Technology in an Alternative Modernity

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Summary

Classical philosophy of technology was centrally concerned with modernity issues. It typically treated technology as a general entity, a black box. Since the empirical turn philosophers in the field have paid more and more attention to specific aspects of technology and specific technologies. In so doing they tend to neglect the original modernity issues. A gap between micro analysis and macro issues emerges and threatens to grow larger. This essay is an attempt to close that gap. As a general methodology it tries to combine micro technology analysis with macro modernity issues.

A synthesized theory about the relationship between technology and culture is proposed on the basis of the analyses of both technology and culture. In particular technology is analyzed into three major elements: the scientific, design and functional elements. This analysis builds on the dual characterization and pushes it further. Culture is also divided into three components: material, lower and higher cultures. With the analyses of both sides a detailed picture of the relationship between them with much finer granularity may be constructed. This turns out to be a synthesized theory, because key elements from all the major existing theories are incorporated. The elements include determination from technological determinism, instrumentation from common sense instrumentalism and culture-ladenness from various contemporary theories, such as Feenberg's underdetermination thesis, Ihde's ambiguity thesis and Winner's politics of artifacts thesis. This synthesized theory is called cultural instrumentalism. The gist of it is that technology is a culture-laden instrument of the core of culture.

Technology in this essay is discussed in the general framework of a theory of alternative modernity. In contrast to Feenberg's weak alternative modernity this theory proposes a strong alternative modernity. Its central idea is to distinguish two sets of features of Western modernity. Individualism and industrialization are regarded as essential to modernity in general, whereas scientism, capitalism-commercialism and democracy are treated as peculiar to Western culture. So a strong alternative modernity should have the first set of features, but at the same time be different from Western modernity in a nontrivial way with respect to the second set of features. Western modernity here is a theoretical and historical concept. An alternative to Western modernity doesn't have to be non-Western.

In this general framework of alternative modernity, which has to be kept sketchy, the core of this essay is to defend a general embracing-controlling-stance on modern technology. For this purpose both dystopian substantivism and utopian fetishism of technology need to be refuted. Cultural instrumentalism certainly provides theoretical support for the general stance. But the refutation has to be carried out in the bigger context of modernity theory. The dominance of modern technology is the common ground of both dystopian substantivism and utopian fetishism. They are refuted by pointing out the cultural background of this dominance. For the former it's mainly capitalism-commercialism and democracy, whereas for the latter it's mainly scientism. Therefore, the embracing-controlling-stance on modern technology calls for an alternative modernity.

The case study of China is important in two respects. First, it constitutes a substantial part of the comparative cultural context for studying Western modernity. Its peculiarity can be more easily identified in a comparative cultural context. Second, in China we can clearly see how the embracing-controlling-stance of technology was well implemented in its tradition but gradually lost in its modernization process. The case study of two specific technologies, modern medical and information technologies demonstrates how the general stance can be applied to specific technologies. The main issues involved in the specific technologies are all closely related to modernity, scientism in the former case and personal freedom in the latter. This further shows that our dealing with modern technology cannot be well done independent of the general context of modernity.

Zusammenfassung

Klassische Technikphilosophie hat sich zentral um Modernitätsthemen gekümmert. Sie sah Technik typisch als eine ganze Einheit. Seit der empirischen Wende Philosophinnen im Bereich der Technikphilosophie haben immer mehr Aufmerksamkeit spezifischen Aspekten der Technik und spezifischen Techniken geschenkt. Damit tendieren sie dazu, die ursprünglichen Modernitätsthemen zu vernachlässigen. Eine Kluft zwischen Mikroanalyse und Makrothemen taucht auf und bedroht, immer breiter zu wachsen. Diese Arbeit versucht die Kluft zu überbrücken. Als die generelle Methodologie, sie verbindet Mikrotechnikanalyse mit Makromodernitätsthemen.

