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*Machiavelli, Leonardo, and the Future of Modernity**

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Over the last decade, there have been numerous transformations in world affairs. Numerous events -- including the end of Soviet communism and the cold war, the emergence of a global market economy, explosions of ethnic violence, terrorism, and xenophobia, radically new information technologies, and changing political systems -- have led some to speak of the "end of history." To assess this notion, it is useful to reconsider the origins of modernity, which can be symbolized by the intersecting careers of Leonardo da Vinci and Niccolò Machiavelli. These two extraordinary minds foresaw and actively proposed what came to be the typically "modern" social and political order, based on the fusion of pure science and technology. The resulting union of theory and practice coincided with transformations in both military technology (cannon and gunpowder) and communication (printing). The result destroyed the foundations of medieval society by fostering social equality and large-scale communities governed by centralized bureaucracies. In politics, the modern epoch has been characterized by the nation-state, in which the dominant political systems control stable territorial units with large populations identified by language and culture. In the last years of the 20th century, we are witnessing a double transformation of military and communications technologies, reversing the trends begun in the late 15th century. If this view is correct, we can anticipate changes in the theories and practices of politics. In the realm of political opinions, both Lockean liberalism and Marxian socialism, as well as the ideologies that have developed from them, will become increasingly anachronistic. In practice, regimes will be characterized by socio-economic and cultural inequality and geopolitical fluidity, more akin to pagan antiquity or the middle ages than to politics since the revolutions of 1776 and 1789. In political philosophy, such transformations will necessitate a return to the ancient distinction between theoretical and practical wisdom -- and therewith a qualification if not abandonment of the quest for what Bacon called "the conquest of nature" for the "relief of man's estate."

I. Machiavelli, Leonardo and the Origins of Modernity

While there have been many definitions of "modernity," I wish to focus on characteristics that have been shared by regimes of different ideologies and distinct political systems in both Europe and North America.

Over the last three centuries, these societies developed a unique combination of scientific knowledge, technical expertise, and political practice. In prior epochs, these three domains of human activity were largely distinct. Modern civilization, by contrast, can be characterized in good part by the capacity to integrate abstract theoretical science, practical technology, and social organization.¹

Although most of us usually take this unification of theory and practice for granted, it has played a central role in our civilization. The results have included hitherto unimagined control over natural phenomena, the extension of Western political and cultural influence to virtually every known human population, and the emergence of a truly global market economy. The institution of the nation-state has been accompanied by ideological mobilization of massive populations and military conflicts, including two World Wars, that dwarf all prior violence in human history. With the end of the global rivalry between communism and Western capitalism, however, there is reason to believe that our cultural and historical epoch is at a major turning point.

To assess the future, we can gain perspective by considering the origins of modern industrial civilization. Although Western culture is rooted in a combination of the Judeo-Christian and classical Graeco-Roman traditions, the persistence and vitality of medieval Europe suggests that this combination in itself did not foreordain modernity. While the beginnings of industrial commerce and the nation-state can be traced to various developments in the later middle ages, their fusion into a unique civilization finally took form during the renaissance and the century of political and religious warfare that accompanied the reformation.

In a recent volume entitled *Machiavelli, Leonardo, and the Science of Power*, I have argued that these transformations were symbolized by the careers of two great figures in the Florentine renaissance: Leonardo da Vinci and Niccolò Machiavelli.² Although it is not generally recognized, Leonardo and Machiavelli were contemporaries whose paths crossed between 1502 and 1507, when Machiavelli was a leading official in the republican government of Florence and Leonardo, having left Milan following the defeat of Ludovico Sforza, served briefly as military architect and technical advisor to Cesare Borgia before returning to work in his native Florence. A brief summary of this remarkable story will suggest why their experiences can give us surprising insight into the contemporary situation.

Machiavelli apparently met Leonardo in the fall of 1502, when both were with Cesare's court in Imola. Because Piero Soderini and the Florentine

Signoria feared Cesare's developing army, Machiavelli had been dispatched to Imola to keep an eye on the mercurial and brutal son of Pope Alexander. Shortly thereafter, Leonardo left Cesare's service and returned to Florence, where he was engaged on a number of projects in collaboration or contact with Machiavelli. The most important of these was an attempt to redirect the Arno river to defeat Pisa. Official documents prove both that Machiavelli was responsible for the execution of this project and that, to confirm its feasibility, Leonardo visited the site in July 1503. Although Leonardo's *Notebooks* contain maps of the Arno and other extensive research into methods of redirecting the river, this attempt failed for reasons spelled out in a memoire by Machiavelli's assistant Buonaccorsi. Leonardo also collaborated with Machiavelli in rebuilding the fort of La Veruccha, a strategically important site outside Pisa, and in a military assistance mission to Piombino. Finally, Machiavelli played a role in Leonardo's commission to paint "The Battle of Anghiari," the ill-fated fresco in the Great Council Hall of the Palazzo Vecchio which Cellini described as a "school of the world."³

These experiences left a mark on Machiavelli. Leonardo's *Notebooks* demonstrate that the great artist-scientist-inventor had been active in devising technical schemes of city planning and socio-economic development for Sforza in Milan as well as countless ideas for airplanes, industrial tools, weapons, military and civilian architecture, and domestic conveniences. These plans (and most notably the notes on maps intended to serve as the foundation for regional economic development) suggest that Leonardo worked out the broad outlines of the what Bacon later described as a political regime based on the scientific "conquest of nature."

Machiavelli's enthusiastic support and direction of the ill-fated scheme to rechannel the Arno in 1503-1504 seemingly reflected this same optimistic view of science and technology. The project collapsed, in part because the architect in charge at the site (Colombino) did not follow plans like those found in Leonardo's *Notebooks*, and in part because Soderini and the Signoria were not willing to devote the full resources needed. By 1506, Machiavelli was writing a friend that humans could never "conquer" or control nature fully because we are unable to control *our own natures*. Individuals are bold or cautious, intelligent or foolhardy -- and leaders often succeed only when the necessities of the situation fit their personalities or natures.⁴

The lesson of these experiences was distilled in Chapter 25 of *The Prince*. Founders like Moses can control the "river" of "fortune" by digging "dikes and dams" (like the earthworks Machiavelli sought to use to redirect the Arno) -- but they can only control "about half" of fortune. Whereas an optimist like Leonardo dreamt of the total success of a

combination of natural science, technology and political power, Machiavelli saw the potential of this typically modern synthesis while retaining a realistic sense of its limits. Both shared, however, the goal of bridging the gap between theoretical wisdom (be it philosophy or theology) and technology or practice which characterized pagan antiquity as well as medieval Christianity.

In addition to envisioning what came to be viewed as "modernity," Machiavelli and Leonardo each contributed to the emergence of early "modern" nation-states. To be sure, Machiavelli failed to create a successful citizen army and thereby to found a lasting republic in Tuscany capable of expanding its power to Northern Italy. But in 1529, Thomas Cromwell apparently brought a manuscript of the unpublished *Prince* to Henry VIII -- and, according to Sir Reginald Pole, this text guided Henry in the remarkable transformation of his policies leading to the suppression of the monasteries, the expansion of royal control, and the emergence of the English national state in its modern form. And even if this story is contested, one can hardly deny that by the end of the 16th century, no astute statesman was unaware of the Machiavellian transformation of statecraft.⁵

Although most of Leonardo's practical schemes were also failures, he too had influence on a powerful king as well as a more diffuse contribution to Western thought. Leonardo spent his last three years in almost daily conversation with the King François I, generally acknowledged as the founder of the modern French state. When he died in Amboise in 1519 -- in the King's arms according to Vasari -- Leonardo had thus had ample occasion to advise a monarch directly on the means of linking science and technology with political power. More broadly, although Leonardo's legacy was transmitted primarily by an oral tradition rather than through books (even the *Treatise on Painting* was not published until the 16th century), it is generally admitted that his influence was incalculable in virtually every field of science, technology, and art if not in politics narrowly defined.

I do not pretend, of course, that all features of modernity were caused uniquely by the inventive genius of these two Florentines. For my argument, it is enough to suggest that the thought and experiences of Leonardo da Vinci and Niccolò Machiavelli foreshadow and symbolize the origins of our era of industrialized nation-states. If so, perhaps they can help us see something that has become as invisible as the air we breathe. Why did modernity arise? What was it that led Leonardo and Machiavelli to envisage a profound reconstruction of society and government, using insights of theoretical science as guides to human practice?

II. The Origins of the Modern Nation-State

At one level, contemporary societies are characterized by the form of organization known as the "nation-state." Large-scale populations sharing a language and culture are united by a centralized political regime. To understand the future of these typically modern regimes, it is instructive to look more closely at their beginnings. According to many textbooks, it was Machiavelli who first introduced our concept of "the state" (*lo stato*). In fact, we can now see that the conceptual innovations underlying modern politics owed more than has been realized to the experiences just described.

