirement in 1937. Despite this distinguished career Tansley's academic life was marked by an intense struggle to open up botany to the concepts of ecology and to have ecology accepted as part of the natural sciences.[165] Tansley was influenced by many currents of thought. In 1920 he published a textbook titled <u>The New Psychology and its Relations to Life</u> and in 1922 moved to Vienna to study with Freud disgusted with academics.[166] In Tansley's presentation of Clements' concepts of succession, development, quasi-organism, complex organism and climax he emphasized the physical character of these processes and their relationship within a system.

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164 Ibid.

165 Ibid., 9.

166 Ibid., 10 and 208 n 2. Tansley was characterized as a Bolshevik owing to the cooperative nature of interrelationships in much of his thought.

Though Clements was characteristic of the rationalist side of ecological thought and followed Haeckel's opposition to spiritual interpretations of holism, his conceptual and theoretical leanings did not display the practical rigor that Tansley sought in trying to make ecology a respectable science. Clements grew out of the observational tradition of botany in which the researcher rode along in the country side compiling lists of the observed plant and animal species producing Linnaean taxonomies.[167] Clements' concepts of complex organisms forming climax communities were not researchable given current methods. It thus amounted to an idealist concept of mere speculation for Tansley. It was in an effort to add conceptual rigor to ecological analysis that Tansley expanded the concept of system in the ecologist's lexicon.

Concepts of systems appear in scientific thought stretching as far back as Heraclitus and his notions of universal ebb and flow in the sixth century B.C.[168] In general terms a system in the twentieth century was understood from physics as an ensemble of intersecting parts that produce the processes or behavior of the whole unite. In reviewing Clements' book Research Methods in Ecology (1905) Tansley noted the need for an invigorated conception of systems. In 1935 Tansley coined the term ecosystem.[169]

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167 Ibid., 17.

168 Ibid., 33. See also Ludwig von Bertalanffy, General systems Theory: Foundations, Development, Application revised edition, (New York, George Braziller, 1968, fourth printing 1973), 160.

169 Golly, Ecosystem, 8.

Tansley's ecosystems brought ecology closer to the quantitative rigor he had sought by linking it to the physical sciences, primarily through the concepts of system and equilibrium. Tansley emphasized that the idea of a biome's (a term invented by Clements referring to a component of an ecological community) interaction with the environment to form an ecosystem allowed for a wider use of matter cycling and energy theory in ecology.[170] The study of ecosystems, for Tansley, was the study of physical, chemical and biological components in an equilibrial system. Tansley's concept of dynamic equilibrial ecosystems were composed of four basic elements: first; ecosystems closest to equilibrium are most likely to survive. Second; ecosystem equilibrium develops slowly as ecosystems become more and more integrated. Clements' climax community represented the closest state of perfect dynamic equilibrium that an ecosystem may approach. Third; since an ecosystems equilibrium was measured by its stability its equilibrium can never be absolutely perfect. Fourth; Tansley noted that though the components of ecosystems may themselves undergo constant change the scientific method could isolate the specific physical processes of the components involved in any particular change.[171]

The concepts of organism, equilibrium and the interrelationship between structure and function were developing along various lines in virtually every discipline.

170 Ibid., 24.

171 Ibid., 16.

By the 1920s the various formulations began to coalesce into a widely accepted concept of the equilibrial system. Lawrence J. Henderson probably had the greatest impact on the development and spread of the concept of equilibrial system, especially in the social sciences.[172] Henderson's professional life was devoted almost entirely to the study of the organization of organisms and later to the organization of society. Henderson taught at Harvard from 1905 until his death in 1942. Initially his interests focused on biology, specifically the new field of biological chemistry, but also physiology. By the mid twenties Henderson began to pursue interests in philosophy and sociology through the concepts of self regulating equilibrial systems.

Henderson was introduced to the concept of equilibrium in physical chemistry while an undergraduate at Harvard. He received an MD from Harvard Medical School in 1902 after which he studied at Strassburg under Franz Hofmeister, a pioneer of the application of physical chemistry to biological chemistry.[173] From his earliest studies Henderson focused on the interaction of heterogeneous elements within biological organisms especially their modes of self-regulation. Regulation for Henderson, as for all scientists of the time, was a regulation of equilibrium, or neutrality

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172 Cynthia Eagle Russett, The concept of Equilibrium In American Social Thought (New Haven, Yale university Press, 1966), 141-2.

173 John Parascandola "Organismic and Holistic Concepts in the thought of L.J. Henderson" Journal of history of Biology 4 (1971): 67.

as he sometimes called it.[174] His studies of self-regulating organic mechanisms, however, lead him to conclude that evolution and natural selection alone were not enough to explain self-regulating organism. The parameters within which this process occurs must be considered. Henderson concluded that the environment within which an organism resides must also be suited for life. Equilibrium had to be considered in terms of the system within its supportive environment.

Henderson considered himself a scientist. He was drawn to materialist explanations but recognized that living organisms could not be described in purely mechanical terms, at least not in the mechanics of Newton. The developments occurring in physical theory, however, especially statistical mechanics, proffered rigorous explanations and quantitative techniques that did not necessarily require the a priori elimination of what was peculiar to the subject of biology. Henderson had begun to wonder if the focus of evolutionary theory on the selection of the individual organism was unduly narrow. By 1912 he had come upon the realization that the individual organism and its environment were intimately interconnected forming a complimentary relational process. His research into this question led to his first book _The_

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174 See for example L. J. Henderson and O. F. Black, "A study of the equilibrium between Carbonic Acid, Sodium Bicarbonate, Monosodium Phosphate, and Di-Sodium Phosphate at body temperature," _American Journal of Physiology_ 21 (1908), 420-426. And L. J. Henderson, "The Theory of Neutrality Regulation in the Animal Organism" in the same issue.

Fitness of the Environment (1912) which set the tone for the rest of his career:

> Life as we know it is a physico-chemical mechanism, and it is probably inconceivable that it should be otherwise. As such, it possesses, and, we may well conclude, must ever possess, a high degree of complexity,-physically, chemically, and physiologically; that is to say, structurally and functionally... Next, living things, still more the community of living things, are durable. but complexity and durability of mechanism are only possible in internal and external conditions are stable. Hence automatic regulations of the environment and the possibility of regulations of conditions of within the organism are essential to life.[175]

Cosmic and biological evolution must somehow be linked in an integrated orderly process.[176] For Henderson this meant that the existence of a teleological principle inherent in matter and energy, organizing the universe in space and time, surely could not be simply the result of chance.[177] Henderson was acutely aware that this view might lead to the charge of vitalism. He stressed that by teleological he did not mean purpose or design but rather an evolutionary "harmonious unity."[178] There was simply no other word to describe the kind of adaption he was proposing. In Fitness he had blasted the philosophies of Bergson and Driesch, contemporaries who did not attempt to explain life in materialistic or utilitarian

175 Henderson Fitness pg 31.

176 Ibid., 278-9.

177 Ibid., 308.

178 Henderson "The Order of Nature: an essay," (Cambridge, Harvard University Press, 1917), 204-206. Quoted in Parascandola, Organismic and Holistic Concepts, 76.

terms, terms that turn of the century life sciences demanded. Yet they were more alike than not owing to the history and fundamental holism of the organism concept.

Shortly after the publication of Fitness Henderson realized that the statistical mechanics of Gibbs could improve his case, not only concerning the integral relationship between organism and environment but also the improving the rationality and scientific character of an organismic argument. Henderson explicitly adopted Gibbs' concept of the physio-chemical system noting that Gibbs had established scientifically that the world of physical chemistry is made up of equilibrial systems.[179] Furthermore, Gibbs asserted that there was a link between the equilibrium of systems and their change over time, their evolution.

The fundamental concept in Gibbs' systemics was that of equilibrium. All systems, according to Gibbs and many other physicists at the turn of the century, tended towards dynamic equilibrium. Equilibrium was a process characteristic of all natural phenomena, a law which could be precisely defined and in many cases measured. Gibbs emphasized the value of calculating the equilibrium quantities from the probability distribution method Maxwell and Boltzmann had derived from Gauss' original theory of errors.[180] For Gibbs, and later Henderson, a variation in the phase space of a system represented a change in the distribution, or organization of

179 Parascandola, "Organismic and Holistic Concepts," 75.

180 Sklar, Physics and Chance, 48 and 60.

system components.[181] The re-equilibriation (or dissipation) of a system to its new environment depended upon many factors of change such as temporal, energetic, spatial and the material involved.

Henderson believed that the tendency of systems towards equilibrium, in the case of living systems, betrayed teleological implications. And teleology in turn raised questions of origins. He granted that mechanism could not account for everything, namely the origins implied by the teleological nature of self-regulating equilibrial systems but at this point "thought had arrived at one of its natural frontiers."[182] Organization, on the other hand, was well within the bounds of rational thought. The equilibrial processes of systems that betrayed some form of teleology did so because of the undeniable organization of elements and processes that made life possible.[183]

Henderson, however, did not simply equate organization with mechanism. Organization made the very physio-chemical phenomena of life possible. Organization was a concept of structural functional relationships between organism and environment. The physical elements of a system were mechanical while the relationship between them was non-mechanical. It was the properties of relationships between elements that made evolution of the system possible. Dynamic

181 Ibid., 58.

182 Parascandola, "Organismic and Holistic Concepts," 78.

183 Henderson was one of the first scientists to insist that modern medicine must focus on the whole individual and urged physicians to return to a Hippocratic understanding of the patient as a human being together with the doctor within a social system. Ibid.

equilibrium and the organization required for life became intimately linked concepts. For if organization was the foundation upon which evolution and life depended and equilibrium was the form of organization found in nature, both physical and biological, the logical conclusion was the necessity of equilibrium for life processes. Dynamic equilibrium was essential to life and all life acts to preserve its delicate equilibrium through some manner of regulatory processes. And it was this process which warded off entropy.[184] How life escaped the second law of thermodynamics, Henderson thought, need not be conceived in mystical terms. Henderson had come to view the tendency towards dynamic equilibrium as a basic fact of nature and the law of adaptation of organisms as an established a fact of nature.[185]

By the early 1920s Henderson had begun to take an interest in social matters. But until the late 1920s he was skeptical that the social sciences could approach its subject matter in a scientific manner. His views changed after reading Vilfredo Pareto's Trattato di Sociologia General (1916). Pareto's work changed Henderson's view that the social sciences could indeed become scientific. For Henderson Pareto's concept of the social system so closely mirrored his own conception of organic systems that he would latter write "equilibrium of a social system is similar to that of a

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184 The survival of a single organism was, for Henderson, almost infinity improbable. And the continued survival of the flora and fauna of the earth was an unacountable miracle. Ibid., 101.

185 Ibid., 100.

living organism."[186] This was primarily due to Pareto's application of the equilibrium concept to social problems. In a later work Pareto's General Sociology: A Physiologist's Interpretation (1935) Henderson utilized a discussion of Gibbsian physio-chemical systems as an explanatory device to describe Pareto's concept of the equilibrial social system. Much of Henderson's latter work was almost entirely focused on the social sciences. He became closely involved with the Harvard Business school and eventually took an office there. Among his students and attendees at a series of lectures on "Concrete Sociology: A study of Cases" were George C. Homens and Talcot Parsons.

Henderson provided a device that added new scientific rigor to the central organizing concept of functionalism in the social sciences. Functional explanations up to this point had difficulty fully jettisoning evolutionist causality. The social norm - the point of reference by which social scientists observed, compared and judged social functioning - increasingly appeared to rely upon vague and suspicious notions of survival or maintenance of an essential social quality. The concept of equilibrium popularized by Henderson proved a perfect match for the functional theories that had been developing since Boas. With equilibrium an image of structural stability between these interrelationships began to emerge which could account for change without deploying the unscientific idea of an essential or necessary

186 L. J. Henderson, "Blood and Circulation from the Standpoint of Physical Chemistry," in H. H. Dale, J. C. Drummond, L. J. Henderson, and A. V. Hill, Lectures on Certain Aspects of biochemistry (London, University of London Press, 1926), 201-204. Quoted in Parascondola, "Organismic and Holistic Concepts," 104.

predetermined end state or a vital force compelling progress. This is because equilibrium held within it a conception of the normal as a field rather than the normal as point. An essential vital core grounding the judgment of social function gave way to the normal itself as a functional element. The normal in fact became the equilibrial. George Homens captured the marriage of these disciplinary concepts when he pointed out that "the idea of Survival or continuity can be made rigorous only if survival is redefined as equilibrium."[187]

There were, of course, dissenters on the question of equilibrium in the social sciences, including Harvard sociologist Pitrim Sorokin. Their criticisms centered on the problem of quantifiability of social phenomenon. Sorokin preferred the term homeostasis introduced by the physiologist and Harvard colleague Walter Cannon. Cannon, like Sorokin in the case of the social sciences, had misgivings about directly importing into biology a concept from physics and statistical mechanics. By the 1930s the anxiety of being identified with vitalism had passed but the distinction between nature and culture had intensified. Sorokin agreed that "a social system, when disturbed, tends to preserve its integrity." But he questioned whether a concept that required mathematical precision would be confusing or misleading in the messy world of social phenomena studied by the human

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187 George C. Homens, The Human Group (New York, 1950), 307. Quoted in Russeett, Equilibrium, 141.

sciences.[188] Cannon's formulation of homeostasis, however, allowed the social sciences to import the logic of equilibrium without the quantification.