Eine kombinierte Theorie über die Beziehung zwischen Technik und Kultur wird aufgrund der Analysen beider vorgebracht. Namentlich Technik wird in drei Hauptelemente (das wissenschaftliche, Designs- und funktionelle Element) analysiert. Diese Analyse basiert auf der Doppelcharakterisierung der Technik, aber geht über sie hinaus. Kultur wird auch in drei Komponenten (die materiale, niedrigere und höhere Kultur) geteilt. Mit den Analysen beider Seiten ein ausführliches, feinkörnigeres Bild der Beziehung zwischen Technik und Kultur kann konstruiert werden. Sie ist eine kombinierte Theorie, weil Hauptelemente von allen bestehenden bedeutenden Theorien einbezogen werden. Sie enthalten Determinierung vom technologischen Determinismus, Instrumentation vom üblichen Instrumentalismus und Kulturbeladenheit von den zeitgenössischen Theorien, z. B. Feenbergs Unterdeterminierungsthese, Ihdes Ambiguitätsthese und Winners These von den politischen Artefakten. Diese kombinierte Theorie wird als kulturellen Instrumentalismus bezeichnet. Ihrer Hauptpunkt lautet, dass Technik ein kulturbeladenes Instrument des Kerns der Kultur ist.

In dieser Arbeit Technik wird im Rahmen einer Theorie von alternativer Modernität diskutiert. Im Gegensatz zu Feenbergs schwacher alternativer Modernität diese Theorie schlägt eine starke alternative Modernität vor. Ihre zentrale Idee ist es, zwei Merkmalegruppen der westlichen Moderne zu unterscheiden. Individualismus und Industrialisierung werden als der generellen Modernität wesentlich identifiziert, während Szientismus, Kapitalismus-Kommerzialismus und Demokratie werden als westlicher Kultur eigentümlich betrachtet. Deshalb muss eine starke alternative Modernität die erste Merkmalegruppe tragen, aber mittlerweile bezüglich der zweiten Merkemalegruppe von der westlichen Moderne deutlich unterscheiden. Westliche Moderne ist hier ein theoretischer und geschichtlicher Begriff. Eine Alternative zur westlichen Moderne ist nicht unbedingt nicht-westlich.

Im Rahmen der alternativen Modernität, die skizzenhaft bleiben muss, der Kern der Arbeit ist, einen generellen annehmenden-kontrollierenden Standpunkt in moderner Technik zu verteidigen. Zu diesem Zweck sowohl dystopischer Technik-Substantivismus als auch utopischer Technik-Fetischismus müssen widerlegt werden. Kultureller Instrumentalismus bietet bestimmt dem generellen Standpunkt theoretische Unterstützung. Aber muss die Widerlegung im großen Kontext der Modernitätstheorie durchgeführt werden. Die Dominierung der modernen Technik ist der gemeinsame Grund sowohl des Substantivismus als auch des Fetischismus. Sie sind damit entkräftet, den kulturellen Hintergrund dieser Dominierung zu enthüllen. Im ersten Fall er ist hauptsächlich Kapitalismus-Kommerzialismus und Demokratie. Im zweiten Fall er ist vorwiegend Szientismus. Deswegen verlangt der annehmende-kontrollierende Standpunkt in moderner Technik nach einer alternativen Modernität.

Die Fallstudie über China ist wichtig in zweierlei Hinsicht. Erstens, sie konstituiert einen bedeutenden Teil des komparativen Kulturkontexts, in dem westliche Moderne studiert werden darf. Ihre Eigentümlichkeit kann in diesem Kontext leichter identifiziert werden. Zweitens, man kann in China klar sehen, wie der annehmende-kontrollierende Standpunkt in Technik in ihrer Tradition gut ausgeführt, aber in ihrem Modernisierungsprozess Schritt für Schritt verloren worden ist. Die Fallstudie über zwei

spezifische Techniken, die moderne Medizintechnik und die Informationstechnik, zeigt, wie der generelle Standpunkt auf spezifische Techniken angewendet werden kann. Die Hauptprobleme in den zwei Techniken sind alle mit Modernität verbunden, Szientismus im ersten Fall und persönlicher Freiheit im zweiten. Dies macht weiter deutlich, dass die moderne Technik unabhängig vom generellen Kontext der Modernität nicht gut behandelt werden kann.

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My PhD study in Germany has achieved its original goal, a major part of which is to obtain a first-hand experience of the European society and write down some thoughts. The ideas which I have been pondering on for many years are systematically formulated and this sets the framework for future study. However going back to college at this late phase of life is not an easy endeavor. Without the help from various sources it would have been much more difficult.