In the last decade of the 15th century, while working in the service of Duke Ludovico Sforza of Milan, Leonardo da Vinci explored the design of a new form of regime based on technological control of nature and large scale urban planning. Among these plans were maps on which he outlined a grandiose scheme for redirecting the Arno River in order to expand and regularize agricultural output. And on these maps (some of which were discovered only in the 1970's in Madrid), Leonardo summarized the laws and regulations necessary for the resulting society. To extend the economic and social benefits of a scientific control of nature to a large population, rules would be needed to insure funding and maintaining such collective goods as dams (enabling control of water supplies for agriculture) and urban infrastructure (needed to control the ever-present risks of disease in large cities).

Leonardo's projects were thus political as well as scientific and technological. They can be considered one of the earliest instances -- and perhaps the first clear case -- of what was to become the Baconian project of using science and technology to "conquer nature" in order to ensure "the relief of man's estate." As in modern industrial society, Leonardo imagined that individuals would be attracted by self-interest and the quest for social advancement to expand the wealth of the community and therefore to strengthen the domestic as well as foreign power of those in power.

It is of interest that Leonardo's projects for Ludovico Sforza included the development of the Arno valley, for this implies the expansion of Milanese control to include Tuscany. An expansion of wealth seemingly required an expansion in the size of regime, even if it might entail the loss of Florentine independence. In the last years of the 15th century, the French invasion of Italy suggested the possibility that small city-states were no longer militarily viable. By 1512, when both Sforza's Dukedom in Milan and Soderini's republic in Florence were overthrown (thereby depriving both Machiavelli and Leonardo of positions of power), the problem of scale in political and

military organization was more visible than ever before. Perhaps this helps explain why, in Chapter 26 of *The Prince*, Machiavelli openly espouses what has come to be called the "nation-state."

Both Leonardo and Machiavelli seem to have understood that political regimes would not be stable and self-supporting unless they expanded in scale to encompass an entire linguistic and cultural community. For my argument, it is irrelevant whether this common theme was the result of direct conversation between the two, or merely a parallel reaction as two men of genius observed the fundamental transformations in Europe at the end of the 15th century. What matters is that we can find, in the *Notebooks* of Leonardo and the *Prince*, *Discourses*, and *Art of War* of Machiavelli, ample evidence that both perceived basic transformations to be occurring in European society -- and that both based their radical proposals on the necessities created by these deep-seated changes.

To explore these changes, I will use the ancient Greek term *techne* to describe the ensemble of practices, skills, and information associated with action, combining what we call "technique" (or know-how) and "technology" (material tools and productive systems). For philosophers like Aristotle, science or theoretical knowledge -- the quest to understand and explain natural phenomena -- was sharply contrasted with practical wisdom and judgment. In particular, knowing was distinct from (and superior to) making or doing. How, then, was the gap between scientific theory and *techne* overcome?

I suggest the answer lies in transformations in three domains of *techne*: the means of controlling natural necessity (*productive techne*, making available machines, goods and services for human use), the means of communicating force (the weapons, tactics, and strategy that comprise *military techne*), and the means of communicating ideas (the *social techne* of disseminating and coordinating the elements of practical culture). Productive *techne* provides control over supplies of food, water, and all commodities of life, whether necessities or luxuries. Military *techne* is necessary to protect the society and its members, both from dissidents within and from enemies without. Social *techne* is needed to communicate and regulate other elements of culture, generating legitimacy for social rules and thereby making it possible to expand the scope of effective communities.

As the failures of both Leonardo and Machiavelli indicate, it is perhaps an error to focus -- as we usually do -- on productive *techne*: a genius who understands how to transform human practice will have no effect unless these innovations can be transmitted to others and their benefits preserved for the next generation. Hence, I will argue, the key innovations underlying the

modern nation-state took place in the domains of social and military techne. In both areas, as I will show, techne can influence the strength and scope of centralized governments by altering the relative advantages of the offensive and defensive forces of rival societies.

The case is clearest with regard to military techne. Leonardo originally presented himself to Ludovico Sforza as an inventor of novel weapons and defenses, and was employed by Cesare Borgia as "military architect." His *Notebooks* contain many military inventions that were only realized over the last century, including tanks, airplanes, mortars, shrapnel, and machine guns. By 1503, when he returned to Florence and worked with Machiavelli on the fortifications of La Veruccha, Leonardo had come to understand that cannon had totally transformed the dialectic of warfare, requiring among other things the redesign of castles and other defensive fortifications.

Throughout the middle ages, a well-fortified castle -- especially if supplied with water and food -- could be largely impregnable as long as it was not betrayed by one of its defenders. This meant, of course, that a local lord or seigneur could claim independence from central authority whenever he was willing to challenge central authority at all costs. It followed that the scope of political control depended more on the character and skill of the ruler than on the structure of the regime or the customs, language, and economic interests of the governed. An outstanding leader like Charlemagne expanded rule, but the extent of this power evaporated in the hands of weak successors.

The invention of cannon changed all this. Once a castle wall could be breached by cannon-fire, a king could use larger military forces to overcome a rebellious baron or lord no matter how valiant the latter might be. No longer did the defense have an ultimate military advantage over the offence. Both Leonardo and Machiavelli explicitly recognized the importance of this transformation of military techne into an instrument of advantage for the offense.

For Leonardo, new fortifications were required -- and he was the first to design them. The medieval fortress had high, thick walls. Its defenders could not, therefore, use the new cannon without leaving the protection of the castle walls. In contrast, attackers could destroy those walls from a distance with massive artillery. Leonardo therefore proposed new fortifications, with low walls (so that defenders could fire cannon over the defensive perimeter to keep the enemy at a distance); in place of the square redoubt of the medieval castle, he also conceived of walls that were curved or angled, so that enemy shells might bounce off harmlessly.

Machiavelli explicitly endorses these new ideas in *The Art of War* and *Discourses*, but he sees an added dimension of the military balance. Medieval battles were often the affair of small numbers of soldiers on each side; even when large armies met, often an encounter between a handful of nobles (perhaps including the King himself) would determine the outcome. During Machiavelli's career as Second Secretary of the Florentine republic, for example, armies engaged in major military campaigns were ridiculously small by our current standards (as is illustrated by his dispatches on the difficulties the Holy Roman Emperor encountered in forming a force of 10,000 men). With the invention of cannon, small armies were becoming obsolete. For the defense, it became imperative to keep the enemy at a distance so that attacking cannon could not destroy the ruler's center of power. For the offense, it was necessary to move and defend heavier equipment than had ever been used in warfare before.

Long before he proclaimed the importance of a citizen army in *The Prince* (see especially Chapter XII), Machiavelli had seen the benefits of what would become the French *levée en masse*. In 1509 - 1510, he personally engaged in recruiting a Florentine army based on citizens (who would be defending their own homes and hearths) rather than mercenaries (like the troops of Cesare Borgia who were so easily dispersed when he was deprived of power by Pope Julius II). By the time of writing the *Prince*, *Discourses* and *Art of War*, Machiavelli had therefore clearly worked out the logic of a more egalitarian, popular military force as the only effective response to the introduction of gunpower and cannon.

The transformation in military balances can be stated not only in terms of the new superiority of the offense over defense, but also as the substitution of political legitimacy and egalitarian self-interest for individual valor and heroism as the guiding principles of warfare. Throughout the middle ages, *inequality* of honor, status, and military skill were essential to the defense of a community. With the introduction of cannon, the requisites of honor, status and skill were replaced by the minimal requisite of the willingness to defend one's society (*morale* as distinct from *moral virtue*); gunpower thus promoted equality. As Machiavelli put it with his usual pungent wit, under modern conditions even a pimp could be a good soldier.

To recruit and motivate a large-scale citizen army, however, new means of communicating beliefs and rules were needed. Unless a large population has access to common information about external threats and the means of controlling them, there is no way to form an army of considerable size. With shared political beliefs and social customs, a large community

could protect itself against invading armies. To this end, both Machiavelli and Leonardo were aware that printing could constitute a second fundamental transformation, of comparable importance to that of cannon and military techne.

Although Gutenberg had introduced movable type in the middle of the 15th century, printing spread only very slowly in Europe. It is worth noting that Machiavelli and Leonardo were among the earliest major figures in Western intellectual and scientific history to use printing to disseminate their works. In 1504, following the disastrous failure of the Arno diversion, Machiavelli wrote and had printed *The First Decennial*, a rhymed poem summarizing the history of Florentine foreign policy for the ten years following 1494. In 1509-1510, Leonardo provided the illustrations for printing the mathematician Pacioli's *Divina Proportione*. In the years after losing office in 1512, Machiavelli published his play, *Mandragola*, as well as *The Art of War* and *Florentine Histories*. When they died, both Leonardo and Machiavelli left major works with the intention that they be published posthumously.

Printing transformed the balance between offensive and defensive power in exactly the opposite direction from cannon. Throughout the middle ages, instructions to subordinates were either verbal and direct or written by hand, posing strict limits to the scope of society. Only a small army could be mobilized at any time. Only a few could read and write. For the communication of ideas to subjects and civilians, technical ability was unequally distributed, just as in the military domain only a few could be virtuous warriors.