Cannon's area of interest was the autonomic nervous system. Together with the Mexican physiologist Arturo Rosenblueth Cannon developed the realm of the nervous system as an object that resided in between mechanistic and probabilistic explanations. Homeostasis might be called a soft version of equilibrium. The hard version from the physical sciences propounded by Henderson emphasized experimental testability and quantitative measurement of closed systems. It was simply understood that "every institution, political or otherwise, must necessarily work out an equilibrium, if it is to survive."[189] In studying this "working out," quantification was desirable where possible but need not limit the application of explanatory devices by the social scientist.

Despite common sentiments such as Sorokin's against the quantification of social phenomena there emerged an explicitly quantitative approach to social phenomena known as sociometry. The focus was primarily upon small groups linked to the emerging disciplines of group psychology and industrial psychology. Sociometry, however, encompassed a more general ambition than the disciplines growing out of the reformed scientific management that followed Taylorism. The

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188 Pitrim Sorokin, "Le concept d'equilibre est-il necessaire aux sciences sociales?," Revue Internationale de Sociologie 44 (1936), 521. Quoted in Russett, Equilibrium, 134.

189 Eliot D.Chapple and Carlton S. Coon, Principles of Anthropology (New York, 1942), 361. Quoted in Russett, Equilibrium, 143.

concerns were the same but the scope was far more grandiose. "Sociometry is an axis with two poles. The arm toward one pole is directed toward the discovery of the deeper levels of society's structure. The other is directed toward promoting change of society based upon the dynamic facts found in its structure."[190]

The basic techniques of sociometry originated in German psychology in the late 1920s and early 1930s. These techniques were introduced in the U.S by Jacob Moreno in his Application of the Group Method to Classification published by the National Committee on Prisons and Prison Labor in 1932. In 1934 Moreno published Who Shall Survive? broadening the appeal of sociometric methods to the social sciences generally.[191] In anthropology sociometric techniques were seen as the realization of Malinowski's" method of cultural analysis."[192] Sociometry provided quantitative techniques which meshed perfectly with the general principles of

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190 J. L. Moreno, "Three Dimensions of Society" (1949); quoted in J. Nehenevajsa, "sociometry: Decades of Growth," in Sociometry Reader, J. L. Moreno and others eds. (Illinois: The free Press, 1960), 707.

191 This text dealt with the question of natural selection in the social realm. It tries to identify the means to discover the social laws, if not the laws themselves, governing social evolution and survival. "Who shall survive? The question could be asked only in a society which is, as sociometry has proven with overwhelming evidence, satisfied with wasting a very considerable part of its human element. In contrast, in would lose meaning in a sociometric society where no one would be cast out and all be given an opportunity to participate to the best of their abilities, in other words, to survive." J.L. Moreno, "Social and Organic unity of Mankind," Sociometry Reader, pg 6.

192 Donna Haraway, "Signs of Dominance: From Physiology to a Cybernetics of Primate Society, C. R. Carpenter, 1930-1970," Studies in history of Biology William Colman and Camille Limoges eds. (Baltimore: The Johns Hopkins University Press, 1983), 164.

structural functionalism. The journal Sociometric Review appeared in 1936 followed by Sociometry in 1937.

According to Moreno sociometry represented the furthest development of "measurement in the social sciences" with "influence beyond its pales, upon all branches of social sciences, anthropology, sociology, psychology, psychiatry etc."[193] The basic focus of sociometry was the comprehension and measurement of the socius. This was accomplished through the measurement of the social system "down to its social atoms."[194] The social atom was understood as the nucleus of social relations, the smallest social structure in a community. "One part of the structure is interdependent with another part; a change in position of one individual may affect the whole structure."[195]

Analysis of the geometry of social relations, relations through space over time, would reveal the goal or tele around which a group was organized. This goal of the group was called the group criterion. Once the group criterion was identified therapeutic procedures could be implemented to aid in better more efficient organization towards the goal. Sociometrists fully recognized that interrelationships in human society were somewhat obscured by depth-producing factors such as language and self-consciousness. These factors, however, were not seen as problematic for

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193 Moreno, Sociometry Reader, vi.

194 Ibid., 5.

195 Ibid., 20.

sociometric theory and practice per se other than to make the problem of observer interference more difficult.

Though sociometry did not specifically focus on the principle of equilibrium its methods were easily adapted to such concerns. "Imbalance" between group criterion and the structure of social relations easily translated into a problem of the "proper equilibrium" of social dynamics from which therapeutic procedures to alleviate diseqiulibrial social pathologies could be drawn up. The principle of equilibrium, whether in its quantitative or heuristic form, soon became an essential element of the social object, an essential a-priori for any rational discussion of social phenomena. This shift in the epistemological nature of the object of government had immense practical import. Elton Mayo in his well known book The Human Problem of an Industrial Civilization notes that workers can function effectively only when their relationship with their surroundings is maintained in a state of equilibrium: "physiologists have found that work can continue to be performed only in a steady state."[196]

The Refinement of Equilibrium

By the mid 1930s the analytical and heuristic principles of equilibrium and homeostasis were considerably refined. Physical and social scientists understood that a steady state must obtain for effective work, whether in a gas, a cell,

196 Elton Mayo, The Human Problem of an Industrial Civilization (Cambridge, 1933), 28. Quoted in Russett, Equilibrium, 143.

individual or society. How this equilibrium was enforced remained unclear. In scientific management theory after the reform of Taylorism the individual ceased to be a machine requiring fine tuning and adjustment and became a decision maker. Affective authority became an interpersonal process rather than a possession. "The individual [became] seen to be free to decide for or against acceptance of norms, instructions and standards; at the very least they [norms were] no longer viewed as unproblematically internalized."[197] The individual as an organizational subject capable of choice rendered authority as the source of equilibrial stability within the organization very problematic. Authority no longer compelled social change. It came to be understood that in the firm "decision is in its important aspects a social process... [T]he process of decision in individuals is a psychological process socially conditioned."[198] The new problem for the manager of a large organization was the alignment of collective goals with those of the individual in a way that integrated the individual as decision maker with the imperatives of the organization. How such direction and management of a collective were to proceed posed a new challenge to management theorists. What precisely was an organization? How was it related to authority and what form

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197 Peter Miller and Ted O'Leary "Accounting and the Construction of the Governable Person," Accounting Organizations and Society 12, no. 3, (1987); 259.

198 C. Bernard, The Functions of the Executive (Cambridge: Harvard University Press, 1938). Quoted in Miller and O'Leary, Accounting, 260.

must authority take in light of the emerging principles of organization?

The introduction of a reformulated equilibrium into the social sciences spread from Harvard and Chicago into the wider community of social scientists emerging from premise "into a carefully defined analytical description."[199] The eventual effect was the convergence of central questions in both the social and life sciences: explaining the principles, if not the mechanisms, by which organization and the direction of collective goals produce and maintain the social and biological organization of a system. In the social and life sciences the emergence of organization as an important concept was accompanied by a reformulation of the old discourse of authority into a new one of dominance. Processes were no longer directed but induced.

The physiologist Charles Manning Child pointed out that

> [O]nly the simplest sort of integration is possible without definite and more or less persistent dominance, that is leadership... [A]pparently all that is necessary for the beginning of orderly integration in protoplasm is a quantitative difference in the rate of living and the possibility of communication. Dominance or leadership in its most general physiological form apparently originates in the more rapid liberation of energy.[200]

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199 Russett, Equilibrium, 125.

200 C. M. Child, "Biological foundations of social Integration," Publication of the American Sociological Society 221 (1928): 32. Quoted in Haraway, "Signs," 144.

Organization without dominance and hierarchy would, by definition according to Manning, remain simple, characterized by the organization of simple "communistic" zooids.[201]

Higher levels of organization required specialization of function and differentiation of parts into a hierarchy and division of labor. The sociologist George Lundberg was quite clear that the mechanisms of integration and maintenance of organization and dominance were not merely a fundamental characteristic of social systems. They were also the goal of social science. "[If] we follow this [scientific] method as faithfully in the social sciences as we have followed it in physics it may yield us a corresponding reward in our power of control."[202] Lundberg's sociological theory often utilized analogies from physics. Human behavior, according to Lundberg, resembled energy functions understood as the "amounts of change in relationships."[203]

Decline of Equilibrium

Some critics felt that the concept of equilibrium applied to the social sciences amounted to nothing more than ideology, criticisms which persist today. There were internal logical problems with the principle of equilibrium as well

201 Ibid., 144.

202 George Lundberg, Foundations of Sociology (New York: 1939), vii. Quoted in Russett, Equilibrium, 125-126.

203 Ibid., 127.

however. During the same period that Henderson was adopting Gibb's formulations of equilibrial systems to move biological theory away from vitalist cosmology, Gibbs equilibrium was coming under intense scrutiny within physics.

In 1912 P. and T. Ehrenfest published a critical review of statistical mechanics in the Encyclopedia of Mathematical Science titled "The Conceptual Foundation of Statistical Mechanics." The general argument of the piece was that the development of Gibbsian equilibrial statistical mechanics was too general and focused only on special cases.[204] The Ehrenfests offered successive expositions and critiques of Gibb's approach to both the theory of equilibrium and the theory of the irreversible approach to equilibrium and also illustrated Gibb's association of statistical mechanical quantities with thermodynamic quantities by means of "thermodynamic analogies." This amounted to the reliance on a large number of "loosely formulated and perhaps even inconsistent statements occupy[ing] a central position" within his formulations.[205] In the case of poly-atomic molecules, for example, the equilibrium theory gave wrong results and in the case of radiation patently absurd results. For the Ehrenfests and many others these failures in predictive reliability potentially cast doubt upon the entire theory.

Max Planck's turn of the century research into radiation and the absurd results of kinetic equilibrial statistical

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204 Sklar, Physics and Chance, 59-76.

205 Ibid., 70.

mechanic predictions of this phenomena was one of the origins of quantum mechanics. The development of quantum mechanics saved the general concept of equilibrium but totally reformulated statistical mechanics.[206] In the physical sciences at the turn of the century, and especially after the 1916 publication of Einstein's "The Foundation of of the General Theory of Relativity," the underlying dynamic behavior of systems and their components began to be understood by scientists as fully contingent in nature. The laws of quantum mechanics governed nature, at least at the micro-level.[207] The deterministic laws of classical mechanics have since served merely as convenient approximations. At the practical level, however, it was not the theoretical problems of equilibrium and point mechanics, even in its Gibbsian probabalistic-statistical variant, that lead to these concepts fading utility. It was the development of much more effective social and material technologies that began to emerge in the late 1930s.

The discipline of primatology illustrates this well. Primatology's object sits comfortably between the life and human sciences.[208] It was not a matter of naturalization of culture or socialization of nature. Rather dominance, hierarchy and the division of labor had become fundamental

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206 Ibid., 72.

207 Ibid.

208 A focus on primatology "has the double advantage of highlighting the question of the human being's place in nature and the complex relations of natural and social sciences." Haraway, "Signs," 135.

principles of complex systems in both the social and natural sciences.

Primate studies developed within the ecological paradigm of the physiological community.[209] Unlike the social sciences, however, primatology developed as an explicitly quantitative experimental scientific discipline. There was never any dissension over the applicability of such methods because primatology's object was understood to be unproblematically natural. Yet the questions primatology asked were often directed at social questions - the mechanisms involved in the maintenance and reproduction of complex social structures for example. Thus, primatology often asked the same questions as the social sciences. Most important, in practical terms, was that primatology offered an arena in which social dominance patterns could be studied using experimental methods unavailable to the social scientist. Methods such as the physiological defect experiment in which the dominant male of a primate troop is altered or removed and the effects upon troop behavior monitored. By the mid 1930s the concepts of organism as a community and equilibrial system and that of the relationship between function and structure as well as the application of quantitative procedures to analyze such complex social organization and integration all came together in the elaboration of hierarchy and dominance as the primary and necessary mechanisms of equilibrial organization.

The functioning and operation of the objects of the life and human sciences had become very nearly unified

209 Haraway, "Signs," 143.

epistemologicaly by the end of the 1930s. This unification was marked at a symposium held in September 1942 as part of the celebration of the fiftieth anniversary of the founding of the University of Chicago. The published volume from this symposium was titled "Levels of Integration in Biological and Social Science."

The epistemological unification of the social and biological objects of study lead not to the discovery of the mechanisms of structural equilibrium. Instead the the concept of equilibrium receded in importance, surpassed by the principles of dominance and hierarchy. Stable systems become less a matter of structural equilibrium and more a matter of structural control. With the decline of the principle of equilibrium the norm receded even further. Equilibrium formed a kind of stop-gap measure - it was not quite essentialist in point mechanical terms. But it functioned in a pseudo-determinist fashion to maintain structural integrity.

The investigations into the workings of systems according to the rationality of functionalism gave rise to the focus of attention on system structure. The norm having slid into disfavor as an explanatory device lead to the adoption of the principle of equilibrium as the mechanisms maintaining structural integrity. Though the concepts themselves had existed for centuries the emergence of structure and equilibrium together as an explanatory principle for the new rational object of interrelational process is surely no accident. The efforts to discover the mechanisms of equilibrium - the precise process of structural integretiy maintainance - lead to the overturning of this principle rather than the discovery of its operation.

Equilibrium and structure ramain important explanatory principles. But they are no longer central. The search for the mechanisms that control complex processes by the late 1930s began to look elsewhere. The replacement of the normal and equilibrial as rational conception of the object of government coencided with the mobilization for World War II. The war effert had an immense impact on the continuing development of the epistemological aspect of the object of government. One aspect of the war effort was particularly relevent for this developement - operations research. It is with operations research that control as a principle for understanding complex processe. At the same time and linked to this new epistemology of the object of government control emerges as a technology for managing these processes.