First my heartfelt thanks go to my primary advisor Prof. Dr. Armin Grunwald, who essentially made this study possible. When I first contacted him he gladly accepted me as a PhD student. Then he helped me obtain a Visa and become a PhD candidate in the School of Humanities and Social Sciences at Karlsruhe Institute of Technology (KIT). In the process of the study he offered me valuable comments and advised me on relevant resources. His help extended from the study to my personal life in Germany. He kindly provided me a financial support at his Institute for Technology Assessment and Systems Analysis (ITAS). He even played a crucial role in granting Visas to my family and assisted me in job hunting. Despite an intensive work schedule his responsiveness is truly impressive. I also want to express my gratitude to Prof. Dr. Michael Decker, who arranged my work at ITAS, which was very beneficial to my PhD study. I am grateful to Prof. Dr. Hans-Peter Schütt for taking the role of my secondary advisor. I learned a lot from his comprehensive knowledge in Western thought and unrestricted discussion. The comments from many other people are also appreciated. Outside KIT, our friend Dr. Li, Ming recommended me two important books in post-modern medicine and made relevant copies for me. They are used in the case study of modern medical technology. I owe him thanks too.

Of course such an endeavor also required the support from my family. Giving up a highly paid IT job for academic research doesn't only affect my own life. I especially thank my wife Xu, Yinghui for her understanding of the meaning of this endeavor. It has brought about some hardship in our family life with a very young child, including an unexpected long period of separation due to visa issues. She acted courageously to overcome the difficulties. And during the hard time our extended family offered unconditional support. To this I can only feel lucky and indebted.

CONTENTS

Introduction

In this introduction I clarify some general matters of this essay. The Background and Motivation section puts this PhD study in context, including the historical context, the current state of philosophy of technology and some personal background. The General Approach section explains some general aspects of methodology. The Structural Overview section lays out the general structure of the essay.

Background and Motivation

Historical Context

In five centuries Western modernity has expanded to many parts of the world and it has dominated humanity for the past two centuries. Modern science and technology, as one pillar of Western modernity, have been well accepted almost everywhere on the globe without much resistance. But it's not the case with capitalism and democracy, other pillars of Western modernity. The acceptance of capitalism and democracy is uneven among the traditional cultural spheres. They have taken root in India after centuries of British colonization, although with some cultural resistance. They have been welcome in the traditional Chinese cultural sphere mostly recently, except Japan as the pioneer, which achieved fast modernization in the 19th century. South Korea, Taiwan, Hong Kong and Singapore are newcomers whereas mainland China has started to adopt capitalism to a certain extent. But in the Muslim world the resistance is tenacious, with religious conflict with the West as a major reason.

With the decolonization after the Second World War and the globalization at the turn of century, human history has entered a new phase. Instead of a few power or superpower nations dominating the international stage, more and more nations are playing more and more important roles. As we enter the new millennium, humanity is bundled together more than ever before. We have to work together to face our common challenges. This has become obvious in handling the recent global financial crisis and global warming. G-8 has to be replaced by G-20. That's symbolic. As the world moves to being multi-polarized, nations are becoming more and more conscious of keeping their own cultural identity and protecting their own cultural heritage. Certainly most nations want modernization (no matter how they interpret it), but they just don't want to copy everything from the West. The recent Afghanistan and Iraq wars clearly showed how difficult it is to export democracy by force. This could well be the death toll of an age of hegemony and unilateralism.

The concept of alternative modernity gains much significance in this context. The West has led humanity into modernity. This has become an irreversible trend. No matter what the interpretation is, modernity has been primarily associated with progress. But Western modernity is probably not the only way to modernity. In fact, from Marx through the Critical Theorists to post-modernists Western intellectuals have brought up much criticism of Western modernity. And from the Critical Theory has evolved the contemporary alternative modernity theory, represented by Andrew Feenberg's philosophy of technology. Criticisms in many cases are accompanied with proposed solutions. Therefore, alternative modernity is not just a concern of non-Western cultures. The Western societies themselves also strive for some reforms.

Most of the criticism made by Western intellectuals has been done from within the Western culture. Instead, this essay is intended to provide a cross-cultural perspective. It tries to propose a

strong alternative modernity theory in contrast to a weak one. To achieve that, it has to examine Western modernity from a comparative perspective. Specifically Chinese culture is used as an important reference. The characterization of Western modernity is done in comparison with Chinese culture.