Whereas cannon shifted the advantage of *military* communication (the delivery of force) from defense to offence, the printing press shifted the advantage of *social* communication (the delivery of information) from the offense to the defense. The capacity to disseminate information allows a government to make laws and enhance their legitimacy through shared beliefs and attitudes. Because a common language allows the expansion of the community to which messages are directed, larger populations can be governed from a single center. The result is the potential of organizing larger economic systems (the markets of modern industrial society) as well as mobilizing larger armies.

The expansion of the size of political units to the linguistic and cultural communities that we call "nations" thus had military as well as political effects. For defense against enemies in the age of gunpowder and cannon, the nation-state had a dual advantage. On the one hand, larger borders by

definition increase the distance between frontier and the center of power (capitol city or royal court); on the other, larger populations make it possible to raise larger armies -- and hence to keep the enemy far from the capitol city or royal court.

The twin revolutions of gunpowder (cannon) and printing (mass media) thus accomplished a *double reversal* in the dialectic of *techne* and power. During the middle ages, expertise in military *techne* ultimately benefitted the defense, whereas superiority in social (or civilian) *techne* benefitted the offense. As in other stable historical epochs, inventions (e.g., the "Greek fire," used to allow attackers to burn wooden defenses) usually provided only marginal changes in this overall system. Both Leonardo and Machiavelli realized that the last decades of the 15th century represented a sudden and massive reversal in the potential of communicating both military force and information: now expertise in military *techne* would ultimately benefit the *offense* (as illustrated by the sudden conquest of Italy by the French), whereas expertise in social *techne* could benefit the *defense* (as was confirmed by the equally sudden withdrawal of foreign armies who could no longer control conquered populations by defeating a few noble or royal leaders).

In this view, what we call "modern" society owes its origins to a complex relationship between scientific knowledge, *techne*, and politics. To assess the future of our civilization, we therefore need to consider the principles underlying the dialectical relationships between what humans know, how they do things, and the way they live together. How has the emergence of a science capable of controlling nature fundamentally transformed the human condition? Why do both military *techne* and the way information is communicated influence political thought and institutions? And what factors contribute to stable configurations of technical expertise, political power and social communication?

III. Science, *Techne*, and Politics⁶

Every human society develops technical knowledge in productive and social activities. To avoid a reducing this complex information to material technology -- a neo-Marxist usage that tends to underestimate the importance of technique (or what Americans call "know-how"), I have used the ancient Greek term *techne* to refer to the ensemble of information requisite for a culture to function.

Techne in this sense is a natural necessity for our species' survival. For approximately 2 million years, our human ancestors made and used tools and weapons. Over time, the techniques of production and use have changed. Even among chimpanzees, different populations have distinct "tool kits" and modes of using them; indeed, by anthropological standards these variations from one chimpanzee population to another are at least as marked as those between distinct human cultures.⁷

Some elements of techne are shared by most if not all members of a society, whereas other aspects of technique and technology are specialized. In the simplest human groups, however, the gap between the most complex or specialized technical information and the average or typical knowledge of techne is limited. For example, Lévi-Strauss' description of the Nambikwara of the Amazon basin suggests a simplicity of techne which virtually all individuals were likely to share.⁸

In contrast, the techne of contemporary industrial societies is so complex that no one can grasp all of its features. Indeed, even within a given activity such as using a computer, no single individual could possibly know how to make, use, and repair all aspects of the technologies we take for granted. As has often been noted, no one computer programmer is likely to understand every line of code of a complex program that has been developed over time by numerous individuals; still more difficult is an understanding of every feature of the computer hardware on which this program will run. And even if a computer expert understood the hardware and operating system of an MS-DOS system used to run the program on IBM compatible computers, would that genius have equal familiarity with Macintosh, UNIX, and other systems (many of which can be configured to handle similar software routines)?

From automobile mechanics, air traffic controllers, and nuclear power technicians to advertising executives, investment portfolio managers, and government bureaucrats, the specificity and complexity of modern techne is daunting. In many fields, four to six years of specialized education are required after the completion of the so-called "general education" of secondary school or even of higher education. Leaving to one side such professions as medicine, science, and law, in no prior civilization has entry into the highly skilled segments of the work-force presupposed such long training and apprenticeship.

The source of this immense variety and power of modern techne is, as has often been noted, the continual positive feed-back between natural science and practical techne. In classical antiquity, as in all other early civilizations,

those who made or used things were sharply distinguished from those who sought to understand the world in mythic, religious, poetic, or rational terms. The Greek artisans were separated from the scientists or philosophers by barriers of class and of activity: making and knowing were considered sharply different domains. In Plato's academy, for example, it was forbidden to "construct" a mathematical proof.⁹ Aristotle expresses the crucial view more broadly when asserting that, in the best regime "the citizens must not lead the life of artisans or tradesmen, for such a life is ignoble and inimical to excellence"; the artisan or maker of things is merely "instrumental" to the happy life of the citizen or, in the highest case, of the philosopher.¹⁰

Leonardo da Vinci's career illustrates the breakdown of this barrier. As a young artist in the bottega of Verrochio, Leonardo was an artisan among artisans as well as an artist in a workshop that produced brass castings for lightning rods and party favors as well as portraits of the nobility and altarpieces for churches. Untutored in science and ignorant of Latin (until he learned the language in his 40s), Leonardo's interest in mathematics and natural science was met by hostility among the scholars in Florence; only after he moved to Sforza's court in Milan in 1483 was Leonardo able to gain respect for his attempt to bridge the existing chasm between artisan or artist and scientist or philosopher.¹¹

By the 16th century, it was no longer astounding (though still unusual) to encounter a major scientist who made his own tools. Galileo's success with the telescope was due to his ability to seize upon a technical innovation by a Dutch inventor, modify it, and produce his own superior instruments within a matter of days.¹² Whereas the ancients were hostile to a mechanical approach to mathematics, Pascal not only invented a computer, but used the argument "from the machine" as a key element in theological reasoning.¹³

While ancient natural science was devoted to understanding nature -- and hence divorced from *techne*, in modern times the sciences have been closely integrated with (and at times confused with) *techne*. Ortega pointed to one aspect of this transformation: the bureaucratization of science -- and with it the oddity that, for the first time in human history, utterly mediocre individuals can make essential contributions to scientific theories.¹⁴ As the average adult increasingly encounters more material techniques and technologies which can be used but not understood, scientific explanations of the natural world itself become increasingly complex and mysterious to all but the most specialized. Today, citizens want the benefits of an industrial and scientific complex whose theories, principles and practical techniques are increasingly beyond comprehension.

While this story is commonplace, its political implications are rarely explored. The gap between the ensemble of *techne* and science needed by a society and the knowledge of the average adult varies according to time and place. As this "knowledge gap" increases, the governance of the community becomes more difficult. Among preliterate hunter-gatherers or scavenger-gatherers (as among tool-using chimpanzees), the gap is minimal: imitation is adequate for most adults to learn the most advanced skills. Differences in natural ability, such as the hunter's aptitudes for following animal trails or accurately throwing a spear, are the only limit on the universalization of *techne*. Such cultures do not develop centralized governments or complex religious doctrines, doubtless because the coordination of behavior and dispute settlement can be achieved by prolonged discussion and consensus. Customary behavior and simple ritual normally suffice to establish common expectations and overcome social conflict.

As the gap between the average individual's knowledge and society's science and *techne* increases, institutions are needed to overcome the tension between competing needs, desires, and expectations. More elaborated belief systems arise. Religious doctrines are developed to justify social control. Specific laws or rules governing contingencies are developed. Writing -- one of the most powerful instruments of social *techne* -- permits the formalization of laws and the establishment of bureaucracies. Written laws and centralized commands in turn require enforcement, including the emergence of courts associated with the emergence of more powerful governments.

These developments can be understood as the emergence of a *techne* of social control and political power, needed to minimize the disruptive implications of expanded technical specialization. The character of the belief systems linking the average adult's knowledge with society's science and *techne* is not, however, simply determined by the size and scope of this knowledge gap. Here, another factor enters: the predictability of the environment and, as a consequence, the likely effectiveness of human plans and actions as means of achieving desired goals.

As behavioral ecologists and evolutionary theorists have discovered, the predictability of resource flows in space and time is a major factor in the social behavior of animals. Where a species has adapted to a stable environment in which resources are predictable, populations tend to reach the so-called carrying capacity of the environment, numbers of young are reduced, and investments in biomass and energy devoted to each individual offspring are maximized. Technically called a *K*-strategy, these behavioral responses are contrasted to the high-fecundity, low-investment reproductive behaviors (or *r*-strategy of species adapted to environments in which resources

are patchy and unpredictable. Symbolized by the differences between elephants and fruit-flies, this difference between *K*-strategies and *r*-strategies can also be seen in human cultures that confront differing environments.¹⁵

For humans, as I have argued elsewhere, perceptions of the future have become a critical factor in politics as well as economics.¹⁶ When life seems predictable, routines and habits suffice as means to survival and successful reproduction. In times when change appears to be chaotic, in contrast, humans tend to elaborate rituals and beliefs in the hopes of controlling events that are otherwise difficult to predict. Those who fear unpredictability are likely to invoke the intervention of divine powers; when outcomes cannot be justified in other ways, religious doctrines can provide reassuring explanation and hope.