Chapter 5:
The Emergence of Control:
Operations Research and a New Object of Government

The scale of the war effort dramatically increased the intellectual cross-fertilization and synergy within the social and natural sciences. Indeed, all disciplines worked together in one form or another. The combination of huge scale and unprecedented cross-disciplinary cooperation had an immense transformative effect on the very basis of rational thought. This cross-fertilization gave rise to new technologies to be deployed upon the new biosocial object of government. One of the most important aspects of the war effort for our story is that of operations research. Operations research was the largest effort ever undertaken to bring together every imaginable academic discipline with the single-minded goal of producing useful techniques and strategies to win the war. "The war effort brought about the most radical disciplinary mixing, administrative centralization and social reorganization of science and engineering ever attempted in the United States."[210] Operations research and the war effert altered forever the rational understanding of complex processes and their mechanisms of stability and change.

Control represents a drasticly different form of knowledge from that of the norm. For control is entirely contingent upon the arrangements of relationships within a

210 Edwards, The Closed World, 47.

system. Control does not operate upon an object but a process. It has no identity per se nor does its target. Control is fluid. It has no basis in essentialist epistemology. After World War II the norm, and its shortlived surrogate - equilibrium - were fuly replaced by an epistemology of control. Control, like the norm before it, requires knowledge to operate. And its exercise also produces knowledge. The epistemological transformation from societies constituted by the norm to societies constituted by control can be seen rather clearly as the following discussion will illustrate. It is also clear that control is an activity of government just as producing and acting upon the norm had been. I shall speculate only briefly about what form governmental activity might take vis-a-vis the new societies of control. I will restrict myself to illustrating the epistemological shift leading to the governing principle of control in the hopes that this will lay the groundwork for future analysis into governmental practices carried out upon an object concieved in terms of control.

The story of operations research is the story of modern systems theory and the introduction of contingency, in the form of cybernetics and information, into the biological and social sciences. It is the story of the replacement of a neo-essentialist or proto-probabalistic structural/functionalism with a fully probabilistic and fully contingent structural/functionalism.[211]

Operations research remains a specific field of study with its own focus. It refers to specific methodologies born of the war effort. The methods and techniques which emerged during its formation in the theoretical and practical ferment of the war effort were, however, much more general in scope and effected every discipline at the epistemological level. The very perception of reality and thus political rationality was greatly effected as well. Machines and their operators were reconceived as part of a single system. From the beginning, operations research endeavored to incorporate the machine operator as seamlessly as possible into the development and functioning of the machines "themselves." The range of operating conditions and error rates for both machine and operator were calculated together by the same statistical methods and techniques. The operator became part

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211 Haraway calls this "cybernetic functionalism." Haraway, "Signs." It should be noted that this contingency is not relativity in the sense that any thing goes. Contingency in this context means that everything is connected, structure effects function but function also effects structure and so on. Moreover this contingent process of transformation is not understood to be a linear process simply looped back on itself constituting merely a slight revision of deterministic causal analysis. Contingency refers to the range of possible choices and thus possible effects of function upon structure meaning probabilities are linked corolationally rather than causally to other probable effects. Or, to put it another way, in the modern conception of the cybernetic system, "causes cause causes to cause causes." according to Anthony Wilden. Without linear relationships causal determinist concepts loose their force. Thus the contingency of modern rational epistemology does not mean causes disappear allowing for anything goes, as the modernists accuse the post-modernists of implying, but when causes point to an infinite number of possible effects or other causes, which is what happens with the dissolution of linearity, causal reasoning loses its objectivity and becomes subjective. See Anthony Wilden, System and Structure: Essays in Communication and Exchange 2nd ed. (London: Tavistock Publications Ltd., 1972, 1980), 39.

of the machine while the machine became part of the operator. Together they formed a new and larger goal oriented system. It was not a case of reduction of one to the other or a simple prosthetic addition to an inefficient organic system. It was the construction of a wholly new object.[212]

The homeostatic goal oriented system ceased to be a solely natural or given process whose proper functioning and very naturalness was marked by its normal or equilibrial behavior. The function or goal of such a system became an engineering problem resulting in what is today known as control theory. When the normal and the equilibrial became the result of engineering decisions it lost its givenness, its inherentness. Not because it was no longer natural but because nature no longer appeared given. Nature too became an engineering decision. The last vestige of nineteenth century vitalism was swept away. Not by rational denial but by rational acceptance of holism as an object of the communications engineer. "The ability to study goal-direction, function, and signification entirely without necessary reference to living systems has removed a gnawing

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212 This is the origin of what Donna Haraway calls the modern cyborg. This joining is not quite the same as the traditional view of technological extension of human capabilities characteristic of tools and technology. The difficulty of the distinction between prosthesis and self , however, is very old. In book 18 of Homer's Iliad Thetis, mother of Achilles, requests a shield of Hephaestus for her son. The scene of Hephaestus' workshop suggests that for the prosthetic devices to work, whether those for his own frail legs or for Achilles' shield, they must be imbued with, or inhabited by wearer. They must become part of the person, not merely an addition. See Elaine Scarry "The Merging of Bodies and Artifacts in the Social Contract" Culture on the Brink: Ideologies of Technology Gretchen Bender and Timothy Druckery, eds. (Seattle: Bay Press, 1994).

irrationality from the heart of organicist biology."[213] Operations research represented the formation of a new rationality of government. It signals the end of disciplinary government centered on the identification and production of the norm and the birth of government by control through modulation and the identification of system structures and production of knowledge about how to alter succesive sequences of system states. Equilibrium was the last manifestation of the norm and the last rational knowledge of disciplinary political rationality.

During the 1930s Vannevar Bush, an electrical engineer at MIT, worked on the new problems involving large electric power networks. To aid in this work he had invented an electric powered mechanical device he called a differential analyzer. It was designed to calculate differential equations related to switching and transmission capacities. Immediately after it was shown to work in 1935 the Ballistics Research Laboratory (BRL) at the Army's Aberdeen Proving Ground ordered one. Another differential analyzer was ordered by the University of Pennsylvania's Moore School of Engineering. The construction of both of these machines was personally supervised by Bush.[214]

During World War II Bush was in charge of the Office of Scientific Research and Development (OSRD). The OSRD was a

213 Haraway, "Signs," 180.

214 After 1935 such "computers" worked alongside mechanical counterparts and were eventually completely replaced by them in both name and purpose. The Moore School and the BRL later collaborated to produce the ENIAC during World War II, the first full-scale electronic computer.

huge and unparalleled effort of over 6,000 scientists and engineers which produced both material and logistic technologies for the war department. Technologies such as computer controlled anti-aircraft guns, radar, the industrial production of penicillin and antimalarial drugs as well as methods of resource allocation, antisubmarine warfare and material transport operations.[215] These successes were the result of an unprecedented level of interdisciplinary collaboration. MIT's Radiation Laboratory, for example, employed about 4,000 people from 69 different institutions. In 1945 the OSRD budget exceeded $100 million compared to the prewar total for Military research and development had been $23 million. This was the birth of what Eisenhower later called the military-industrial complex.

During World War I mathematicians such as Norbert Weiner worked on ballistics tables at the Aberdeen Proving Grounds. Their job was to calculate the ranges of various combinations of projectile materials and charges for the Army's various artillery pieces. Wiener and the other mathematicians were called "computers." In the 1930s, when computers were still wholly biological, Wiener closely followed the work of Cannon and Rosenblueth on autonomic nervous systems.[216] For Wiener the organicism of Cannon's homeostatic self regulating nervous system was more than metaphysically linked to the purely mechanical and mathematically precise servomechanisms

215 Haraway "Signs," 179. And Paul Edwards The Closed World: Computers and the Politics of Discourse in Cold War America (Massachusetts: The MIT Press, 1996), 115.

216 Haraway, "Signs," 179.

being produced for a wide variety of industrial processes. They were variations of the same processes.

At the beginning of World War II Wiener once again applied his immense mathematical skills to the problem of weapons targeting. This time, however, Wiener included the human element into his calculations: artillery, projectile, target and fire crew. Wiener contacted Bush, his old colleague at MIT now with the OSRD, about the relevance of his prewar computation research work both for Bush's difference analyzer as well as, and more importantly, for operations research and the war in general. Bush referred the matter to Warren Weaver of the Fire Control Section of OSRD. Weaver put Wiener to work on the problem of gunnery control.

The physiologist Rosenblueth accompanied Wiener to Fire Control and together they tackled the problem of gun control in terms of the human operator together and complex weapons as part of a single unified system. Initially their task was the improvement of anti-aircraft weapons. Wiener started with the idea of building machines that would approximate the behavior of human gunners but without the "breakdowns" or "wild oscillations" humans experienced when faced with bringing down modern aircraft.[217] In short, the human component of a whole system performed efficiently up to point but after a certain threshold of sensory input had been reached their efficiency dropped considerably and the system as a whole failed. The problem was a traditional engineering one; the refinement of system capabilities beyond their current range.

217 Haraway, "Signs," 180.

Human and machine capabilities, like any other form of behavior from an engineering point of view, was understood in terms of statistics. Performance was plotted on a curve which revealed, among other things, the range of efficient behavior, the boundaries of useful performance which could be expected for that environment. Optimal performance as it was traditionally understood was linked to equilibrial system behavior. The problem for the engineer was to maintain equilibrium within an environment, but in this case the environment presented radically changing conditions.

Wiener and Rosenblueth sought to discover precisely how the "mechanism" of homeostasis operated in order to enhance this operation and expand the boundaries of efficient organismic behavior. The "mechanism" turned out to be very unmechanistic however. And it was this discovery that quickly displaced equilibrium as a fundamental explanatory principle. The mechanism and new explanatory principle they discovered was feedback. The initial model was the early steam engine governor and the later more complex servomechanisms derived from that governor. The product of these mechanisms, their output - the mechanical or electrical substance which caused the change when reintroduced back into the larger machine to which they were attached - came to be called feedback. Though it was mathematically implied in the equations behind their design, the feedback produced by these devices was not initially considered a substance of which measurements could be obtained. There was not anything between the machine and its governor to be measured.

By the late 1930s the space between the machines had become something more than empty space. Early researchers such as Cannon, Rosenblueth and Weiner had come to view feedback as the key to understanding the processes of equilibrial self regulation in both machines and biological organisms. Feedback was more than an instantaneous effect or automatic response characteristic of classical mechanical reactions. Feedback was intimately linked to system maintenance, survival and even expansion. It verged on the teleological or goal directedness because it was so closely related to the continuation of systemic processes. Knowledge of feedback implied the ability to affect the very equilibrial processes of life (or machine) itself. As the concept of self regulation became more highly defined feedback was distinguished between negative and positive. Negative feedback refers to the circular process of self corrective cycles in which information from the effects of a previous adjustment is returned, or fed back, to the system further adjusting the process away from oscillatory and erratic behavior. Positive feedback reinforces oscillatory behavior and leads to system breakdown.

Wiener and Rosenblueth proposed the radical idea that the space between the governor and the machine, or the brain and the body, was occupied by the process/mechanism of feedback. Feedback was not simply a cause in the classic sense but it was responsible for the regulation and governing process of homeostasis that made governors work. If feedback could be isolated and manipulated the process of homeostatic regulation could be made more efficient. The trick was measuring this element or quantity called they called feedback.

In the early 1920s the mysterious element that passed between two machines, such as a governor and steam engine, had become important for practical work in electric communication. Research in telegraphic communications and electronics focused the attention of a very few mathematicians on isolating precisely what it was that was being sent over the wires crisscrossing the globe. The question was how substance being sent was related to how it was sent. In communications engineering this substance had previously been called intelligence even in the civilian arena. It referred simply to the speech of the sender distinguished from distortions caused by the sending apparatus which was called, simply enough, noise. But it was clear that this substance was not simply the voice of the sender that was carried over the wires. But it was not clear to communications researchers precisely what this substance really was, what it was composed of.

In 1928 R.V.L. Hartly showed that a mathematical relationship existed between the medium of transmission and the substance being transmitted. This substance was henceforth called "information." Hartly found that the logarithm of the number of possible states of a transmission channel, such as the various conditions of wear and tear of a telegraph cable, provided a measure of the information handling capacity of such a channel.[218]

However, attaining precise measurements of the condition of every inch of telegraphic cable was not feasible. The mathematical techniques of statistical mechanics common in physics were precisely the kind of equations electrical engineers required for the identification of the probable states of the system as well as the transition of a system from one probable state to another. The substance of information became quantitatively knowable by statistical analysis of its conditions of transmission. Information, it turned out, was not a substance at all but a relationship. A relationship, moreover, between processes rather than parts.

The process of feedback, linked to the concept of information, made feedback a communication process. Radar technology was closely associated with radio. The conceptualization of feedback as a communication process thus came quite easily. But it was a unique sort of communication that was also linked to the goal-directedness associated with feedback mechanisms. For the problem of anti-aircraft guns communication meant a radar's observation of the position of an aircraft communicated to the gun pointer, whether a machine or a person. The gun and the pointer's position was then calculated relative to the aircraft's position. Since

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218 A. R Meetham ed. Encyclopedia of Linguistics Information and Control (Oxford: Pergamon Press, 1969) s. v. "Communication Theory" by P. M. Woodward, 46. I was unable to determine whether Hartly was the first to use this term or not. After Hartly, however, the term information replaced intelligence as a general term while intelligence has been reserved exclusively for the contextual sense of knowledge tied to meaning, especialy in the military.

the aircraft is moving of course, this process of communication is repeated over and over until the two positions are closely aligned. This is a process of communication between (or about) one state of a system and another. In this way mechanisms of communication was realized to be closely linked, if not identical, to to process of control and control was recognized to be a two way process between controlling and controlled aspects or functions of a system. Homeostasis and equilibrium became understood as the general process of information processing, one which regulated or controlled the changes between system states ensuring that they did not vary greatly. Control, in this its most basic sense, is the selection of feedback inputs into current states of a system to alter - in a predictable way - the system's transition into future states. Information, in other words, is the key to system behavior.