The State of Philosophy of Technology

Modernity is undoubtedly intertwined with technology. On the one hand modern society is unimaginable without the support of modern technology. If any major technology was taken away, modern society would malfunction, in the worst case even collapse. On the other hand technology also has been heavily shaped by modernity. Traditional technology encompassed a wide range of methods. But modern technology has been more and more intertwined with modern science. Traditional technologies that cannot be incorporated into the scientific worldview are often abandoned, or at least suspected. This close relation between modernity and technology is reflected in a new phenomenon, the dominance of modern technology in modern society.

Early criticisms of Western modernity recognized the important role of modern technology, but it was not treated as a target. For instance Marx's main target of criticism was capitalism. He didn't see any big problem with modern technology, although the capitalist economy was built on large scale production with machines. Modern technology became an issue in later criticisms of Western modernity. It's evidenced in Heidegger, the Critical Theorists and Ellul, among others. This can be counted as the starting point of modern philosophy of technology. A distinct feature of these early theories of technology was that they treated modern technology as a general entity in the large context of Western modernity. Due to the rapid development of the field, this is already called "classical philosophy of technology." Contemporary philosophy of technology is developed out of some major complaints about classical philosophy of technology. Brey summarizes them into three criticisms, which accuse it to be pessimistic, deterministic and too general and abstract, respectively (Brey 2010: pp. 38-39).

The transition from classical to contemporary philosophy of technology has now been recognized as an "empirical turn." This title is primarily related to the third criticism above. "Empirical" is said against "general" and "abstract." A common feature of contemporary philosophy of technology is attention to details. Technology is no longer treated as one so-called "with a capital T." Philosophers are more and more interested in specific technologies and specific aspects of technology (design process, engineering knowledge, etc.). With this change of general approach the other two aspects are also affected. Attention to details obviously makes the theories less pessimistic and deterministic. However, different theories are affected in different degrees. Borgmann was included in *American Philosophers of Technology: The Empirical Turn* (Achterhuis ed. 2001), but the general tone of his theory is close to classical philosophy of technology. His view of modern technology is to a large extent still pessimistic and deterministic. A significant part of the contemporary philosophy of technology is still concerned with the relationship between technology and society or culture. Brey calls this society-oriented approach. A more radical revolt against classical philosophy of technology is the engineering-oriented approach. This approach focuses on engineering processes, components and products themselves and emphasizes description rather than evaluation of technology with reference to its social context.

Compared with classical philosophy of technology contemporary theories of technology generally have less concern with modernity issues. Among the major contemporary philosophers of technology Borgmann and Feenberg have direct concern. Dreyfus's critique of artificial reason is closely related to the scientific worldview, which is an essential part of Western modernity.

Modernity issues already find little place in Ihde's new phenomenology. The engineering-oriented theories go further to play down all normative issues. Even the recently developed ethics of technology pays much attention to moral issues on the micro level and tends to ignore the general context where modern technology is developed and applied. All in all we see a gap between the micro and macro approaches yawning wide. The conflict was vehemently demonstrated in Winner's charge that social constructivism opens the black box and finds it empty (Winner 1993). Recently Brey also expressed the concern that the society-oriented and engineering-oriented approaches might drift apart (Brey 2010: p. 45).

Effort has been made to close the gap. The anthology *Modernity and Technology* (Misa et al. eds 2003) is an important part of it. The approach suggested by Brey is methodological. Particularly he advocates four types of interlevel analysis: decompositional analysis, subsumptive analysis, deductive analysis and specificatory analysis (Brey 2003: p. 68). These methods are intended to bridge the micro-macro gap. Feenberg's approach is conceptual instead. For him the gap between technology studies and modernity theory is not one involving different levels, but different concepts of technical rationality. Modernity theory maintains a differentiation of rationality from society. Technology studies reject this conception and reveal the social context of technical rationality. However they "lose part of the truth when they emphasize only the social complexity and embeddedness of technology and minimize the distinctive emphases on top-down control that accompanies technical rationalization." (Feenberg 2003: p. 74) Therefore a synthesis of technology studies and modernity theory calls for combination of both fields. On the one hand the concept of technical rationality in modernity theory should be "revised to free it from implicit positivistic assumptions." On the other hand we should "preserve modernity theory's insight into the distinctiveness of modernity and its problems." (*ibid*.: p. 75)

This essay also attempts to combine technology theory with modernity theory. It generally adopts Feenberg's approach, although both theories contained in it are different from his.