Although *techne* serves to control environmental contingencies and hence make life more predictable, ecological transformations cannot always be controlled by the resources available to human societies. As a result, the knowledge gap and environmental unpredictability need to be seen as distinct and uncorrelated factors impinging on human belief systems and social institutions. The interaction of these two dimensions is illustrated in Table 1.

While it would be an error to take this chart too literally, it illustrates an essential point. In the simplest human societies, customary practices and legal rules normally suffice as means of social control. As the knowledge gap increases, elaborate doctrines need to be invented; as unpredictability increases, religious practice and doctrine become more salient. Moreover, there is a dialectical relationship between the two dimensions. As *techne* becomes more effective, individuals perceive the world as more predictable; as expectations for stability rise, people are more likely to focus on their own self-interest rather than on common goals, and less willing to accept undesirable outcomes as the consequence of uncontrollable necessity; whenever social disasters strike, the perceived loss of control leads to demands for social and religious conformity -- thus undercutting the investment in *techne* and reducing the capacity to respond to unforeseen challenges from the natural or political environment. At the extreme, the combination of perceived uncertainty and the information gap can lead to the triumph of political theology -- the quest to regain control over life through fusion of religious belief, political ideology, and the power of the state.¹⁷

Pagan Rome had developed an extraordinarily effective range of *techne* in all domains, including such engineering feats as aqueducts, automated factories, urban amenities, and an extensive network of roads and bridges as well as the organization and armament of the Roman legions that

conquered most of the known world. In terms of the balance of forces between communities, the military techne of the Romans favored its offensive expansion, whereas their social techne (and especially their effective bureaucracy) helped defend the city of Rome as well as the territory it controlled. The result, during the golden age of the Roman republic and early empire, was a substantial gap between popular opinion and the society's techne and science combined with a perceived predictability of the social order -- that is, a configuration suited to centralized power based primarily on secular ideology rather than ritual or theological dogma.

In medieval Europe, much of this techne was lost -- and along with it, most individuals lost much of the perceived capacity to control outcomes. Of course, some individuals retained high levels of intellectual, organizational, and military skills, but relatively advanced techne was only accessible to a few. Communities were limited in scale by the abilities of those in positions of military, political, or religious authority. Under these circumstances, military techne generally favors the defense (since attackers must combine the logistics of combat away from their home base with the need to overcome established defenses), whereas social techne tends to favor the offense (since the best leaders can assemble larger and more effective forces merely by the strength of their personal character and ability).

As an illustrative device, this scheme makes it easier to understand the long term effects of the double revolution in techne first observed clearly in the Italian renaissance by Leonardo and Machiavelli. The dialectic of techne and power helps explain why, in the perceived uncertainty and declining technological sophistication after the fifth century AD, Rome's centralized bureaucratic regime was replaced by the fluid and overlapping claims of religious and civilian authorities. Both Leonardo and Machiavelli seem to have realized that the development of gunpower and cannon in conjunction with the invention of printing and the rediscovery of classical science made possible a double reversal in the political implications of techne. This in turn made it conceivable to imitate the scale and power of ancient Rome through the institutions of what came to be known as the modern "nation-state" in which science and techne rather than religious ritual and political theology.

The theoretical perspective outlined here reinforces the argument that the emergence of modern society can be traced to the reciprocal transformations of military and social techne first noticed by Leonardo and Machiavelli in the first years of the 16th century. If so, to explore the future of Western civilization, we need to imitate their genius by assessing the dialectical relationship between science, techne and politics in our own times. Have the techniques and technologies of communicating military force and

civilian authority changed fundamentally -- and if so, do these changes reverse the political relationships that made possible the successes of the modern nation-state?

IV. The End of a Golden Age

It is a truism to say that the twentieth century has been a time of unprecedented scientific and technological transformation. It is quite probable that never before in human evolution has *techne* been revolutionized so profoundly and so quickly. But change per se is not at issue. According to the theory outlined above, two concrete questions are essential. First, how much has the quality and quantity of technical and scientific information enlarged the gap between popular opinion and the ensemble of social practices or *techne* on which our life is based? And second, do the substantive changes in military and civilian domains of *techne* have the effect of reducing social stability and perceived control over individual life plans?

The answer to the first question is not as obvious as some might think. Of course, the sheer volume of technical and scientific information today is staggering: even specialists complain that they cannot keep up with the flow of new discoveries. But the proportion of adults completing secondary and higher education has never been higher, and mass media extensively disseminate information about the latest technical and scientific developments. Perhaps the effective outcome is a bifurcation within society: for a sub-set of the population in industrialized economies, the knowledge gap between lay opinion and society's science and *techne* has remained stable or declined over the last generation; for the remainder of the population, this disjunction is growing more serious daily.

Benjamin Barber has epitomized these dual effects on the global basis with the title of his best-selling *Jihad versus MacWorld*.¹⁸ Those individuals who confront seemingly unpredictable futures with little understanding of science and *techne* are increasingly likely to take refuge in what is conventionally described as "fundamentalist" religion and is more accurately called political theology. But we understand this evolution poorly if we think the process entails a total rejection of modern *techne*. From the Ayatollah Khomeini to television evangelists, what appears on the surface as an attempt to return to premodern forms of religiosity has often been combined with exceptional attention to (and fluency in manipulating) the latest communication techniques and technologies. Far from trying to go back to a premodern social order, supporters of these religious movements are seeking to preserve modern *techne* by gaining greater control, predictability, and understanding of social events.

Elites with a better understanding of contemporary science and techne -- and a more sanguine view of their future -- are often skeptical of religious enthusiasm and doctrinal rigor. Indeed, some in such elites are reluctant to commit themselves to any form of ideological doctrine, claiming instead that they seek pragmatic solutions to political problems through support for individual leaders. The resulting division in social opinions and attitudes has the effect of contradicting one of the basic premises of the enlightenment project: the universal equalization of educational outcomes.

As a first conclusion, therefore, the coming century is witnessing a profound challenge to the enlightenment view of human equality and social mobility. Constitutional "democratic" regimes based on universal suffrage and public education usually presuppose an informed electorate. As techniques of the mass media are perfected, the knowledge gap can result in a mass public whose opinions are easily manipulated through uses of communication technologies that are controlled by a sophisticated elite.

Marx's critique of bourgeois society indicates clearly, however, that this challenge has been endemic in Western industrial societies for the last century and a half, and hence in itself need not result in a basic transformation of modern civilization. In contrast, rapidly changing techne in the communication of force and of ideas pose a far deeper challenge. As in the age of Leonardo and Machiavelli, we are witnessing transformations in both military and social technologies and techniques that constitute a double reversal in the balance between offensive and defensive capabilities. The result is my second major conclusion: the nation-state, as a political form, is likely to disintegrate slowly over the coming century.¹⁹

Social techne. Consider first the implications of the transformations in social (or civilian) techne -- the communication and coordination of ideas. In the 15th century, the introduction of printing completely revolutionized the capacity of an elite or leader to disseminate a common message throughout the total population capable of reading the language in which it was written. Especially when combined with universal education, and hence the ability to read, printing was therefore profoundly egalitarian, making it possible for any citizen to have enough information to claim a role in the political process.

Combined with a centralized bureaucracy, printing therefore made possible the dissemination of the laws, regulations, and political ideologies of the emerging nation-state. Printing also made possible the dissemination of plays, novels, and other literary productions extending the shared cultural experiences and meanings to a broader public. And, through printing, it was

even possible to disseminate scientific or technical expertise to elites dispersed in space throughout national and international communities. In short, printing created large populations sharing a common language and culture (national communities) and the means to legitimate and administer centralized governments controlling them.

At first, electronic media reinforced this tendency of print media to central control over information dissemination. The earliest mass media based on the electronic transmission of language and images were radio and network television, which -- like printing -- sent common messages from a single source to an entire population. In the 1930's, those like Hitler and Stalin who understood this social techne were able to establish totalitarian regimes that exploited the knowledge gap between elite and mass public.

Over the last generation, these implications of electronic media have been completely reversed. The internet is perhaps the most obvious example of the new fracturing of mass publics by specialized information technologies that can no longer be controlled by the center. In place of early main-frame computers, the personal computer makes electrical contact with specialized or "private" audiences inexpensive, fast, and unusually difficult to monitor from a single central source. With computerized switchboards, telephones have become an almost uncontrollable network through which FAX and e-mail as well as voice messages have largely replaced more easily monitored postal communication.

The internationalization of techne makes it difficult for any government to trace with certainty every use of electronic communication to bring together dissidents, terrorists, or foreign agents. However extraordinary the "hi-tech" measures developed for police and the secret services, offensive counter-measures also constantly evolve. Even a single individual as determined as the American "Unabomber" can escape detection for decades. In relationships between societies, whereas the printing press strengthened the defense, the new social techne makes it easier for an expansionist or hostile power to mount a challenge to the centralized nation-state. Most of the major new information technologies of the 21st century promise to weaken further the defensive capacity of centralized governments.