The mechanism or process of feedback Wiener and Rosenblueth were looking for was that of homeostatic control. Information processing thus referred to the taking in of information from one state to the next and the calculation of this data to produce an output which was fed back into the system as a form of control. Information processing became understood as the process that complex systems performed - whether biological or mechanical - in order to adapt to a changing environment. If this control process of homeostatic systems could be manipulated the behavior of the whole system could be controlled.

Wartime operations research revolutionized all aspects of war fighting from managerial concerns centered on logistics to weapons design, production and mode of deployment. The key was the use of statistical methods in the identification of optimum performance for a given set of condition with given tools towards a pre-specified end. Like the communications engineers before them operations researchers began from the premise that all states of the transmission medium could not practically be known in advance. In this purely practical engineering setting probability was understood to refer to states that were in principle measurable but in practice extremely difficult. All processes had to be understood in probabilistic terms based on incomplete data.

The human operator, understood as a complex information processor, could be inserted into a larger system together with other information processors -both machines and humans - to achieve a predefined goal. To develop integrated weapons systems the human/machine engineer specified the conditions of maximum and minimum performance of the given systems in a given setting and combined this with the specification of the goals of the weapons system linked with feedback. Optimization was never considered in isolation. Optimization of performance in relation to the goal was a characteristic of the whole system whether anti-aircraft gun, gunners and spotters or naval vessels, their cargo and the methods of moving them. Operations research was itself a new technology essential in the allied victory. More convoys survived, anti-aircraft hits per thousand rounds fired increased, destruction per pound of munitions in aerial bombardment increased, and so forth. In virtually every case of increased effectiveness in the war effort the new technique or tool directly responsible was developed in terms of an information processing system composed of many interconnected parts.

Any system whose states could be adequately specified and formalized could be controlled. The problem was how to precisely specify these parts and how they interacted so as to streamline their interaction, their communication, in a desired way and steer the process in a desired direction. That is, the problem was one of understanding the precise operation of communication and control in complex multidimensional processes. Engineers at OSRD quickly began working from the premise of feedback as communication and information processing developed by Wiener and Rosenblueth. The human sciences soon adopted these principles as well, also stimulated by the requirements of war.

The machines of World War II were incredibly noisy and incredibly fast. They were also incredibly complex. The new challenges of communication and coordination were fundamental to the war effort. Such challenges were the specific domain of the Psycho-Acoustics Laboratory (PAL) set up at Harvard under the direction of the experimental psychologist S.S. Stevens within the jurisdiction of the OSRD. PAL was composed primarily of communications engineers and psychologists focusing on "those problems arising from the fact that a human being is part of the total circuit."[219] PAL was the largest university based program conducting psychological research during the war.[220] Researchers at PAL considered their work to be a form of language engineering. Thus was born the discipline of psycholinguistics. The PAL researchers made no distinction between the technology of hardware and the technology of language and listening. The din of battle made communication a psychological and psychophysical problem.[221]

One of the first PAL experiments established that the problem of noise was relevant not so much at the individual level of the soldier but at the level of coordination between soldiers and especially between soldiers and commanders. Noise was a command and control problem, a systemic problem. The individual tialgunner for example could withstand a considerable amount of fatigue and perform relatively well. But coordination between a tail-gunner and a waist-gunner, for example - the organized response of the plane's entire defense system against enemy attack - suffered enormously. The problem grew exponentially when larger systems such as aircraft carrier battle groups and amphibious landings were

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219 George Miller, F.M. Wiener, and S.S. Stevens, "Transmission and Reception of Sounds Under Combat Conditions," Summery technical Report of Division 17, Section 3, NDRC (Washington, DC: NDRC, 1946), 2. Quoted in Edwards, Closed World, 212. One of the most practical products of PAL were vinyl ear plugs - called Ear Wardens - which cut background noise yet allowed voice commands to be heard thus maintaining the chain of command.

220 James Capshew, Psychology on the March (unpublished PhD dissertation, University of Pennsylvania, 1986) 127. Quoted in Edwards, Closed World, 212.

221 Ibid., 214.

considered. The research at PAL and in linguistics in general was closely connected with the developments of Shannon's communication theory. At a Symposium on Information Theory at MIT in 1956 "nearly every aspect of cognitive science was represented."[222] Noam Chomsky delivered a paper on an early version of his theory of Transformational Generative grammar. PAL's last military contract expired in 1961 but its work continued with support from National Science Foundation and National Institute of Health grants.

Information

During the war, research focused primarily upon received signals. The "extraction of signals of a given ensemble from noise of a known type" such as that of radar tracking a plane.[223] Electronic communications and the sending of signals received comparably less resources. The improvement of communications could be achieved relatively easily by simply boosting power to the transmitter. After the War considerably more effort went into the sending aspect of communication. What emerged was a means of formalizing and quantifying the entirely non-essential, non-corpuscular substance of information and feedback. With this development, statistics has completed its three hundred year journey from the counting and enumeration of things, first by their essential

222 Edwards, Closed World, 229.

223 J R. Pierce, Symbols, Signals and Noise: The Nature and Process of Communication (New York: Harper and Row, Publishers, 1961), 42.

qualities then to reveal their essential qualities, through probability and the first questioning of essences and determinism, to the enumeration of relationships and the contingent assemblages of complex systems with no essential quality at all.

In 1948 Claude Shannon, an engineer for Bell Laboratories, published "The Mathematical Theory of Communication" in the Bell Systems Technical Journal. This has become the seminal work in what has come to be called information theory or statistical information theory. Wiener's work in tracking systems provided much of the mathematical background for this work.[224] The problems were similar in that for both sending and receiving of information one is faced with the problem of distortion and error, or noise. In any transmission of a signal, whether that received from the radar readings of a planes location or voice over a phone line "it is unfortunately characteristic that certain things are added to the signal which were not intended by the information source."[225] Shannon had basically done what had previously been considered undoable. He decreased the number of errors in a transmission over a noisy channel without recourse to increased transmitter power or larger bandwidth. This was achieved through a reconceptualization of what the communications process actually entailed. A communications

224 Shannon emphasized his debt to Wiener but Wiener pointed out that much of Shannon's early work, following Hartly and Nyquist - also of Bell Labs, proceeded his own work in this field. Claude E. Shannon and Warren Weaver, The Mathematical Theory of Communication (Chicago: University of Illinois Press, 1949, Illni Books, 1963), 3.

225 Ibid., 7.

system, according to Shannon, should be understood in terms of the information it can transmit rather than the symbols that might represent what is transmitted. That is, communication is a problem of coding.

Shannon discovered that for the discrete signal, such as words made from an alphabet as in the Teletype, proper coding would maximize the rate of transmission and decrease the amount of distortion and errors in the received message. In the 1940s the machines partly determined the simplest coding algorithm of base 2, the binary digit or bit. This became the standard unit of measure for information and the most basic level of of coding. The binary digit conveniently matches the simplest division of process states into on or off, electrical current flowing or not flowing. Any symbol can be coded using the binary digit.[226] The coded message simply had to be within the limits established by Hartly's probability algorithm for channel capacity. However, channel capacity was now understood in terms of amount of information transmitted rather than number of symbols.

For continuous message sources, such as a spoken voice or the reflected signal from radar, the equations are much more complicated but the same theory holds. The difference is that a range of band limited frequencies is specified to

226 The bit may be most commonly recognized today in the form of the ASCII text coding scheme. It becomes apparent here how Shannon could avoid concern for semantics. The contextual of a symbol, its meaning, is irrelevant to the symbols efficient transmission. There are ways in which these areas of coding and semantics overlap and cannot be fully separated. This was pointed out early on By Warren Weaver who introduces Shannon's theory of communication in the 1949 book reprinting Shannon's original article. Such linkages were the basis for subsequent artificial intelligence work.

which the coding must comply. Continuous messages, understood in terms of a curve, had previously been approximated through the assignment of a finite number of points through which such a curve passed. Exact prediction with this method would require knowledge of all the infinite possible points through which any given message curve might pass. Instead of assigning a finite number of points Shannon divided the curve into a set of frequencies. This method of specifying a message encompassed the entire curve and all its possible points within a finite set of parameters. This reduces the number of variables from the infinite to the finite.

Each frequency and its parameters were assigned, through calculations of its probable state, in a manner similar to the standard methods used in astronomy for identifying the (probable) position of a star. Within the range of possible points in each frequency Shannon used the statistical techniques developed by Gibbs to specify the probable state of a portion of a given volume of gas.[227] With these probability distribution formulas describing the maximum message transmission capacity of a given channel, along with a given power and a given frequency range could be specified. This capacity thus specified the proper coding of the message for the most efficient transmission. That is, a transmission whose sent message maximally corresponded with the received

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[227] Gibbs called this state a micro-cannonical ensemble, a state characterized by a uniform distribution of probability. This probability itself refers to the average values of the phase quantities of molecules in what is called the overwhelmingly most probable Maxwell-Boltzmann distribution. Such an evenly spread probability distribution is itself called ergodic. See Sklar, Physics and Chance, 67.

message. These frequencies and their corresponding maximally efficient coding schemes do not eliminate error. This was shown to be impossible. But such errors, or rather the frequency of errors, could be calculated.

"The fundamental problem of communication" Shannon writes "is that of reproducing at one point, either exactly or approximately, a message selected at another point."[228] Information in Shannon's theory is not to be confused with meaning. He explicitly avoided equating his theory of communication with a theory of meaning. The "semantic aspects of communication are irrelevant to the engineering problem. The significant aspect is that the actual message is one *selected from a set* of possible messages."[229] Proceeding from the work of Hartly Shannon understood the amount of information to be the measured by the logarithm of the amount of available states of the transmission system. But it was Shannon's focus on the role of probability or uncertainty in the actual generation of the message within such a transmission system which brought the full significance of probability into view.

Shannon proceeded with the application of Gibbsian statistical mechanics, routine in communications engineering. The use of these equations in communications engineering had been driven primarily by practical concerns not philosophical

228 Shannon, Mathematical Theory, 31.

229 Ibid., 31. Italics in original.

exploration.[230] In reducing uncertainty "information turns out to be exactly that which is known in thermodynamics as entropy."[231] It is here that Shannon's work provided communications engineering with one of its most valuable practical applications.

As Hartly pointed out information was linked to the many possible states of the communication system. Information must then be a purely relational quantity. As a concept information applies to the communication system as a whole rather than to individual messages (the realm of semantics). Unqualified, pure information is a meaningless abstraction. It exists only as a relationship at a given time. Thus, Shannon found, the correlation of input to output in a communications system the similarity between message sent and message received, would be strengthened if uncertainty were reduced. Within a communication system, Shannon discovered, information was precisely what reduced uncertainty and therefore strengthened the correlation between input and output.

The place of equilibrium in Shannon's theory is that it describes the characteristic of the distribution of probability within a frequency defined by certain statistical parameters. These parameters are themselves derived from the curve of errors produced in measuring the frequency itself. A frequency and its parameters refer to each other in an

230 In 1925 L. Szilard produced the first extended discussion of information in physics, begun by Boltzmann's initial observation of the entropy - information link that emerged in thermodynamics. Von Neumann later explored information in the context of quantum mechanics.

231 Weaver, Mathematical Theory, 12.

irreducible way. They determine each other without having characteristics unconnected one to the other. Until this point, outside of physics, the concept of equilibrium was applied to the exact point through which a statistical curve passed. It was, in other words, a mixture of probabilistic equilibrium and the equilibrium of atomistic classical mechanics for which the second law of thermodynamics specified the ultimate equilibrium; the universal heat death of maximum entropy.

Shannon discovered that entropy was not such a scary thing. It could be quite useful to the communications engineer - not because engineers were nihilists or happy conspirators in the production of instrumental rationality designed to alienate the worker from his labor or the individual from his soul but because entropy, understood in terms of information could be constructive. Information turned out to be the measurement of the different organization of a system from one state to the next. Entropy, or information, was actually a measure by which organization could be increased. Increasing organization, the reduction of randomness is, of course, negative entropy. In communications engineering proper coding is a form of message construction and thus a form of increasing organization.

Entropy in information theory, like equilibrium, is not to be conceived as a deterministic force. Early equilibrium expanded the scales of explanation in limited cases, such as cell division and the discovery of vitamins, and it succeeded in making biology a rigorous science, as Henderson had hoped.

But as an explanation for heredity and evolution, equilibrium maintained the old characteristics of a deterministic life force sucking living organisms to its center rather than explaining their historical movement. Grand explanations in terms of equilibrium before the 1940s sounded not much different from the "evolutionism" that had been rejected as unscientific and tainted with vitalism and superstition. Entropy had even gained deterministic powers.

Information provided the conceptual tools to account for equilibrial, and for that matter entropic, processes in a non-deterministic manner freeing rational thought from the clutches of determinism once and for all. The life sciences have since become a very special kind of communications science. Recall from the discussion of physics in part three that entropy refers to the degree of randomness or disorganization in a state or phase of a dynamic process. The second law of thermodynamics states that systems, in isolation from all but the influences internal to it, will become increasingly less organized and more and more perfectly randomly distributed. Such a random distribution was the opposite of organization. Information and entropy are thus said to be high when organization is low.

Organization was precisely what Shannon, and all his predecessors, were trying to specify with probabilistic descriptions of the state of a transmission channel. When Shannon devised his equations for the specification of frequency parameters of a transmission channel he was measuring the (probable) level of organization of such a channel at any given state (time). When the probable organization of a channel's state is calculated one is left with the parameters or constraints within which a message may be transmitted. Thus the parameters specify the proper coding necessary for efficiency. Information (or entropy) is thus a measure of the level of constraint or freedom of choice in the construction (coding) of a message.