Personal Background

I came from China and was educated in both computer science and philosophy. Then I went to the US to continue my study in both fields. Once I lived in the US I had the chance to put Chinese and American cultures side by side and reflect on them. On one side is an eastern culture in the early phase of modernization and on the other a Western culture with a fully developed modernity. The stark contrast could be felt in many aspects of society. As China was undergoing modernization, modernity was already a big concern for me when I was in college. But the life in the US gave me the opportunity to have a direct experience of a modern society and make some deeper reflection on it. On the other hand my Chinese background provided me a different perspective when I was pondering on Western modernity. I sort of had a view from outside.

In the first decade of the 21st century the Chinese society went through dramatic change. More and more I felt the urge to go back and have a direct experience. The general impression was that material life there was getting closer to the American society. Supermarkets filled with all sorts of goods, a big net of expressways and private vehicles were just several examples. Chinese students studying in the US today would definitely feel much less cultural shock than my generation. However, as the initial excitement faded away, I could feel the fundamental difference again. Anyways, Chinese modernization is still a theoretical problem to be tackled.

The plan to live in Europe for some time came out long time ago. I had been well aware of the difference between the American and European societies. Again I wanted a first hand experience. I believed this was necessary for me to formulate a less biased modernity theory. In any event

Europe is where modernity was born. After ten years of work in the IT industry I thought it's time to concentrate and write down years of thinking. My background in computer science and philosophy made the choice of philosophy of technology rather natural. And as discussed above technology is also closely related to modernity. Finally a PhD study in the field of philosophy of technology in Germany met my various needs well. From the life in Germany I did experience some important differences between the American and German societies. Among them the most prominent are a strong environment consciousness, a comprehensive welfare system including free education and governmental support of museums, theaters, etc. This definitely broadened my view of Western modernity. If we regard the modernity embodied in the American society as a reference, the German society displays an alternative modernity in some important aspects.

About a dozen years ago a prototype was already in shape. It has undergone significant development since then. Compared with the prototype I now have something much richer. This essay draws much from my personal background. The modernity theory presented here is based on my life in the Western modern societies, especially the US, and reflections from a comparative perspective. The technology theory benefits from my work in the IT industry. The philosophical training I received enables me to handle philosophical issues at ease. As an enthusiastic amateur photographer I even incorporate my experience from photography practice into the essay.

General Approach

Western Modernity as a Theoretical Concept

The difference between modern and traditional societies is easily discernible. A major task of modernity theory is to characterize modern societies. Unfortunately this is not an easy task. Modernity is such an elusive concept that consensus is difficult to reach. Each major modernity theory picks a different feature set to characterize modern societies. Brey clearly distinguishes two types of modernity theories: the cultural-epistemological theories and institutional theories (Brey 2003: pp. 36-37). The former focus on cultural forms and modes of knowledge, whereas the latter on social and institutional structure. Generally this is a distinction between cultural and social theories. Related to the different focuses on modern societies is disagreement on the beginning of modernity. The cultural theories tend to regard Renaissance in the 15^{th}-16^{th} century as the beginning of modernity. In contrast the social theories normally put the starting point at the Industrial Revolution and political revolutions in the 18^{th} century.

Various complicated factors cause this lack of consensus. First, the transition from traditional to modern society in the West was a gradual process. In addition, the development of different areas of society was uneven. Ideas are always easier to formulate than institutions. Culture always advances faster than economic and political structure. Second, major Western modernized nations had their own particular situations and followed different paths of modernization. So they may bear particular characteristics. Third, what makes things more complex is that, these nations have realized problems in modernity and made reforms in various forms. Some have deviated from certain principles of Western modernity.