The proliferation of electronic modes of storing and communicating data undermine centralized governments in other ways as well. Whereas radio, moving pictures, and television originally created common cultural symbols, often shared in real time by the entire national population, the multiplication of cable channels on TV, computers, and the internet -- to name only the most obvious technological changes -- multiply specialized subcultural

domains. More and more, the citizens of modern societies quite literally live in distinct informational worlds as set apart from each other as the life of a medieval court was distinct from that of a peasant village.

In the world of business and industry, the global scope of these developments has also introduced new structural limits in the powers of central governments to control events. Armed with the *techne* of modern communication, large firms with international markets make decisions that cannot easily be controlled or even predicted by a single national government. Increasingly, political decisions must be made in the light of capital flows and investment decisions over which public leaders have only marginal influence.

Finally, science -- by continually revolutionizing the means by which individuals can shape their life histories -- generates new *techne* whose social effects elicit cultural and ideological controversy. Research on the biology of reproduction led to new techniques of birth control, such as the pill, which in turn profoundly transformed sexual and social behavior. Most citizens -- and even most intellectuals -- are unaware of the complex causal relationship between abortion, divorce or single-parent families and a *techne* giving women control over reproduction.²⁰ The result is political controversy within as well as across conventional partisan lines, further challenging the coherence of centralized governments.

In the rivalry between societies, these trends in social *techne* thus have the effect of favoring the attacker relative to the defender. Unlike the changes in *techne* which made it possible to create large, centralized nation-states within which law and order was the rule rather than the exception, the transformations now in process insure ever greater instability. Whereas nation-states promised equality under popularly legitimized laws, moreover, these changes destroy legitimacy and confront centralized governments with ever-increasing internal inequality and heterogeneity. And, of course, that very heterogeneity offers external enemies or internal dissidents potential refuge against centralized control. In short, new developments in social *techne* have reversed the political relationships that originated with the development of printing and mass culture in the Italian renaissance.

Military techne. Throughout the first half of the twentieth century, developments in the means of communicating force tended to reinforce the general pattern that Leonardo and Machiavelli first observed with cannon and gunpowder. Airplanes and aerial bombardments, tanks, and the techniques of massing and rapidly moving large armies all favored the attacking force over the defense. As Hitler demonstrated in throughout central Europe, the blitzkrieg could overcome conventional defenses with apparent ease: the

Maginot Line was as vulnerable to the Panzer Divisions as the castle walls had been to the early cannon. Prior to 1945, the limits of power for the offense were only reached when lines of communication became radically overextended (as in Hitler's invasion of the Soviet Union) or the attacker failed to follow-up rapidly enough on an initial advantage (Hitler's failure to invade England before lend-lease could replace the awesome losses symbolized by Dunkirk).

For an attacking force to overcome these limits, as the United States did, an awesome superiority in material resources as well as scientific manpower and social techne were required. Roosevelt's capacity to organize and American industry's ability to deliver hitherto unimagined quantities of military equipment can thus be seen as the high point of the modern nation-state. Ironically, although the post-war epoch can well be called the "golden age" of industrial society, the introduction of nuclear weapons -- which finally ended World War II -- marked the beginning of a radical reversal of the power relations arising from military techne.

The atomic bomb, once acquired by rival powers, has had paradoxical effects on international relations. When combined with missile delivery systems, the power of deterrence created by the threat of massive retaliation suddenly gave the defending power practical invulnerability, at least in the protection of its central base of power. During the 1950s in the United States, those "isolationists" who imagined a return to the "fortress America" symbolized by George Washington's Farewell Address seemed anachronistic. In retrospect, they may merely have anticipated historical developments by half a century.

Nuclear weapons and intercontinental missiles appear at first to favor the offense due to the increase in the quantity and range of destructive power communicated by these new "delivery systems." On closer analysis, however, it is the defense that benefits relatively the most. The reason is that the crucial techne rests in the miniaturization of components -- that is, a reduction in size and increase of speed per unit of either explosive force or distance -- and *not* in total explosive power per se. In the never-ending arms race of measures and counter-measures, contemporary techne make it possible for rivals to observe, predict, and react to each other with greater and greater precision, speed, and coordination.

The results are paradoxical. Miniaturization makes it possible for an attacker to use means of terrorism to destabilize an enemy, but such methods enhance the morale of the defender (as was already evident in the Battle of Britain or the Allied strategic bombing of Nazi Germany). As Saddam

Hussein has demonstrated in the aftermath of the Gulf War, a regime can thus withstand massive attacks short of all-out nuclear devastation or its equivalent with conventional weapons.

When combined with the diffusion of social techne described above, the miniaturization of means to communicate force thus offers a relative defensive advantage to any population willing to suffer extensive losses in materiel and human life. First observed in Vietnam and Algeria, where Western nations encountered insuperable limits in communicating the extent of their power, the ubiquity of this dialectic has more recently been confirmed by the failures of the Russian army in Afganistan and Chechnya.

The transformation in military techne has thus reversed the relative advantages of offense and defense in the communication of force. Once again, as in the middle ages, a defender with skill, commitment, and material resources can achieve almost complete invulnerability against external enemies. Paradoxically, within any linguistic and cultural community, this means that centralized governments no longer can pretend to the "monopoly of the legitimate use of force" which, for Weber, was the very definition of the state. In place of stable national communities with geographically defined boundaries, whose defense could be assured in situations short of open warfare and whose wars tended to become "total" and world-wide in scope, we see increasingly fluid rivalries as ethnic and political groups vie for power within as well as across formal national frontiers. As if to symbolize this change, Sarajevo now stands for the disintegration of the multi-ethnic Yugoslavian nation-state, whereas it once represented the spark for World War I.

The Double Reversal. The effects of transformations in social and military techne can be summarized as a double reversal in the dialectic of offense and defense. At the origin of modernity, printing and mass culture unified what had previously been diverse social worlds, favoring the emergence of centralized control over populations presumed to have a shared national identity; today, computers and electronic media have produced social disintegration and reduced effectiveness of the central command-and-control systems of the nation-state. At the origin of modernity, gunpowder, cannon and citizen armies gave the leaders of a nation-state an unparalleled capacity to expand their power to the limit of shared language and ideological legitimacy; today, the combination of nuclear weapons and the proliferation of "conventional" weaponry has reduced the capacity of centralized governments to deliver force effectively both on external rivals and internal enemies.

Not surprisingly, these factors interact with the knowledge gap between elites and mass publics. Throughout its period of vital growth, modern industrial society relied on universal education and the equalization of skills and life-styles. Ideologically, this correlate of both military and social techne took the form of equal "natural" or "human rights." Now, the multiple transformations of techne are creating a world of heterogeneous ways of life and radically inegalitarian technical competence. Mass ideologies encounter proliferating sects. Traditional institutions are losing their uncontested legitimacy. In place of "rights," we see increased reference to conflicting cultural, religious, or ethnic "values."

The result, of course, is increasing instability. As we have seen, however, perceived instability leads to greater reliance on religious doctrine and ritual. Modern industrial societies, devoted to the control of nature, secularized public life by creating the welfare state as an instrument of predictability for all citizens. Today, the costs of maintaining these institutions exceeds their effectiveness while the pressures of cultural controversy (whether in the form of hostility to immigrants or the resurgence of political theology) reinforce the dialectic of change. In short, we seem to be facing the decline of nation-states as we have known them since the revolutions of 1776 and 1789. The Golden Age of industrialized wealth, freedom, and peace, enjoyed in the U.S. and Western Europe since the 1950's, may well be coming to its end.)

V. The Perennial Philosophy

I conclude that the modern welfare state (or, to use a conventional synonym, "the modern democratic state") is not likely to be in existence two centuries from now. Our age of peaceful and free prosperity under law may not even survive the next two decades. While regrettable, I believe that this outcome may well be the best that can be hoped for. To see why, we need to consider the domain of productive techne -- the modes of controlling nature and providing the means of human life -- of which I have said little to this point.

Modern industrial society created a world of abundance, in which plentiful and predictable supplies of material goods became available to mass publics. Although marred by periodic depressions during its centuries of development, Western civilization has not confronted a major depression or world war for the last half century. As predictability and abundance of basic goods and services has been achieved, individuals have been able to move through time and space with unparalleled independence. Security, mobility

and comfort under the rule of law have been taken for granted. Except for the punctuation of terrorist attacks and largely ineffectual protests, the principal issues have been how far it is feasible or legitimate to expand wealth and achieve equality while protecting individual freedom.

These trends now seem to have reached their limit. On the one hand, the costs of the mature welfare state everywhere exceed the resources to pay for them. In part, this is due to the effects of medical techne: as life expectancy has been prolonged, the average proportion of the individual's lifetime spent in productive activity has fallen. Social techne also plays a role: education in preparation for work has been prolonged as more of the population completes secondary education and college. As retirement constitutes a longer proportion of a lifetime, fruits of productive techne are shaped to appeal to the old as well as the young. A progressively smaller proportion of the community thus does the productive work and funds ever-increasing demands for resources.