Complete freedom would be an instance of complete lack of structure to constrain one's choices - i.e. complete randomness. In the English language the letter "U" has a very high probability of following "Q." In the visible spectrum orange has an even higher probability of following yellow. Because a reasonably large sample size tends to be representative of the whole, a probability equation can be made for any sequence, relative to other variables acting on such a sequence. The statistical regularities arising from the organizational of such a sequential phenomena is known as an ergodic process.

Shannon found that in any information source that is not completely random there exists a statistically determinable parameter of that source. Within these parameters there is a necessary amount of extra information. This extra information in a message was known as redundancy. Nyquist had previously referred to this redundant component of the signal as useless, conveying no intelligence.[232] Efficient transmission before Shannon consisted largely of trying to eliminate this redundancy. Information as a measure of organization however meant that noise (errors in received message) could be

232 Pierce, Symbols, Signals and Noise, 39.

accounted for by inserting extra bits into the coded message. That is, adding redundancy specifically tailored to the communication channel's capacities (parameter) increased the correspondence between sent and received messages. These extra bits acted as checks against errors caused by noise in the transmission process. Redundancy turned out to be a "predictable departure from the random."[233]

This is an important point. At first glance it appears that Shannon is suggesting that entropy counteracts entropy. What it actually amounts to is that organization "itself" is a source of counter-entropic or negentropic effects. Shannon called this relative entropy. Shannon's relative entropy is derived by comparing the actual degree of entropy of an information source at the time of transmission (by calculating its statistically probable organizational state in Gibbsian statistical mechanical fashion) and comparing this entropy with the maximum entropy the same message source could possibly have independent of ergodicity. For example in the English alphabet a completely random selection would produce an "A" 1 in 26 times - the same frequency as "X." In actual usage of the English language, however, constrained by the parameters of grammar, its organization or relative entropy, "A"

233 James Gleick, Chaos: Making A New Science (New York: Vicking Penguine Books, 1987, Penguine Books, 1988), 256.

occurs much more frequently than "X."[234] It has been said that these effects of entropy are what "gives time its arrow."[235]

The effect of this distinction between absolute and relative redundancy reduced the concept of entropy, and, as a result, also the concept of equilibrium from an all powerful force acting on every thing in a uniform way to a much more complex process in which the effects of entropy at one time and place can "counteract" the effects of entropy at another time and place.

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234 Shannon calculated that the redundancy of English is about 50%. Weaver, Mathematical Theory, 13.

235 See Ilya Prigogine and Isabella Stengers Order out of Chaos: Mans New Dialogue With Nature, with a forward by Alvin Toffler (New York: Bantam Books, 1984). This is actually a matter of great dispute within physics. Einstein's relativity made time a matter of illusion i.e. relative. In classic and quantum mechanics time is, in principle, reversible. See Sklar Physics and Chance for a complex treatment of statistical mechanics which illustrates the problems with the "objectivist" view. The two views of time are intimately bound up with the question of whether probability is an objective feature of reality, as Pierce insisted, or is merely a reflection of our lack of complete knowledge, as indicated by Einstein and later David Bohm's contention that "God does not play dice with the universe." Note the irony of "objectivism" as a form of "irrationality" in the post-quantum age, an irony not widely acknowledge outside of theoretical physics save for its compartmentalized form as a "social" phenomenon relative only to feminist theory and literary criticism and not to the "real world." It is basically a continuation of the "vitalism - mechanism debate", sometimes infused with spirituality, as in the writings of Fritjof Capra's The Tao of Physics or versions of the Gaia principle, and sometimes "objective" as in modern systems theory and the new science of chaos, in physics, such as Murray Gell-Mann's The Quark and the Jaguar, or complexity and emergence, in the life and human sciences illustrated by Brian Goodwin's How the Leopard Changed its Spots. In any case, probability - objective or relative - has demolished the essentialist determinism of the classical paradigm of an atomistic point mechanical system as a form of rational explanation.

Cybernetics

Shannon's formalization of information had dramatic ramifications for virtually every discipline. In conjunction with feedback and information processing a new paradigm for understanding the world emerged. Cybernetics replaced the epistemological basis of affectiveness from a one-way command with that of a two-way message sending and receiving system. Wiener and Rosenblueth were explicit in their view of the unity of the set of problems centered on statistical mechanics, communications and control in both the machine and living organisms.[236] It was soon realized that social organization also fell within the purview of cybernetic epistemology. This is because cybernetics does not generaly distinguish between the material involved in a system. The focus is upon organization of relationships. The importance of structure lies with analyzing specific material manifestations of systems and the nature of interactions. A system is defined by its organization, however, not its structure. Shannon's specification of a formal mathematical methode of conceptualizing information makes the transitions between system states, that is, the organization of relationships within a system, thinkable and manipulable. Systems became governable.

In 1942 Rosenblueth gave a presentation of the research he and Wiener were conducting to the Cerebral Inhibition Meeting organized under the auspices of the Macy Foundation. The concept of feedback was introduced to a wide variety of

236 Haraway, "Signs," 180.

disciplines including engineering, psychoanalysis, mathematics neurophysiology, philosophy, sociology and anthropology, notably including Gregory Bateson and Margerate Mead. Rosenblueth, Wiener and Julian Bigelow, a fellow engineer in the Fire Control section, published "Behavior, Purpose and Teleology" in the journal Philosophy of Science. They described goal oriented behavior in both the machine and human as a process of negative feedback. Henceforth, cognition, group dynamics, social organization in ant, monkey and human populations as well as the successful tracking and targeting of enemy missiles or human genes was linked with the new formulation of communication as a cybernetic control system.

The Macy Foundation sponsored numerous conferences spreading the concept of feedback and control. The first regular meeting held in 1946 was titled "Feedback Mechanisms and Circular Causal Systems in Biology and the Social Sciences Meeting." In 1947 Wiener coined the term cybernetics to give a name to the newly unified set of concepts and the methodologies of investigation of systems according to these concepts. Wiener summarized the themes of cybernetics as: "(1) The Gibbsian point of view has revolutionized modern life; (2) society can only be understood through the study of messages and communication facilities; and (3) physical functioning of the living individual and the operation of new communication machines are parallel in their attempts to control entropy through feedback."[237]

237 Norbert Wiener, Cybernetics and Society: Human use of Human Beings (Boston: Houghton Mifflin, 1950). Quoted in Haraway, "Signs," 180.

A few years later, an introduction by Wiener and others to an Academy of Sciences conference illustrates the radical epistemological shift being wrought by cybernetics:

> The concepts of purposive behavior and teleology have long been associated with a mysterious, self-perfecting or goal seeking capacity or final cause, usually of a super-natural origin. To move forward to the study of events, scientific thinking had to reject these beliefs in purpose and these concepts of teleological operations for a strictly mechanistic and deterministic view of nature... The unchallenged success of these concepts and methods in physics and astronomy, and later in chemistry gave biology and physiology their major orientation. This approach to problems of organisms was reinforced by the analytical preoccupation of Western European culture and languages. The basic assumptions of our traditions and persistent implications of the language we use almost compel us to approach everything we study as composed of separate, discrete parts or factors which we must try to isolate and identify as potent causes. Hence, we derive our preoccupation with the study of the relation of two variables. We are witnessing today a search for new approaches, for new and more comprehensive concepts and for methods capable of dealing with the large wholes of organisms and personalities.[238]

The authors thought that these new concepts, even if "expressed in different terms" represented "an attempt to escape from these older mechanistic formulations that now appear inadequate, and to provide new and more fruitful conceptions and more effective methodologies for studying self-regulating processes, self-orienting systems and organisms and self-directing personalities."[239]

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238 L. Frank and others, "Teleological Mechanism," Ann. N.Y. Acad. Sci., 50 (1948). Quoted in Bertalanffy, <u>Systems</u>, 16.

239 Ibid.

Systems Reformulated

Thermodynamics and statistical mechanics made points and identities much more complex, but reality until the 1940s remained firmly corpuscular. The growing importance of probability and statistics and its fundamental importance for statistical mechanics existed uneasily within the epistemology of point mechanical systems. The development of a formal theory of information and its circulation in terms of cybernetic feedback loops also radically transformed the concept of systems. The reemergence of the system concept as a general explanatory device focused attention upon dynamic relationships. The basic schema of a Gibbsian interconnected and dynamic system, adapted by Henderson into biology and Parsons in the social sciences, was transformed by the continued evolution in the statistical reasoning that had given it its earlier form.

Ludwig Von Bertalanffy first articulated the modern form of the system concept. Bertalanffy explicitly rejected the mechanistic interpretation of interaction yet he was not satisfied with metaphysical and materially ineffective explanations. He attempted to grasp the specific operations by which systems functioned, were maintained, transformed, expanded or destroyed in a relational non-point mechanical way. Bertalanffy made the fundamental distinction between open and closed systems to move beyond the vitalism-mechanism controversy.

Bertalanffy, an Austrian biologist, published his first book <u>Theories of Development</u> in 1928 (translated into English in 1933) in which he stressed that the task of the biological sciences was to discover the laws specific to biological systems, what was needed was a "system theory of the organism."[240] His goal was no less then the settlement of the vitalism-mechanism antithesis. Bertalanffy was well aware that his biological theories constituted a natural philosophy and as such would not be widely received.[241] Bertalanffy first presented his ideas of a general systems theory in the United States to, one of the few forums in which such non-mechanical ideas found acceptance outside of spiritualism: Charles Morris' semiotics seminar at the University of Chicago in 1937.[242]

For Bertalanffy the adoption of closed equilibrial systems explanations in the life sciences constituted an unwarranted abstraction. An abstraction which obscured rather than clarified the behavior of such systems, especially complex highly organized systems such as those of concern to the life and human sciences. Bertalanffy was aware, however, that in biology a holistic theory such as his was too close to the vitalism that the lacuna of early twentieth century biology had worked so hard to exercise.[243] When the

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240 Ervin Laszlo, "Origins of General Systems Theory in the Work of Von Bertalanffy" in Ervin Laszlo ed., The Relevance of General Systems Theory: Papers Presented to Ludwig von Bertalanffy on His Seventieth Birthday (New York: George Braziller, 1972), 3.

241 Bertalanffy, General Systems Theory, 11.

242 Thomas Sebeok, The Sign & Its Masters (Austin: University of Texas Press, 1979), 66.

243 Bertalanffy, General Systems Theory, 12-13.

theoretical was discussed, system remained in the background and relationships were understood in mechanical terms. All that was necessary was to assume an equilibrial arrangement and the important work of clinical research could proceed. Equilibrium, after all, was an established fact of science. "Excessive" attention to natural philosophy, Bertalanffy thought, revealed that the equilibrium concept in the life sciences necessarily occupied an explanatory position very similar to Bergson's elan Vital in vitalist epistemology. But Bertalanffy did not reenter the vitalism mechanism debate. He merely pointed out that the closed system concept of physics applied to living organisms would require such a vital force. But he proposed that an expanded conception of systems appropriate to the life sciences, one that attempted to explain change rather than stability, would not require an epiphenominal force to propel it through time and space foiling entropy.

The concept of open systems brought to the fore two fundamental issues in the analysis of complex processes - statics and dynamics.[244] Statics refers to the homeostatic maintenance of a systems organization relative to its environment while dynamics refers to changes in this organization. Neither is reducible to the other but both require the other for their existence (as well as their differentiation on the part of the observer). In informational terms both are ways of identifying the states of a system and the transition processes between such states.

244 Ibid., 158.

In other words, statistics and dynamics are two general categories of system organization.

The distinction between open and closed systems and statics and dynamics had the effect of erasing the lingering differences between organic and inorganic systems and process. The distinction between biological, chemical, electronic and mechanical systems since World War II has become the level of complexity of organization rather than a qualitative distinction. Generally speaking, the more complex an organizational structure the greater the distance the system may be from a source of energy. Simpler systems require a closer proximity to an energy source.

As a form of organization homeostasis and equilibrium became one possible state among many. They are an important states but have been stripped of their causal properties laying unmentioned at the heart of prewar biology and social science. After the war homeostasis became one of four general categories or descriptions of states of system organization; homeostasis, homeorhesis, morphostasis and morphogenesis. In this new context homeostasis refers to an entropic process in which the level of organization is maintained by the importation of negative entropy. Homeorhesis concerns an increase in complexity of organization but in terms of development rather than evolution; Morphostasis is a neutral entropic phase of transition; And morphogenesis is an unpredictable change in organization to a higher order of complexity associated with evolution.

In 1954 the Society for General System Theory was organized by Kenneth Boulding, an economist with the Center for Advanced Study in the Behavioral Sciences in Palo Alto California, and many others at the Annual Meeting of the American Association for the Advancement of Science.[245] System, information and cybernetics came together to form the epistemological basis of rational explanation and the production of rational techniques of management where change and transformation was not caused but constrained, not authorized but modulated.