Under these circumstances the modernity theory proposed in this essay is not intended to be an accurate characterization of Western modernity. Rather it represents a particular perspective. Specifically this is a comparative perspective. Western modernity is examined in a cross-cultural context. For one thing, when Western modernity is viewed from within Western culture, it's more like a dramatic breakaway from the past. But when it's viewed from outside of Western culture significant continuation from the traditional Christian culture is detectable. From this general

perspective the following approaches are adopted in characterizing Western modernity. First, modern society is considered as a whole and all the areas including culture, economy and politics are taken into account. Ideas are treated on the same footing as institutions. Second, the American society is given higher priority. Due to its unique history the American society on the one hand inherited many elements from Western Europe, but on the other hand it also freed itself from some traditional constraints. The result is that it has carried the spirit of Western modernity to a powerful extreme. Third, the reforms in Western societies are recognized. These new elements are treated as deviation rather than part of Western modernity. The notion of postmodernity adopts similar approach, but it at the same time assumes that Western modernity is the only possible form of modernity. That's why it calls deviation from Western modernity "post*modernity*." In contrast this essay holds a broader notion of modernity (cf. Part I). It takes deviation as an alternative instead.

Generally Western modernity is a theoretical concept. It's an abstraction that may not match any specific modernized Western society perfectly, including the American society. Besides, it only corresponds to a particular historical period. So it's normal to see deviation in contemporary Western societies. But just like concepts such as straight line and plane in geometry this abstract concept captures essential aspects of a historical condition, which has become so significant for the whole humanity. Its focus is put on how the traditional society was transformed. So it provides a good model and reference for societies to build a viable alternative, both for the non-Western cultures and the Western as well.

Combine Micro Technology Analysis with Macro Modernity Issues

Modernity is just one subject of this essay. The other is technology. On the background of the current state of philosophy of technology, this essay contains an effort to combine technology theory with modernity theory. The technology theory proposed in the essay is built on various contemporary theories. The spirit of the empirical turn is carried to a significant extent. The theory is based on an analysis of technology into three elements. Many details of technology are included in the analysis. Specific technologies are also used as examples to illustration the ideas. The theory's view of modern technology is neither pessimistic nor deterministic. The key ideas of the culture-ladenness of technology and the limit of technology from contemporary theories are incorporated. On the other hand, the determination of technology is also recognized to a certain extent. And more importantly, the instrumentation of technology is revived in a special way. These are key ideas from the two traditional theories, technological determinism and common sense instrumentalism. Generally we have a theory which is a synthesis of major traditional and contemporary theories and is based on detailed analysis of technology.

However, the modernity issues in the classical philosophy of technology are not ignored. Instead of the deterministic view of modern technology, the dominance of modern technology is recognized as a basic phenomenon of modernity. First, as classical philosophy of technology claimed, this is the direct cause of many modern malaises. Second, this phenomenon needs to be explained. But it cannot be explained by modern technology itself, as classical philosophy of technology maintained. Instead it has to be explicated in a large cultural context. Here is where the technology theory and the modernity theory can work together. Specifically, the technology theory explains why technology dominates in such and such a cultural context and the modernity theory explains why such a cultural context becomes reality in modern society. In this way the two theories are combined.

Further, micro technology analysis and macro modernity issues are combined with a technology theory about the relationship between technology and culture that are sensitive to both. Micro

analysis and macro issues don't have to be independent of each other. If we consider modern technology as a box, then classical philosophy of technology treats this as a black box and is mostly concerned with the relation between the box and its large context. On the contrary, contemporary philosophy of technology opens the black box and discloses what's inside. Nevertheless it tends to overlook the large context, although it also pays attention to the area near the periphery. There is no reason why we cannot have a integrated picture that includes both the inside and outside of the box.

Focus on Technology

With a subject as broad as modernity, how to control the scope of the essay is always an issue. In a dissertation one can only handle a limited number of topics. However the modernity theory I want to propose involves general characterization. Leaving out any part would damage the integrity. So the best choice is to include all the parts and outline the basic ideas. Compared with modernity technology is a much more specific subject. Due to the limit of scope, this essay has to focus on technology. The core question this essay tries to answer is, what should we do with modern technology? In this way the modernity theory has to be kept sketchy. But it's necessary for answering the core question, for the simple reason that modern technology cannot be well understood without modernity as a whole. The modernity theory provides the historical and cultural context for a theory of modern technology. Generally a sketchy modernity theory is treated as a framework, in which a full-scale technology theory is proposed in this essay.