On the other hand, the individual benefits of our techne seem almost unlimited. Bio-medical intervention provides a good illustration. Organ replacement, genetic engineering, and psychopharmacology promise to remedy unpleasant as well as life-threatening physical and psychological conditions. Hence the demand for ever-new means of gaining control over our lives constantly increases beyond society's capacity to provide equal benefits to all.

The urge to conserve our gains is understandable. Ideologically speaking, however, conservatism confronts a dilemma. Western civilization has been inherently progressive in its understanding of history, relying on economic growth to resolve social conflict. Lacking a clear theoretical model of the future, conservatives are led to an awkward choice between the administrative prudence and competence epitomized by Michael Oakeshott and a closure of society reflecting either the political theology of Carl Schmidt or the nationalism of Jean Marie LePen.

In the United States, the attack on the welfare state reflects, however unconsciously, the awareness that an egalitarian paradise is unattainable. Despite their different ideologies, European conservatives and social democrats also find it necessary to confront mounting governmental deficits. The promises of Lockean liberals and Marxian socialists are thus equally difficult if not impossible to satisfy. Already, the collapse of the Soviet Union and its allied communist regimes in Eastern Europe has destroyed Marx's dream that a proletarian revolution will lead to a classless society of secure

abundance. The lesson of this failure needs, however, to be understood in more general, theoretical terms.

Western politicians and intellectuals have been too hasty in congratulating themselves for the end of the cold war. Marx's theories were based on an incorrect understanding of human nature and an overly optimistic view of history: if so, it seems increasingly unlikely that effective social democratic reform will occur. Less obvious but equally troubling, similar questions can be directed at the political theories of Locke and his successors, from which the logic of the market economy and liberal constitutional regimes is derived.

Because the United States has emerged as the world's only superpower, it is particularly instructive to consider for a moment the fragility of the theoretical understanding on which the American regime rests. According to Locke, the untrammelled productive energies of individual labor can, through the market economy, create free and fair prosperity. Will Locke's ideas and the political doctrines based on them survive more effectively than Marxism?

Locke's view of human nature -- and especially his view of the "state of nature" -- no longer can withstand examination in the light of contemporary natural science.

- Locke taught (and Western social science generally followed him in believing) that the human brain is a "tabula rasa," whereas both neuroscience and ethology have demonstrated the contrary; from observations of primate behavior to brain imagine and behavior modifying drugs, research has rediscovered a view of human nature as contrary to Lockean liberalism as to Marxism and socialism.

- Locke derived all value from human labor, whereas modern economics shows that exchange value arises in the intersection of supply and demand; in an age of automation, the labor theory of value is an intellectual embarrassment if not an ideological justification for inequalities of wealth.

- Locke claimed the world contained space and resources for doubling the human population without negative political consequences: in the 1690's, this proposition may have been a convenient justification for seizing North America from its native inhabitants, but the three hundred years later the threat of global overpopulation is ignored at our peril.

Similar challenges could be directed to the view of human nature elaborated by modern philosophers as diverse as Descartes, Rousseau, Kant, Mill, and Heidigger.²¹

Deep theoretical flaws underly the practical dilemmas confronting the modern welfare state. Neither Locke nor Marx place a central importance on political leadership. Both liberalism and socialism sought to resolve human social and political conflict through structural or institutional devices: constitutional regimes that guarantee equal "rights" to individuals ("we hold these truths to be self-evident: that all men are created equal..."), or classless societies that ensure adequate resources to all ("from each according to his ability, to each according to his needs"). Conservatives often proclaim the need for effective leaders and the centrality of law -- but lack a universally acceptable theoretical ground for articulating their image of the good society. The modern welfare state seeks to reconcile these claims, combining the protection of "human rights" and the enforcement of "justice" with "entitlements" to basic goods and services administered by popularly elected constitutional governments.

It is now apparent that it will be impossible to maintain these expectations within the structures of free consent and popularly elected political officials. The centralized state lacks the ability to control outcomes to the extent that modern ideologies proclaim should be the case. The market economy needs to be monitored constantly, but the decisions of governmental officials are not always effective in achieving desired results. Attacked by the discontented within and abroad while facing impossible demands, the welfare state (or "modern liberal democracy") will thus be destroyed by the very success of the techne created by modern scientific and industrial institutions.

Only two options seem open. The first, which many feel is more attractive, consists in the defense of stability, peace and abundance through the further extension of scientific and technological control over nature. The second, apparently less attractive, is a reversion to the more chaotic and violent modes of life characteristic of the decline of empires in prior human history. Why, then, have I spoken of a return to a mode of life akin to the pre-modern West as "the best to be hoped for"? The answer lies in the very power of the productive and reproductive techne on our horizon.

What are we to do if forced to choose between a "brave new world" and the end of the centralized nation-state? The maintenance of stability may indeed be possible -- but at the cost of extending the techne of behavioral control through biological and chemical means, converting each society into something resembling the "eusocial" world of insect communities.²² Over

the next generation, it will become possible to manufacture humans to specification. Revolutions in neurochemistry and neuropharmacology will reveal that Prozac and Ritalin are but the first of extraordinary new means of controlling behavior. As the human genome and its functional mechanisms are understood more completely, both health and behavior will become subject to manipulation using hitherto unimagined techniques. In many cases, it may not be necessary to impose these methods by centralized decision-making. As indicated by the freely chosen use of psychopharmacology to control mood and behavior, the quest for security could lead to self-imposed chemical or genetic behavior control enforced by social ostracism of deviants.

The social techne of communicating information may thus no longer be needed as the principal means of organizing and controlling a population. Military techne would also decline in importance, at least on any domestic population whose behavior was controlled by chemicals in water supplies and food. Cultural diversity could then become a device for strengthening social control, much as opium was used by the Turks and vodka by the Russians. Lest this view seem absurd, reread *Brave New World* with specific reference to the technologies Huxley imagined. Is there any function for which contemporary science does not promise a more effective solution in the coming century?

If we are faced with the alternative of a bee-hive society under technological control or the disintegration of centralized states, why should we prefer the latter? On the one hand, I would argue, the central authorities can not be expected to achieve perfection in their implementation of the techne -- and in such a totally centralized, technically regulated order, failure could be disastrous for the entire species. And on the other hand, I suspect that attempts to introduce the brave new world of total technical control will encounter the implacable resistance of human nature itself.

Differences in temperament or personality are to some degree innate. Some individuals seek novelty and risk; others prefer predictability and security. The brave new world, even more than the modern welfare state, can be described as a *K*-selected social strategy, minimizing risk and maximizing investments in each human life. Spirited individuals, seeking risk and honor, would thus have to be controlled by chemical or genetic means. The point can be restated in philosophic terms, as Fukuyama has more recently suggested: the demand for honor or "recognition" will be a perpetual challenge to the "final" state at the "end of history. Ultimately, the issue is the central question of Western philosophy, as can be seen in the dialogue between Strauss and Kojève.²³

From the Luddites to contemporary terrorists, some individuals react with violence to the imposition of centrally defined order on their private lives. To achieve success, the brave new world of technological control would require hitherto unimagined success in its implementation of scientifically designed techniques. We have no reason to believe that humans can control their own uses of *techne* with sufficiently low margins of error to insure success. In escalating the goals to a total biochemical and genetic redesign of the species, one is reminded of the mythic conversation between George Bernard Shaw and Isadora Duncan. As the story goes, Shaw said: "Sleep with me: we'll have children with my brains and your body." Duncan supposedly replied: "It would be just our luck that they would have *my* brains and *your* body." *Qui custodet custodes.*

Machiavelli was the first major political theorist to proclaim that human science and *techne* could control natural necessities and historical outcomes. But, as he put it in Chapter 25 of the *Prince*, human leaders were only likely to control "about half" of historical contingency or (to use his word), *fortuna*. Echoing the prophetic letter of 1506 mentioned above, Machiavelli emphasizes in the *Discourses* as well as the *Prince* that the limit on the human conquest of nature will be the inability of humans to control their own nature.

There is much to be said for Machiavelli's prudence. Leonardo, the artist, scientist and technician who advised various rulers without taking responsibility for the results, seems to have been more optimistic. Unlike Leonardo in this regard, at the outset of modernity Machiavelli saw its promise -- but also its limits. In claiming that a "new route" in political life was open to humans, moreover, Machiavelli -- unlike Bacon, Hobbes, and other moderns who shared Leonardo's belief in a scientific control of nature -- did not pretend that a new science of politics could engender an "eternal" commonwealth of plenty and assured peace. Indeed, Machiavelli himself claimed that the view of human nature on which his project rested was shared by "all writers" on politics -- i.e., by the Greek philosophers in the Socratic tradition (Plato, Xenophon, and Aristotle) as well as by Sophists (like Thrasymachus and Gorgias), not to mention Christian writers from Paul to Augustine and Aquinas.