It was precisely these epistemological transformations brought about by the development of general systems theory, information theory and cybernetics that allowed Francis Crick and James Watson to discover the double helix of DNA and the nature of the hereditary material in 1956. This material was conceived entirely as an information processing, code generation and transmission system. This system produces the dual functions of self-replication and message transmission via messenger RNA that controls protein synthesis. DNA does not cause or determine growth or evolution. Rather, it constrains or organizes the possible states the evolutionary

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245 The name was later changed to Society for General Systems Research. The term "theory" in the name was considered "too pretentious." Bertalanffy, General Systems Theory, 15. Boulding formulated what he called a rough "skeleton" of ascending levels of systems organization: Frameworks, understood as arrangements, structures or maps; Clockworks, simple predetermined dynamic systems; Thermostats, self-regulating systems, closed loop cybernetic systems; Cells, self-maintaining structures and self-reproducing open systems; Plants, multiplicative ensembles of cells; Animals, teleological open systems characterized by an image or knowledge structure which mediates between stimulus and response; Human, self-conscious open systems; Social organization, in which the unit of functional element is not the individual but the role; and Transcendental system, which is knowledge itself. Quoted in Wilden, System and Structure, 357.

process may occupy. DNA is a code that mediates between different states of a system. The environment is a necessary set of parameters (or constraints) upon genetic code transmission. Without the environment providing noise and random mutation evolution would not take place. Only transformation in the form of non-adaptive mutation would occur due to random mutations of self replication. Evolution is a process characteristic only of open systems interacting with an environment. Evolution is now considered to be ba a dynamic process operating principly by selection. Selection is now understood in statistical terms as transition probabilities.

It should be noted that these epistemlogical transformations in complex processes and systems occurred accros the board. The application of methodes emerging from this epistemological reformulation have been applied to all sectors of society. The practical application and efficeincy of these new methodes have not always, perhaps even rarely been analyzed except in terms of refinement of methodes. there has been little critical analysis of purpose. Managment science has been particularly interested in the new technologies of system organization. In this sense systems analysis can be distinguished from systems theory. Systems analysis applies the principles durived from the new epistemology of non-deterministic and open cybernetic information processing systems for the narrow purpose of aiding decision makers by identifying central componants of complex systems and producing optimized ruitines to guide the transition of systems from state to state. This is in fact a definition of control. It is the attemtp to influence state transition by taking into account the multiple objectives within a system and manipulating boundary and resource constraints in order to affect change towards the desired and predefined, yet constantly refined, goal. This is the source of the modern fetish of real-time. This is slightly different from the wider concern of systems theory wih the epistemological aspect of complex processes.

The developments of information theory and cybernetics made it clear that relationships and organization were fundamental aspects of all processes. Perhaps more importantly, they showed that systems could be approached empirically and technical knowledge could be produced about the regulatory process and thus control techniques could be devised to affect system behavior. Such knowledge had immense practical applications.

Innumerable techniques have been developed for the identification and construction of parameters or boundaries for the implementation of control techniques. In engineering and business management one of the most common techniques is systems analysis. Systems analysis is not to be confused with general systems theory though they are very closely related. Systems analysis is a technique developed at RAND in the late 1940's to consider problems of a more speculative nature than those of operations research. Emerging out of operations research systems analysis retained the feature of optimizing communication and the inter linking of every aspect of the system into a functioning whole. But it differs in that it attempts to identify "a range of problems to which there [could] be no 'solution' in the strict sense because there [were] no clearly defined objectives that [could] be optimized or maximized."[246] That is, systems analysis is future oriented. Optimally efficient organization can be constructed with an optimum capacity to adapt to probable short term changes in system organization.[247] In 1946 the Air Force and Douglas Aircraft formed RAND and in 1948 separated into a non-profit corporation.

Other techniques for generating knowledge of complex systems were also developed shortly after the war. Game theory was developed at RAND by Von Neumann and the economist Oskar Morgenstern. Queuing theory, decision theory and ergonomics also emerged directly from the war effort. In one form or another, techniques and technologies arising from the three linked concepts of system, cybernetics and information began to permeate nearly every other discipline.

In 1946 the Psychology Department at Harvard split apart with the social and clinical psychologists joining the new Department of Social Relations under Talcot Parsons. The remaining members of the Psychology Department joined Stevens in at PAL. Parsons was not opposed to the approach of PAL, in fact he was strongly "predisposed" to "conceptions of

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246 L. Bruce and R. Smith, The RAND Corporation (Cambridge MA: Harvard University Press, 1966), 9. Quoted in Edwards, Closed World, 117.

247 This is undoubtedly the source of the current cliches about perpetual training and constant evolution in the popular (business) press. Systems analysis has become a basic management tool taught in business and engineering programs at the undergraduate level generaly going by the name cost-benefit analysis.

cybernetic control, not only in living systems but also in many other kinds of systems."[248] He developed, along with Edward Shils, what he called the "pattern-variable" scheme as the theoretical framework for the analysis of social systems. With a reformulated concept of system explicitly understood as arising not from "variation in terms of a single variable, but also as a resultant of a plurality of independent variables." The existing sociological theories arising from the capitalism-socialism dichotomy, according to Parsons, did not provide the basis for "a rigorous non-deterministic analysis" of individual action or social behavior.[249]

From this pattern-variable principle arose what Parsons refers to as the "primary reference point of all [his] theoretical work," that of the "four-function paradigm."[250] These four functions, or "elementary pattern variables of a social system," are 1) adaptation, 2) system goal-attainment (not unit or individual), 3) integration, and 4) pattern-maintenance and tension-managment. This four-function paradigm was Parson's attempt to deal with the "empirical-theoretical problems that have entered prominently into the critical discussions of this type of theory."[251] That is, the theoretical problem of the neo-deterministic equilibrial systems inherited from Henderson and, later, the homeostasis

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248 Talcot Parsons, "On Building a Social Systems Theory," Daedalus 99 (Fall 1970): 831.

249 Ibid., 843.

250 Ibid., 844.

251 Ibid., 849.

of Cannon. The problem of "consensus vs. conflict" rendered the concept of function itself problematic. For Parsons this came down to a problem of control:

> Clarification of the problem of control, however, was immensely promoted by the emergence, at a most strategic time for me, of a new development in general science-namely, cybernetics in close relation to information theory. It could now be plausibly argued that the basic form of control in action systems was of the cybernetic type and not primarily, as has been generally argued, the analogy of the coercive-compulsive aspects of the process in which political power is involved. Furthermore, it could be argued that functions in systems of of action were not necessarily "born free and equal", but had, along with the structures and process implementing functional needs of the system, differential hierarchical relations on the axis of control.[252]

For Parsons the continuities in the social and biological conceptions of stability and change to evolve together. In 1955 a Harvard graduate student from the Department of Medical Zoology named Stuart Altmann was one of the first to use the term sociobiology to refer to this new way of conceptualizing the social system as a cybernetic communication systems or information processing. Altmann explicitly viewed primate society as a communication system based on the statistical characteristics of information. Cybernetic functionalism permeated his research questions:

> What are the roles of the various sensory modalities in communication? What is the function of the communicative signals in the integration of the society? For every signal: what are the necessary, sufficient and contributory stimuli; what members of of the society respond; and what is their response? What is the relation between communicative feedback and social homeostasis? Are there any social communicative networks that are "self-damping"? Does metacommunication exist? Are

252 Ibid., 850.

> there (a) signals whose only function would be the "acknowledgement" of a signal emitted by another, (b) signals "asking" for a signal to be repeated, or (c) signals "indicating" failure to receive a signal?[253]

In 1956 the sociobiological section of the Ecological Society of America was formally founded.[254] Altmann's work later became the primary material on primates used by Edward O. Wilson in his 1975 book Sociobiology.[255] David Hamburg, a psychiatrist from Stanford University's Medical School, was interested in the implications of communications theory and sociobiology for the study of emotions. As Hamburg conceived of them, emotions were some sort of adaptive complex linked to social evolution.[256] While chairman of the Department of Psychology Hamburg was instrumental in arranging Jane Goodall's chimpanzee studies in the Gombe in Zaire.

In management science the problem of the organizational subject perplexing the discipline in the 1930s was finally resolved. Some management specialists were quite explicit in the source of their ideas. B.G. Schumacher wrote, though

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253 Stuart Altmann, rough draft of research, CRC papers (March 22, 1956) "Monkeys and Other Animal Studies" folder. Quoted in Haraway, "Signs," 183.

254 Haraway, "Signs," 214 n 153.

255 Haraway, "Signs," 183. What is interesting in the ensuing debate over sociobiology is that the criticisms focused attention on what was seen as biological reductionism and a renewed Spencerian social evolution. The epistemological foundations of sociobiology was ignored, namely information processing and communication which theoretically erased the distinction between living and non-living systems and replaced it with a distinction between simple and complex systems.

256 Haraway, "Signs," 182 n 159.

never published, A Sociobiological Approach to Post-Industrial Management.[257] In business management the process of evolution had to be synthesized and the system provided with direction. The goals and choices of individuals within an organization could be considered, in Shannon's informational terms, as combinations and permutations within roughly identifiable parameters. Control-systems theory provided the principles and technologies needed for the identification and shaping of these organizational goals. In the business world and increasingly in the public sector "such a control system was the budget."[258] Control of the budget, understood not only in terms of money but also time, cost and scheduling as well. The budget allowed for the modulation of organizational behavior. Money plays the role of the bit in information theory. Value does not lie in the coinage itself. Coinage is merely the measuring device of currency.

> The budget in a modern large-scale corporation plays two basic roles. On the one hand, it is used as a management control device to implement policies on which executives have decided and to check achievement against established criteria. On the other hand, a budget is a device to determine feasible programs. In either case, it tends to define-in advance-a set of fixed commitments and (perhaps more important) fixed expectations. Although budgets can be flexible, they cannot help

257 B.G. Schumacher, On the Origin and Nature of Management (Eugnosis: Norman 1984), 172. There was a considerable stink raised over sociobiology at this time.

258 Miller and O'Leary, "Accounting,". 260.

> but result in the specification of a framework within which the firm will operate, evaluate its success, and alter its program.[259]

This focus upon the budget should not imply some form of crude economic determinism however. Rather, capitalism has undergone a general transformed along with the art of government. Capitalism is just as much an effect of the transformations of the object of government as other spheres of rational thought and political practice. Deleuze noted that "[t]he operation of markets is now the instrument of social control."[260] To quote Deleuze further:

> nineteenth century capitalism is a capitalism of of concentration, for production and for property. It therefore erects the factory as a space of enclosure, the capitalist being the owner of the means of production but also the, progressively, the owner of other spaces conceived through analogy (the workers familial house, the school). As for markets, they are conquered sometimes by specialization, sometimes by colonization, sometimes by lowering the costs of production. But in the present situation, capitalism is no longer involved in in production, which it relegates to the Third World, even for complex forms of textiles, metallurgy, or oil production. It's a capitalism of higher-order production. What it wants to sell is services and what it wants to buy is stocks. Thus it is essentially dispersive and the factory has given way to the corporation. The family, the school, the army, the factory are no longer the distinct analogical spaces that converge towards an owner - state or private power - but coded figures - deformable and transformable - of a single corporation that now has only stockholders.[261]

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259 R. Cyert and J. March, The Behavioral Theory of the Firm (New Jersey: Englewood Cliffs, Prentice Hall, 1963), 110-111. Quoted in Miller and O'Leary, "Accounting," 260.

260 Deleuze, "Postscript," 6.

261 Ibid.

The irony of societies of control is that the logic of cybernetic information processing systems denies the possibility of certainty - the dream of determinism. Determinism and certainty were the ideals of point mechanical systems based on essential identity. In societies of control determinism and certainty have been replaced by highest probability and correlation. But probability always leaves room for error, signal distortion and the possibility of mutation. Increased manipulatory affectiveness arising from the mastery of probability has thus also been accompanied by the realization of constant potential hazard. The impossibility of determinism and certainty has therefore lead to a state of perpetual crisis and crisis management. Control is always on the verge of panic. In an attempt to head off potential disaster, crisis management in societies of control brings with it a new form of observation.

The reconfiguration of all dynamic processes into cybernetic information processing systems brought with it the discovery (and invention) of the control mechanisms of these system - the program or coding scheme. Though the cause of this reconfiguration is linked to the logic of observation and the responsibility to know the object of government (a logic common to all the arts of government since the late sixteenth century), the effect of this latest reconfiguration was an unprecedented expansion of this logic of observation bringing it to a wholly new level. The will to knowledge operates in (and by) a radical new mode. This new mode of observation we will call profiling.[262]

Observation within the disciplinary mode sought to apprehend the act at the moment it occurred. Disciplinary observation guards against undesirable acts through the constant threat of the act being observed. Profiling, on the other hand, looks at the information code that (statistically) establishes the parameters of a system's processes - its behavior. Choices, or any system behavior for that matter, are understood in the discourse of control as permutations and combinations of predefined sets of code - the program - underlying every (rationally understood) system. Profiling simply seeks to now in advance what the most statistically likely choice or behavior will be. Through reproducing the code of a system and constructing a profile probable system behavior is deduced in advance of its occurring. In societies of control it no longer matters whether the disobedient act is performs or not. The profile reveals its potentialities before hand.[263]

The quintessential example of such profiling is surely

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262 See William Bogard, The Simulation of Survailance: Hypercontrol in Telematic Societies (Cambridge: Cambridge University Press, 1996), especialy chapter 3.

263 The dream of realtime is thus unapproachable. The effort to realize this dream however may turn out to be an important form of normalization in the information age. We are not compelled to seek realtime by an outside political force. We demand it for our competativeness, for our very survival. Realtime is always better than old time but it is always already old. What we are left with is the irony of realtime profiles. This does not deter the desire for realtime however. Witness the amount of money to be spent, in a time of tight budgets and "necessary cutbacks," of database terminals for Missoula's police cruisers just passed in the recent bond issue vote.

the Human Genome Project in the U.S. or the international Human Genome Organization. "The ultimate purpose of [these] programs is to write down the complete ordered sequence of As, Ts, Cs, and Gs - the four nucleotides - that make up all the genes in the human genome."[264] Such knowledge "promises" greater control over our fate. "Genes tell the cells in our body how to act; when a mutation or alteration in a gene changes the information, a cell may function improperly. Identifying the genes and their mutations will provide clues as to which gene causes which negative result. When we know which gene leads to an abnormal condition, we can screen for disease before it occurs - remove a tissue at risk for cancer, treat a patient with drugs, change a diet, or maybe eventually put a corrective gene into a cell."[265]

Gene therapy, like all control technologies, confronts a fearsome opponent - the environment. Cybernetic information processing systems interact with their environment in a symbiotic and mutually constitutive relationship. They require their environment for survival. But the environment is teeming with noise, the potential for errors in coding and signal distortion. The domain of the biological sciences provide a response to the threats posed by the environment that are proving compelling to other disciplines (if that is what we are to continue to call them). "[A] whole new school of thought on cyber-security is emerging. This seeks to mimic

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264 R. C. Lewontin, "The Dream of the Human Genome," in Druckery and Bender eds. Culture on the Brink, 107.