In assessing the future of modernity, therefore, it is the difference between Machiavelli and Leonardo that may be most enlightening to us. If I am correct, they shared the awareness that the revolutions in the *techne* of communicating information and power made possible a new regime that would extend socio-economic freedom and prosperity to national populations. They differed in the extent to which they saw the perennial philosophy of the

West as a mode of understanding human nature and the limits of politics. If we seek to follow Leonardo's optimism, we will need to embark on the creation of what Shakespeare -- with a skepticism akin to that of Machiavelli -- was the first to call a "brave new world." Machiavelli's pessimism reminds us that such a quest for certainty as first proposed, as a philosophic joke, by Socrates in Plato's *Republic*.

I cannot pretend, of course, that my analysis is correct. Still less do I imagine that I have accurately defined the choices that will face our grandchildren. But of one thing I am confident. To understand human life and the limits of both politics and techne, it would be nothing short of folly to ignore the "perennial tradition" of Western philosophy. Most journalists and politicians today seem to believe that the implications of science and technology will take care of themselves. Those among us who are thoughtful can no longer be blind to the dangers of such a belief. If our species is to survive, we will need to continue the age-old exercise of philosophic inquiry into the being of nature and of human nature.

Table 1

Knowledge Gap between
Popular Belief and Society's Science and Techn

	<i>Small</i>	<i>Large</i>
Unpredictability of Individual Life Plans		
<i>Low</i>	Custom or Law (Consensual decisions)	Ideology (Bureaucracies, Governments)
<i>High</i>	Ritual (Religious communities, Priests)	Political Theology (Rigid behavior control)

Appendix: The Differentiation of Natural Science (*episteme*), Techne, and Opinion (*doxa*)

Natural science as we know it was first developed in ancient Greece. Although earlier cultures obviously had knowledge of the inanimate and animate world, explanations of the way things happen were not sharply distinguished from rituals for appeasing the gods and techniques for acquiring food or fighting other societies. The classic example of this pre-scientific or pre-philosophical attitude is the creation myth of the ancient Babylonians -- the *enuma elis* -- which served as an account of the origin of the cosmos, a religious ritual, a legal text, and a guide to agricultural practice.²⁴ A similar fusion of thought, practice, and norms can also be seen in the Judeo-Christian tradition, since neither the Old Testament nor the New Testament admit the truth of scientific knowledge that is divorced from -- and to some degree opposed to -- faith in God as providential creator of the world.

Western science is rooted in the Ionian cosmologists' the concept of "nature" (*physis*) as something which is the same everywhere. This momentous discovery, which we take for granted, is symbolized by Aristotle's remark that "fire burns both here and in Persia." Whereas social norms vary from place to place, depending on human action and belief, nature does not depend on convention, human law, or custom. Or, as Antiphon the Sophist put it, the rules of nature are the same whether humans observe them or not, whereas the rules of law -- the man-made conventions which shape different societies -- only matter when our behavior is observed by others.²⁵

As ancient Greek philosophers quickly saw, the distinction between nature (*physis*) and convention or law (*nomos*) entailed a parallel distinction between popular opinion (*doxa*) and scientific knowledge (*episteme*). Widely accessible in the famous allegory of the Cave in Plato's *Republic*, this distinction was shared by thinkers as diverse as Heraclitus and the cosmologists, Gorgias and the sophists, Socrates and the Platonic and Aristotelian schools, and Epicurus and his followers. To appreciate the significance of this conceptualization, one need only recall that the New Testament teaches that faith, the "one thing needful," is professed through belief (witness the role of the *doxology* in the Christian liturgy). Whereas pagan Greek and Roman thinkers associated law (*nomos*) with popular opinions (*doxa*) that vary from time to time and place to place, Paul distinguishes between Hebrew law and faith -- treating belief in God much as the pagan Greek philosophers understood scientific knowledge (*episteme*).

The twin roots of modern Western thought thus have sharply different ways of relating beliefs or religious faith to knowledge. During the Italian

renaissance, the rediscovery and renewed vitality of pagan Greek thought led inevitably to violent conflict between the authority of the Church (supported by the Jesuits and scholastics) and those seeking a science of nature and human nature. Leonardo, invited to work in the Vatican by Giuliano de' Medici in 1513, fled several years later after being denounced for conducting autopsies to gain anatomical knowledge. By the end of the sixteenth century, despite apparent gains for a non-theological science, the fierce conflict between Protestant reformers and the Catholic counter-reformation provided the impetus for the torture and execution of Giordano Bruno. Although Thomist theologians have worked diligently to integrate scientific discovery and Christian faith, the potential for conflict between the two has persisted from the condemnation of Galileo in the 16th century to the recent attacks on Darwin's theory of evolution by "creation scientists."

The typically modern distinction between natural science, technology, and religious practice emerged slowly after the horrors of the 30 years war (1618-1648). During the last 350 years of Western history, tensions between scientific or technical knowledge and religious belief have repeatedly arisen, sometimes within the thought of individuals, but more often between groups or social classes committed to each side. Each attempt to resolve the conflict, whether by enforcing religious orthodoxy (leading some scientists to rebel against theological doctrine) or by marginalizing religious practice in the name of "enlightenment" (leading some of the faithful to attack science as sinful or atheistic), only confirms the depth of the gap between scientific knowledge and popular belief. Paradoxically enough, the pagan Greek distinction between *doxa* and *episteme* has gained its deepest confirmation from the triumph of Christian monotheism and modern science.

Western civilization has thus been based on a fruitful tension between what the Greeks called *techne* (the combination of technology and practical technique) and scientific knowledge (*episteme*) on the one hand, and social beliefs or religious practices (*doxa*) on the other. Even in regimes based on the principle that "all men are created equal," many citizens understand little if any science. The *techne* needed to run our society is dispersed among specialists, few of whom understand fully the links between scientific theories and practical expertise. Although the optimistic enlightenment view presumed that the gaps between scientific theory, technical knowledge, and popular opinion would be overcome through historical progress, today their contradictions have remained or grown stronger in recent years.

From a broad theoretical perspective, the development of science and a scientific *techne* make this problem inevitable. In the pre-literate societies of hunter/gatherers (or gatherer/scavenger/hunters) -- exemplified by

traditions as diverse as the San or !Kung of the Kalahari Desert, the Ifugao of the Northern Philippines, and the American Plains Indians -- most of the culture's *techne* and science is known to virtually all normal adults. Apart from distinctions in the roles and expertise appropriate to each sex, the principal exceptions are complex medical and theological rituals taught only to a few specialized individuals (chiefs, shamans, and the like). In such societies, custom and law seem adequate to regulate social behavior. Even in emerging civilizations, as is illustrated by the *enuma elis*, customs and legal norms are simultaneously the reigning popular opinions and the instrument of political organization.

As the science and *techne* needed to run a society become more complex, fewer citizens can understand it fully. The gap between opinion and knowledge grows -- and can only be filled by belief systems which are themselves neither entirely scientific nor purely religious. If this interpretation is correct, the proclaimed "end of ideology" of the 1960's was a theoretical impossibility long before the student protests of May 1968 demonstrated the ease with which technocratic decisions could be contested as an ideologically determined exercise of power.

* This text is an expanded version of a lecture at the Carl Friedrich von Siemens Stiftung, Munich (November 12, 1996). I thank Dr. Heinrich Meier for the invitation that gave rise to this lecture, and above all for fruitful dialogue that has greatly enriched my understanding of the issues treated. My earlier work benefitted greatly from insights and suggestions from John Scott and William Connolly.

¹ Stephen Toulmin, *Cosmopolis: The Hidden Agenda of Modernity* (Chicago: University of Chicago Press, 1992).

² Roger D. Masters, *Machiavelli, Leonardo, and the Science of Power* (Notre Dame, Indiana: University of Notre Dame Press, 1996). The first two sections of the current essay draw heavily on the argument set forth in this volume, especially chapters 1 and 7.

³ *Ibid.*, Chapter 1 and, for documentary evidence, Appendix I. Although Machiavelli's biographers and interpreters seem generally unaware of these facts, they have been widely discussed by scholars who have studied Leonardo's life and works. On the relationship between Machiavelli and Leonardo, see E. Solmi, "Leonardo e Machiavelli," *Archivio storico lombardo*, XVII (1912), 231, and Carlo Pedretti, *Studi vinciani* (Geneve: E. Droz, 1957), 17: "Nessun documento può con sicurezza i rapporti di amicizia fra Machiavelli e Leonardo, ma le circostanze sono favorevoli per avvalorarne l'ipotesi." In later works, Pedretti provides considerable evidence of a close friendship: see

Pedretti's *Leonardo da Vinci: The Royal Palace at Romorantin* (Cambridge, Mass.: Harvard University Press, 1972), 32-33, 39, 297-301; *Leonardo: A Study in Chronology and Style* (London: Thames and Hudson, 1973; reprint, N.Y.: Johnson Reprint, 1982), esp. Chapter 1; *Leonardo: Architect* (New York: Rizzoli, 1981), esp. 15, 55, 174, 179, 188, 205. For Pedretti's final judgment, see *Literary Works of Leonardo da Vinci*, II, 51: "In 1502 Leonardo was in the service of Cesare Borgia with the title of 'Architecto e Ingegnero Generale', and with the task of supervising the fortifications in Romagna. He must have had frequent occasions to talk with Machiavelli, especially in the autumn of 1502 in Imola." See also Giorgio de Santillana, "Man without Letters," in Philipson, *Leonardo da Vinci: Aspects of the Renaissance Genius* (New York: George Braziller, 1966), 190; Kenneth Clark, *Leonardo da Vinci: An Account of his Development as an Artist* (New York: Macmillan, 1939), 133-134. More recently, after the completion of my analysis, several maps of the Arno which Leonardo apparently drew between 1502 and 1504 but which to my knowledge had not been reproduced, have been published (see Martin Clayton, *Leonardo da Vinci: A Singular Vision* (New York: Abbeville Press, 1996), pp. 89-105; one of these maps (p. 103 - cat. 56) shows that in 1504 Leonardo surveyed the Arno just west of Florence itself; because there is a careful copy of the map, colored, with legible writing (p. 105 - cat. 57), this map "must therefore have been made for someone else to see" (p. 103). This is also the case for several other maps of the Arno with readable inscriptions which "have traces of sealing wax on the verso." and thus must have been put on walls to be discussed by officials interested in executing projects based on them (p. 100). Insofar as members of the Signoria or their representatives are the most plausible audience, these maps can hardly have been unknown to Machiavelli (who served as the intermediary between Leonardo and Savonarola on other matters). In fact, it is not unreasonable to suppose that these maps were commissioned by the Second Chancellor and Secretary to the Committee of Ten (Machiavelli's formal positions). On the milieu, see Felix Gilbert, "Florentine Political Assumptions in the Age of Savonarola and Soderini," *Journal of the Warburg Cultural Institute*, Vol. 20 (1957), and *Machiavelli and Guiccardini: Politics and History in Sixteenth Century Florence* (Princeton, N.J.: Princeton University Press, 1965); John H. Najemy, *Between Friends: Discourses of Power and Desire in the Machiavelli-Vettori letters of 1513-1515* (Princeton, N.J.: Princeton University Press, 1993), as well as the biography of Machiavelli's assistant and friend Buonaccorsi: Denis Fachard, *Biagio Buonaccorsi: sa vie-son temps-son oeuvre* (Bologna: Massimiliano Boni, 1976).

⁴Niccolò Machiavelli to Giovan Battista Soderini, 13-21 September 1506, in Masters, *Machiavelli, Leonardo and the Science of Power.*, Appendix II, reproducing the translation in James Atkinson and David Sices, editors, *Machiavelli's Personal Correspondence* (DeKalb, IL: Northern Illinois University Press, forthcoming). The key passage reads: "But because times and affairs often change -- both in general and in particular -- and because men change neither their imaginations (*fantasie*) nor their ways of doing things (*modi del procedere*) accordingly, it turns out that a man has good fortune at one time and bad fortune at another. And truly, anyone wise enough to adapt to and understand the times and the pattern of events would always have good fortune, or would always keep himself from bad fortune; and it would come to be true that the wise man could control the stars and the Fates. But such wise men do not exist; in the first place, men are shortsighted; in the second place,

they are unable to master their own natures; thus it follows that Fortune is fickle, controlling men and keeping them under her yoke."

⁵On the history of Machiavelli's *Prince* and its teachings, see Robert M. Adams' edition (New York: Norton, 1977), pp. 227-238.

⁶Because the historical roots of the differentiation between scientific knowledge (*episteme*), technology and technique (*techne*), and public opinion (*doxa*) are presupposed in what follows, a fuller account is presented in the Appendix.

⁷William McGrew, *Chimpanzee Material Culture* (Cambridge: Cambridge University Press, 1992)..

⁸Claude Lévi-Strauss, *Tristes Tropiques* (New York: Atheneum, 1974).

⁹David Rapport Lachterman, *The Ethics of Geometry: a Genealogy of Modernity* (N.Y.: Routledge, 1989),

¹⁰Aristotle, *Politics*, VII.ix.1328b35-40; VIII, iii.1338a30-1338b2 (in *Complete Works of Aristotle*, ed. J. Barnes; Princeton, Bollingen, 1984, II, 2109, 2123). As if to underscore the danger of a reliance on *techne*, Aristotle goes so far as to assert that virtually all conceivable inventions have already been discovered

¹¹For the details summarized briefly here, see Serge Bramly, *Leonardo: Discovering the Life of Leonardo da Vinci*, trans. Siân Reynolds (New York: Edward Berlingame Books, 1991) as well as Giorgio Vasari, *Lives of Seventy of the Most Eminent Painters, Sculptors and Architects*, ed. E. H. and E. W. Blashfield and A. A. Hopkins (New York: Charles Scribner's, 1917), II, 367-407 and the works cited in note 3 above.

¹²James Reston Jr., *Galileo: A Life* (New York; Harper/Collins, 1994)

¹³See Pascal, *Pensées*, esp. 5, 7, 11, and 512; ed. Louis Lafuma (Paris: Editions du Seuil, 1962), pp. 35-37, 244-47. The central importance of this difference between ancients and moderns was most clearly emphasized by Leo Strauss, *Natural Right and History* (Chicago: University of Chicago Press, 1956). On the implications of the transformation of mathematics in modernity, see Roger D. Masters, *Beyond Relativism* (Hanover, NH: University of New England Press, 1993).

¹⁴José Ortega y Gasset, *The Revolt of the Masses* (New York: W. W. Norton, 1932). Indeed, today scientists actively seek to do away with human intermediaries altogether, replacing research assistants with computers. Recently, Eric S. Lander, Director of the Whitehead Institute/MIT Genome Center, answered a question about his goal for research in human genetics as follows: "In the next one to three years, we have to figure out how to get humans out of the loop," he said. "Then we can really get to work thinking about biology and what's going on in life." *New York Times*, Science Times, September 10, 1996, p. C8.

¹⁵See Robert Trivers, *Social Evolution* (Menlo Park, California: Benjamin/Cummings, 1983).

¹⁶Roger D. Masters, "On the Evolution of Political Communities: the Paradox of Eastern and Western Europe in the 1990's, in Michael T. McGuire, ed., *Human Nature and the New Europe* (Boulder, CO: Westview, 1993), pp. 99-130.

¹⁷For the concept of political theology, see Heinrich Meier, *Carl Schmitt, Leo Strauss und Der Begriff des Politischen'* (Stuttgart: Verlag J. B. Metzler, 1988); idem, *Die Lehre Carl Schmitts* (Stuttgart: Verlag J. B. Metzler, 1994)

¹⁸Benjamin R. Barber, *Jihad vs. McWorld* (New York: Times Books, 1995).

¹⁹For an excellent illustration of the thesis with a focus on military techne, see Robert D. Kaplan, "Fort Leavenworth and the Eclipse of Nationhood," *The Atlantic Monthly*, 278 (September 1996), 74-90.

²⁰Lionel Tiger, *The Manufacture of Evil: Ethics, Evolution, and the Industrial System*. New York: Harper & Row, 1987).

²¹E.g., Antonio Damasio, *Descartes' Error* (New York: Putnam, 1994); Larry Arnhart, "The New Darwinian Naturalism in Political Theory," *American Political Science Review*. 88 (1995) 390-400. Cf. Roger D. Masters, *The Nature of Politics* (New Haven: Yale University Press, 1989).

²²Edward O. Wilson, *Sociobiology* (Cambridge, Mass.: Harvard University Press, 1975); Richard Alexander, *Biology of Moral Systems* (New York: Aldine de Gruyter, 1987).

²³Francis Fukuyama, *The End of History and the Last Man* (New York: Free Press, 1992); Leo Strauss, *On Tyranny, Including the Strauss-Kojève Correspondence*, ed. Victor Gourevitch and Michael S. Roth (New York: Free Press, 1991).

²⁴Henri Frankfort, *Before Philosophy* (Harmondsworth, Essex: Penguin, 1949), chaps. 5-7. For the text of the *Enufma elish*, see James E. Pritchard, ed., *The Ancient Near East* (Princeton: Princeton University Press, 1958).

²⁵Antiphon the Sophist, *On Truth*, in Ernest Barker, *Greek Political Thought* (New York: Barnes & Noble, 1968), pp. 95-98; Aristotle, *Ethics*, V.vii .1134b20-1135a5 (ed. Barnes, II. 1790-1791). Cf. Aristotle, *Politics*, I,v-vi.1254a17-1255b40.

renaissance, the rediscovery and renewed vitality of pagan Greek thought led inevitably to violent conflict between the authority of the Church (supported by the Jesuits and scholastics) and those seeking a science of nature and human nature. Leonardo, invited to work in the Vatican by Giuliano de' Medici in 1513, fled several years later after being denounced for conducting autopsies to gain anatomical knowledge. By the end of the sixteenth century, despite apparent gains for a non-theological science, the fierce conflict between Protestant reformers and the Catholic counter-reformation provided the impetus for the torture and execution of Giordano Bruno. Although Thomist theologians have worked diligently to integrate scientific discovery and Christian faith, the potential for conflict between the two has persisted from the condemnation of Galileo in the 16th century to the recent attacks on Darwin's theory of evolution by "creation scientists."

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