265 Joan Marks, "The Human Genome Project: A Chalenge in Biological Technology," in Druckery and Bender eds. Culture on the Brink, 99.

the a biological immune system. Like a living organism, a public network is made up of lots of complex, diverse and highly interdependent components. Like such an organism, it cannot predict what kind of attack it might suffer next, nor how the infection might evolve. Because the organism cannot simply disconnect itself from the world, it protects itself with a combination of semi-permiable firewalls (a skin and cell membranes), sensors (antigens) and circulating killer agents (antibodies and white blood corpuscles)."[266]

RAND researchers speculate that this may be the only viable approach to the problem of computer security since about 95% of the Pentagons communications travel on the public network.[267] Rand and Pentagon researchers are no strangers to this sort of panic however. The corollary principle that arises with the discovery and invention of profiling is deterrence.

Deterrence, in its modern form, emerged from the military's desire to build profiles of and control over warfare. RAND's invention of computer simulations, first to analyze human-machine interaction in military systems at the McCord Field Air Defense Direction Center in Tacoma, Washington in 1950 and later to develop nuclear warfare strategies, arose in part because of the difficulty of

266 "Cyber Wars," The Economist 338 no. 7948 (January 13th-19th, 1996), 78.

267 Ibid., 77.

planning for something that had never happened before.[268] How could one plan for nuclear war when no one knew what is was like? Preparations for nuclear war, no matter the form it took, were tremendously complex. Coordinating in-flight refueling and equipment propositioning required intricate planning. Such planning could not take place in the dark with no sense of what the process was. Planners need to see the nuclear battle field. The only way to do this was through simulating it.

Control presents the possibility not for perfect order, the dream of disciplinary power, but rather perfect deterrence against disorder, which is to say constant vigilance and, where possible, preemptive intervention. But this is only possible if the code is known. Thus in the modern art of government a premium is placed on the production of knowledge of system coding and programing. In societies of control this technique of knowledge and strategy of government goes by the name information.

268 Edwards, Closed World, 122. The best tools for such analysese are digital computers. The industry, however, was heavily invested in analogue technology and was reluctant to pursue what was then a very unreliable technology. George Brown, a RAND consultant believed RAND's decision to build the Johnniac in 1950 was "the key spur to IBM's decision to commit to digital computer develppment."

Chapter 6: Conclusion

Deleuze notes that "the disciplines underwent a crisis to the benefit of new forces that were gradually instituted and which accelerated after World War II; a disciplinary society was what we already no longer were, that we had ceased to be."[169] The "socio-technological study of the mechanisms of control, grasped at their inception, would have to be categorical and to describe what is already in the process of substitution for the disciplinary sites of enclosure, whose crisis is everywhere proclaimed."[170] This is what I have attempted here, in a small way, through a tracing of the history of statistical reason.

The goal of this paper was to trace the transformation of statistical reason with attention to their mutually constitutive relationship with the arts of government especially the epistemological aspect of this art. For Foucault, observation (or surveillance) is both a technique of supervision but also, and at the same time, a strategy for obtaining the truth. Governmentality illustrates how the practices of governing were also involved in the transformation of the epistemological conception of the object of government.

The first of the arts of government - *raison d'etat* and its object the population - gave way to a liberal art of government and society by way of the Physiocrats and their illustration of the economy separate from the will of the

169 Deleuze, "Postscripts," 7.

170 Ibid.

sovereign. These forms of government and their objects are drastically different things. The development and growth of the various disciplines producing knowledge about society lead to yet further transformations of the object of government.

The classical economists mark the emergence of a wholly new object of government - that of society - accompanied by a new art of governing this object- liberalism. Liberal governance constituted an unprecedented degree of freedom of activity for its object - as long as such activity conformed to the norm. This freedom was predicated on a very close relationship between the norm, revealed by statistical methods, and the ability of government to induce normal behavior, often through non-direct interventionary measures such as infrastructural development. Foucault called this form of government disciplinary. The search for more accurate counting procedures and techniques for knowing and intervening in society to assure its proper functioning soon lead to the overturning of determinist epistemology. Determinism had played a fundamental role in legitimizing rationality. Determinism and natural law had actually been the very basis of reason itself.

By the end of the nineteenth century determinism was under intense scrutiny. Simply put, determinist epistemology was no longer producing useful and affective knowledge. The crisis of determinism was not an isolated phenomena. This state of affairs was brought about in all rational knowledge producing disciplines; the physical, natural and social sciences. This crisis of determinism made the epistemological basis of the disciplinary form of government problematic for the norm was a deterministic principle.

The norm as a determining force sounds ludicrous today. But such was the conception of how the normal worked. The process of rendering the norm rational in terms we recognize today is the same process that produced the replacement epistemological for the norm. This epistemological aspect of government is called control.

These transformations have never ceased, they have continued into our present time leading to the current state of transition from disciplinary government knowledge to a government and knowledge of control. In the emerging art of government of control, the strategy of truth appears to be the strategy of information. It should be pointed out that this emerging epistemology holds within it its own form of analysis. Essentialist or neo-essentialist modes of knowing a system such as the prevailing structural-functional accounts of social change will not elaborate and will most likely obscure modern forms of control.

Control is based upon a new formulation of system and process that is non-essentialist. A modern complex system is understood as a set of variables selected by an observer together with a set of constraints effecting these variable. These variables themselves are relationships depicting an organization. a particular organization may take the form of many different kinds of structures generally delineated as complex (energetically and informationaly open) systems such as biological, technological or social or simple (energetically and informationaly closed) systems such as gases in a closed container. A simple system, the classic mechanical system first analyzed by thermodynamics, contains unites (molecules in the case of gases) whose arrangement is independent of the other units in the system. Complex systems, on the other hand, are constituted by units (which are themselves understood to be subsystems) whose arrangement is heavily dependent on the position of other units in the system such as a crystal or an organism. The interconnection and interdependence of the units in a complex system limits the possible states a system may occupy. This limitation also provides the negatively entropic effects observed in living phenomena. In both kinds of systems statistical rationality is the key component analysis. Simple systems are approached by ascertaining the randomness of the spread of units while complex systems are approached by ascertaining the probability distribution of possible future states defined by the relationships between system components. That is, the systems degree of freedom of the system defined in terms of the possible future states or arrangements the system may occupy.

In governmental terms control is not yet exercised upon society as a whole, at least not consciously. Narrow slices of society such as work performance or the construction of infrastructures which enhance specific forms of activity and behavior, especially as concerns business and government. In this sense information is collected and control is exercised through parameter or frequency modulation, the production of profiles and the techniques or tactics of deterrence. Avenues of communication are established in certain areas while hindered in others.

An example of this narrow application, which nonetheless has far reaching effects and implications, is exhibited in a recent issue of the Institute of Electronic And Electrical Engineers (IEEE) journal IEEE Transactions On Systems, Man, And Cybernetics of May 1997. The lead article in this special issue titled "Human Interaction with Complex Systems: Design Issues and Research Approaches" notes that "design, which consciously and purposefully supports human interaction with complex systems, rather than simply the use of new technology at the human-system interface, is a critical issue for the research community."[271] In other words, the new object of government - complex systems - need to be understood in order to govern them properly, to bring out the right order of things and to enhance prosperity.

Perhaps the most well known promoter of the new technologies of government was Robert S. McNamara appointed Secretary of Defense by president John Kennedy. During World War II McNamara worked in the Statistical Control Office of the Army Air Corps planning the logistics of bombing raids in Germany and later the Far East. He increased the flying time of bombers by 30% using statistical systems analysis. He joined Ford Motor Company bringing with him a troop of "whiz kids" from the Statistical Control Office. McNamara appointed

271 Christine Mitchel, and Gunilla A. Sundstrom, "Human Interaction with Complex Systems: Design Issues and Research Approaches," IEEE Transactions On Systems, Man, And Cybernetics 27 no. 3 (May 1997): 265.

the RAND economist Charles Hitch to be the Pentagons comptroller. Together they set up the Office of Systems Analysis and instituted the the Planning-Programming-Budgeting System (PPBS) introducing modern budgeting and cost-benefit analysis to the defense establishment.[272] Lyndon Johnson considered the PPBS so successful that he ordered all federal agencies to adopt it in 1965.[273]

This reform of the federal bureaucracy seems to have had the desired effect. to illustrate this success we can choose a (unwittingly) postmodern interpretation of the effects of these budgetary reforms. Daniel Carpenter, an Assistant Professor of Politics at Princeton University writes in a recent issue of American Political Science Review that "the magnitude of agency response to budgetary signals increased for executive-branch agencies after 1970 due to executive

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272 Command and management became nearly identical procedures. "Every professional military man" according to Lieutenant Colonel David Ramsey Jr., "has heard the theory expressed that management and command are essentially the same thing. Chances are better than even, in fact, that he has never heard any serious dissent from the proposition that the terms command and management are synonymous, or nearly so." Lieut. Col. David Ramsey Jr., U.S. Army, "Management or Command?," Military Review, V. 41, N. 10 (1961), 31. Quoted in Edwards, Closed World, 130. The military did not simply adopt a corporate management technique, however. Rather, corporate management and military command have both felt the effects of the general epistemological transformation in their respective objects of interest. In theory and practice, the new epistemological a-priori of cybernetic information systems, has permeated all rational thought to one degree or another. The object of this rational thought brings with it a new form of government characterized by control.

273 Ibid.

oversight reforms."[274] He notes "[c]control over agency budgets is a critical tool of political influence in regulatory decision making, yet the causal mechanism of budgetary control is unclear."[275] To discover this "causal mechanism" Carpenter advances a "stochastic process model of adaptive signal processing."[276]

Carpenter found that manipulation of aggregate resources in themselves did not account for agency control. Rather, the causal mechanism was the "powerful signals" sent via budgetary shifts. The responsiveness to such signaling, furthermore, was enhanced by the hierarchy of the agency. The greater the hierarchy and consolidation, in other words, the greater the responsiveness to budgetary signals from message senders in congress and the administration. What is most interesting about Carpenter's study, however, is not just his findings but his methodology. Information processing and systems theory used to analyze information processing systems would, it seems be appropriate.

Statistics has been intimately involved in these transformations in the art of government and its object and the transition from an epistemology of discipline to one of control. Statistical methods and statistical reason, however, have never had a distinct form, an essence as it were. Their history is a history of transformation of both thought and

274 Daniel Carpenter, "Adaptive Signal Processing, Hierarchy, and Budgetary Control in Federal Regulation," American Political Science Review 90, no. 2 (June 1996): 283.

275 Ibid.

276 Ibid.

practice. No doubt they will continue to change. But the current form of the art of government and its object and the role played by statistical reason and practices in this new form can be apprehended, at least in a general way. But only if we look past surface effects.

Statistics plays a fundamental role in technologies of control. Besides being fundamental to the specific theory of control illustrated above, statistical techniques are vital for simulations and forecasting of every kind - such as financial forecasting in the global market to forecasting the needs of future communications systems, both permanent and temporary.[277] Ergonomics, also known as human factors engineering, is the extension of wartime discoveries of human performance and machine interaction understood in terms of probability and optimalization. As a distinct discipline it began as the adaptation of humans and mechanical devices in the workplace. It has become familiar to most people as an aspect of health, especially in terms repetitive tasks associated with computer monitors and keyboards. But Ergonomics has a much broader scope than comfortable desks, chairs and keyboards. A recent article in Ergonomics, the publication of record for the discipline, notes that "the history of ergonomics can be described as military ergonomics in the 1950s, industrial ergonomics in the 1960s ergonomics of consumer goods and services in the 1970s and computer ergonomics in the 1980s. It is expected that the 1990s and

277 The military, for example, is experimenting with genetic algorithms to determine optimum battlefield communications configurations. Tony Chang, "Genetic Algorithms in Battlefield Communications," PCAI, (September-October): 28.

early 2000s will be the phase of both macroergonomics and cognitive ergonomics"[278] There are many other instances of statistical techniques operating in the background of every day life subtly altering our ways of behaving.

The current period has been variously described as a post-industrial society, an information revolution or simply the information age. Most of these discussions tend to focus on the production of information as simply another commodity. A commodity that sometimes helps, and sometimes hinders, an otherwise familiar economy of production and society composed of individuals with an essential and universal human nature. Indeed there are many businesses making fortunes marketing information on these premises. Because of the expansion of the amount and availability of stored data a new sector has been added to the economy - the information economy. But these descriptions of information and an information based society do not adequately explain what is new in modern society or how the two are related or the effect of this relationship. It certainly does not provide a basis for critique or active (ethical) participation in modern life.

I believe the information age is not adequately characterized simply by an increase in some "thing" called information. The information age must be seen as the emergence of a new way of conceiving of and governing complex systems, whether human society or individual genetic traits. The epistemology of essentialism and its principles of identity and determinism collectively manifested in terms of,

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278 Hal Hendrich, "Future Directions in Macroergonomics," Ergonomics 38 no. 8 (August 1995): 1617.

and thereby governed through, the norm has given way to the epistemology of probability with its principle of contingency manifested in and governed through information and control and the tactics of profiling and deterrence. This is not to say that attention to remaining essentialist epistemology and practices should be ignored. Abhorrent ethico-political effects continue to arise from essentialist distinctions such as the exclusion and marginalization well documented in feminist and "postmodern" literature. However many abhorrent effects are arising from the new practices of control which cannot be understood and resisted if these are analyzed as if they too emerge form essentialist epistemology. They do not. What we are witnessing in this transition from an epistemology of essentialism to information, I suggest, is the emergence of a new object of government - a cybernetic information processing system - and a new art of government ruling this object - a government of information and control. This form of government does not seek exclusion but inclusion. The question is what form and what purpose this inclusion supports.

SELECTED BIBLIOGRAPHY

Axinn, June, and Herman Levin. Social Welfare: A History of the American Response To Need. 2d ed. New York: Longman, 1982.

Barry, Andrew. "Lines of communication and spaces of rule." In Foucault And Political Reason: Liberalism, Neo-liberalism and Rationalities of government. Edited by Andrew Barry, Thomas Osborne, and Nikolas Rose. Chicago: University of Chicago Press, 1996.

Bertalanffy, Ludwig von. General systems Theory: Foundations, Development, Application. Revised edition. New York, George Braziller, 1968; fourth printing 1973.

Bogard, William. The Simulation of Survailance: Hypercontrol in Telematic Societies. Cambridge: Cambridge University Press, 1996.

Bramwell, Anna. Ecology in the 20th Century: A History. New Haven: Yale University Press, 19879.

Buck-Morss, Susan. "Envisioning Capital: Political Economy on Display." Critical Inquiry 21 (Winter 1995):434-467.

Burchell, Graham. "Liberal Government and Techniques of the Self." Foucault And Political Reason: Liberalism, Neo-liberalism and political rationality. Edited by Andrew Barry, Thomas Osborne, and Nikolas Rose. Chicago: University of Chicago Press, 1996.

Burchell, Graham, Colin Gordon, and Peter Miller, Ed. Foucault Effect: Studies In Governmentality With Two Lectures By And An Interview With Michel Foucault. Chicago: University of Chicago Press, 1991.

Carpenter, Daniel "Adaptive Signal Processing, Hierarchy, and Budgetary Control in Federal Regulation." American Political Science Review V. 90, N. 2 (June 1996): 283-302.

Cassirer, Ernst. The Logic Of The Humanities. New Haven: Yale University Press, 1960, fifth printing, 1974.

Chang Tony, "Genetic Algorithms in Battlefield Communications." PCAI (September-October 1997): 28-30.

"Cyber Wars." The Economist. V. 338 N. 7948 (January 13th-19th, 1996): 77-78.

Dean, Mitchell, Critical and Effective Histories: Foucault's Methods and historical Sociology. New York: Routledge, 1994.

Deleuze, Gilles, "Postscript on the Societies of Control." October 59 (1992): 3-7.

Dyson, George, Darwin Among the Machines: The Evolution of Global Intelligence. Massachusetts: Addison-Wesley Publishing Co. Inc., 1997.

Edwards, Paul. The Closed World: Computers and the Politics of Discourse in Cold War America. Massachusetts: The MIT Press, 1996.

Edwards, Paul ed. The Encyclopedia of Philosophy. V. 1 New York: Macmillan Publishing Co., 1967. S.v. "Bergson, Henri" by T.A. Goudge.

________. The Encyclopedia of Philosophy V. 2 New York: Macmillan Publishing Co., 1967. S.v "Bernard, Claud," by W. M. Simon.

________. The Encyclopedia of Philosophy V. 1 New York: Macmillan Publishing Co., 1967. S.v. "Boltzmann, Ludwig," by Paul Feyerabend.

________. The Encyclopedia of Philosophy V. 1 New York: Macmillan Publishing Co., 1967. S.v. "Boutroux, Emile," by Colin Smith.

________. The Encyclopedia of Philosophy V. 2 New York: Macmillan Publishing Co., 1967. S.v. "Darwinism," by Morton O. Beckner.

________. The Encyclopedia of Philosophy V. 2 New York: Macmillan Publishing Co., 1967. S.v. "Entropy," by G. J. Withrow.

________. The Encyclopedia of Philosophy V. 3 New York: Macmillan Publishing Co., 1967. S. v. "Haeckel, Ernst Heinrich" by Rollo Handy.

________. The Encyclopedia of Philosophy V. 3 New York: Macmillan Publishing Co., Inc. 1967. S.v. "Holbach, Paul-Henri Thiry, Baron D'," by Aram Vartanian.

________. The Encyclopedia of Philosophy V. 5 New York: Macmillan Publishing Co 1967. S.v. "Maxwell, James Clerk," by Arthur Woodruff.

________. The Encyclopedia of Philosophy V. 7 New York: Macmillan Publishing Co., 1967. s. v. "Quantum Mechanics: Philosophical Implications of," by Norwood Hanson.

Fabian, Johannes. Time and the Other: How Anthroplogy Makes Its Object. New York: Columbia University Press, 1983.

Foucault, Michel. The History of Sexuality Volume 1: An Introduction. Translated by Robert Hurley. New York: Random House, Pantheon Books 1978; Reprint, vintage Books, 1990.

________. Power/knowledge: Selected Interviews And Other Writings 1972-1977. Edited by Colin Gordon. New York: Pantheon Books, 1980.

________. "Space, Knowledge, Power." Interview by Paul Rabinow, Translated by. Christian hubert. The Foucault Reader. Edited by Paul Rabinow. New York: Pantheon Books, 1984.

________. Technology Of The Self: A Seminar with Michel Foucault. Edited by Luther H. Martin, Huck Gutman, and Patrick H. Hutton. Amherst: University of Massachusetts Press, 1988.

________. Foucault Live. Edited by. Sylvere Lotringer. Translated by John Johnston. New York: Semiotext(E), 1989.

________. "Governmentaly." Foucault Effect: Studies In Governmentality With Two Lectures By And An Interview With Michel Foucault. Edited by Graham Burchell, Colin Gordon, and Peter Miller. Chicago: The University of Chicago Press, 1991.

________. Discipline and Punish: The Birth of the Prison. Translated by Alan Sheridan. London: Pantheon, 1977; reprint, New York: Vintage Books, 1995.

George, F. H.. Automation Cybernetics and Society. New York: Philosophical Library, 1959.

Gleick, James. Chaos: Making A New Science. New York: Vicking Penguine Books, 1987; Penguine Books, 1988.

Golly, Frank Benjamin. A History of The Ecosystem Concept In Ecology: More Than the Sum if the Parts. New Haven: Yale University Press, 1993.

Gordon, Colin, "Governmental Rationality: An Introduction." In Foucault Effect: Studies In Governmentality With Two Lectures By And An Interview With Michel Foucault. Edited by Graham Burchell, Colin Gordon, and Peter Miller. Chicago: University of Chicago Press, 1991.

Hacking, Ian, The Emergence of Probability: A philosophical Study of the Early Ideas About Probability, Induction and Statistical Inference. New York: Cambridge University Press, 1975.

________. "Biopower And The Avalanch of Printed Numbers." Humanities In Society V. 5 No. 304 (Summer & Fall 1982): 279- 295.

________. The Taming of Chance. Cambridge: Cambridge University Press, 1990, reprint, 1991, 1992.

Haraway, Donna. "Signs of Dominance: From Physiology to a Cybernetics of Primate Society, C. R. Carpenter, 1930-1970." Studies in History of Biology. Edited by William Colman and Camille Limoges. Baltimore: The Johns Hopkins University Press, 1983.

Henderson, L.J. The Fitness of The Environment: An Inquiry into the Biological Significance of the Properties of matter. New York: Macmillin Co., 1913

Hendrich, Hal. "Future Directions in Macroergonomics." Ergonomics V. 38 N. 8 (August 1995): 1617-1625.

Jacob, Francois. The Logic of Life: A History of Heredity. New York: Pantheon Books, 1973.

Kuhn, Thomas. The Structure of Scientific Revolutions. Chicago: University of Chicago Press, 1962; Pheonix Books, 1965.

________. The Essential Tension:Selected Studies in Scientific Tradition and Change. Chicago: Chicago Universtiy Press, 1977.

Lakoff, George. Women, Fire, And Dangerous Things: What Categories Reveal About The Mind. Chicago: University of Chicago press, 1987; Paperback edition 1990.

Lewontin, R. C.. "The Dream of the Human Genome." Culture on the Brink. Edited by Gretchen Bender and Timothy Druckery. Seattle: Bay Press, 1994.

Losee, John. A Historical Introduction to the Philosophy of Science. New York: Oxford University Press, 1972; Reprinted 1988.

Lowie, Robert H.. The History of Ethnological Theory. New York: Rinehart & Co. Inc., 1937.

Machiavelli, Niccolo, The Prince. Edited by Quentin Skinner and Russell Price. Cambridge: Cambridge University Press, 1988.

Marks, Joan "The Human Genome Project: A Chalenge in Biological Technology." In Culture on the Brink. Edited by Gretchen Bender and Timothy Druckery. Seattle: Bay Press, 1994.

Meetham, A. R ed. Encyclopedia of Linguistics Information and Control. Oxford: Pergamon Press, 1969. S.v. "Communication Theory," by P. M., Woodward.

Nehenevajsa, J. "sociometry: Decades of Growth." Sociometry Reader Edited by J. L. Moreno and others. Illinois: The Free Press, 1960.

Moreno, J.L.. "Social and Organic unity of Mankind." In Sociometry Reader Edited by J. L. Moreno and others. Illinois: The Free Press, 1960.

Morris, Charles. Sign, Language and Behavior. New York: Prentice Hall, 1946.

Mueller, John, Karl Schuessler, and Herbert Costner, eds. Statistical Reasoning in Sociology. Boston: Houghton Mifflin Co., 1977.

Noble, David F.. America By Design: Science, Technology, and the Rise of Corporate Capitalism. Oxford: Oxford University Press, 1977; Paperback edition, Alfred A. Knopf 1979.

Osborne, Barry, and Nikolas Rose. "Introduction." In Foucault And Political Reason: Liberalism, Neo-liberalism and political rationality. Edited by Andrew Barry, Thomas Osborne, and Nikolas Rose. Chicago: University of Chicago Press, 1996.

Parascandola, John. "Organismic and Holistic Concepts in the Thought of L.J. Henderson." Journal of history of Biology 4 (1971): 63-118.

Parsons, Talcot. "On Building a Social Systems Theory." Daedalus 99 (Fall 1970): 826-881.

Pasquino, Pasquale, "Theatrum Polititicum: The Genealogy of Capital - Police and the State of Prosperity." In Foucault Effect: Studies In Governmentality With Two Lectures By And An Interview With Michel Foucault. Edited by Graham Burchell, Colin Gordon, and Peter Miller. Chicago: The University of Chicago Press, 1991.

Miller, Peter and Ted O'Leary "Accounting and the Construction of the Governable Person." Accounting Organizations and Society V. 12, No. 3, (1987): 235-265.

Mitchel Christine, Member IEEE, and Gunilla A. Sundstrom, Member IEEE, "Human Interaction with Complex Systems: Design Issues and Research Approaches", IEEE Transactions On Systems, Man, And Cybernetics V. 27 N 3 (May 1997): 265-273.

Pierce, J R.. Symbols, Signals and Noise: The Nature and Process of Communication. New York: Harper and Row Publishers, 1961.

Plato. Republic. Translated with an introduction by Francis Macdonald Cornford. New York: Oxford University Press, 1941; Twenty seventh printing, 1965.

Prigogine, Ilya and Isabella Stengers Order out of Chaos: Mans New Dialogue With Nature. with a forward by Alvin Toffler. New York: Bantam Books, 1984.

Rabinow, Paul, ed. The Foucault Reader. New York: Pantheon Books, 1984.

Rose, Nikolas and Peter Miller "Power Beyond the State." British Journal of Sociology V. 42 No. 2, (June 1992): 173-205.

Rude, George, The Crowd in History, 1730-1848. New York: John Wiley & Sons, Inc., 1964.

Ruse, Michael. The Darwinian Revolution: Science Red in Tooth and Claw. Chicago: The University of Chicago Press, 1979.

Russett, Cynthia Eagle. The Concept of Equilibrium In American Social Thought. New Haven, Yale university Press, 1966.

Scarry. Elaine. "The Merging of Bodies and Artifacts in the Social Contract." In Culture on the Brink: Ideologies of Technology. Edited by Gretchen Bender and Timothy Druckery. Seattle: Bay Press, 1994.

Schumacher, B.G.. On the Origin and Nature of Management. Oklahoma: Eugnosis, 1984.

Sebeok, Thomas. The Sign & Its Masters. Austin: University of Texas Press, 1979.

Sklar, Lawrence. Physics And Chance: Philosphical Issues In The Foundations Of Statistical Mechanics. New York: Cambridge University Press, 1993; Paperback edition, 1995.

Soule, George. Ideas of the Great Economists. New York: Mentor Books, 1955.

Stigler, Stephen. The History of Statistics: The measurement of Uncertainty Before 1900.Cambridge: The Belknap Press of Harvard University Press, 1986.

Weaver, Warren, and Claud Shannon. The Mathematical Theory of Communication. Chicago: University of Illinois Press, 1949; Illni Books, 1963.

Wilden, Anthony. System and Structure: Essays in Communication and Exchange. 2d ed. London: Tavistock Publications Ltd.,1972; reprinted 1980.