The wide range of modernity is demonstrated in the many topics involved. As we will see, almost all the major areas of philosophy are touched, from metaphysics through philosophy of science to political philosophy. Yet the issue of modern technology provides a nice piece of glue to stick all the various thoughts and ideas together. It's just impossible to include sufficient argumentative support for each of the ideas. But positions directly related to the core question are based on solid arguments. In this way the essay keeps focused, but on the other hand it also brings up many topics for further development in the future.

Structural Overview

After a general proposal of an alternative modernity theory, the essay gets into details about the interaction between technology and culture and then how technology should fare in that alternative modernity. Finally Chinese traditional society and modernization and the specific fields of medical and information technologies provide good case studies. So the whole essay is divided into four parts.

In Part I a preliminary alternative modernity theory is proposed. On the basis of a historical survey of Western modernization, some essential features of modernity are extracted from the key events or movements in Chapter 1. In particular individualism and industrialization are identified as the two general essential features of modernity. Roughly individualism covers the political and cultural areas and industrialization covers the economic area. They jointly distinguish a modern society from a premodern one. Chapter 2 talks about an alternative modernity. An alternative modernity is said against the Western modernity, which is treated as a model and reference. The essential features of modernity are extracted from Western modernity. An alternative modernity also needs to be based on Western modernity. In order to clarify what can be counted as an alternative, essential and peculiar features of Western modernity need to be identified. These are scientism, capitalism-commercialism and democracy. A common thought behind them egalitarian universalism is also unveiled. So a form of modernity has to go beyond these features in order to

be an alternative to Western modernity. This is a strong alternative modernity compared with Feenberg's weak one.

Part II is a preparation for the technology theory of this essay. Several major existing theories of the relationship between technology and culture are examined. The examination is carried out on the basis of an analysis of technology, which is the task of Chapter 3. Specifically, built on the dual characterization of technical artifacts, technology is analyzed into three major elements, the scientific, design and functional elements. These three elements are not separable components of technology, but just different aspects of the same entity. However the analysis makes the examination of the existing theories clearer and easier. The theories are grouped into the traditional and contemporary theories, along the neutrality vs. culture-ladenness dichotomy. Chapter 4 deals with the traditional theories. It's demonstrated first that the general foundation of neutrality is the scientific element of technology. For this purpose the neutrality of science in a certain sense is defended against historicism, post-modern criticism and constructivism. Technological determinism and common sense instrumentalism both claims the neutrality of technology. The former regards technology as an autonomous determining power, whereas the latter treats it as an instrument that fits into a straightforward functional slot. The contemporary theories of technology are discussed in Chapter 5. Similarly, the design and functional elements of technology are shown as the foundation of its culture-ladenness. This is a relatively easier task. Then three major theories are examined. Feenberg's theory of underdetermination is derived from the constructivist theory of technology. It claims that technical factors themselves cannot determine the design of a technology. So it has to do with culture-ladenness in terms of design. Ihde's ambiguity theory reveals that the function of a technology is ambiguous without a particular cultural context. The same technology could have quite different functions in different cultural contexts. This is in fact a theory of culture-ladenness in terms of function. Finally Winner's politics of artifacts theory can be deemed as having to do with culture-ladenness in terms of both design and function.

Part III is the core of this essay. It develops a synthesized theory of technology on the ground of the existing theories and then combines it with the modernity theory to provide an answer to the core question. What should we do with modern technology? On the one hand we should embrace it with all the benefits and progress it brings. On the other hand we should control it in order to avoid the problems it causes. Generally speaking this is an embracing-controlling-stance on modern technology. This may appear to be a common sense. But the thinking behind it is far from trivial. First an inspiration for the embracing-controlling-stance can be obtained from the field of photography. Chapter 6 spells out that inspiration. Photography carries the combination of technology and art. Although photography equipment is loaded with cutting edge modern technologies, technology can only facilitate photography practice to a certain extent. Of the four basic elements of photography works technology may help with exposure and focusing, but can contribute nothing directly to composition and attractiveness. These latter two are the art part, which is the core of photography. So the general message about technology in photography is that, it helps but falls short of the core.

The following two chapters handle the two aspects of the general stance in turn. To defend the embracing stance the dystopian substantivism of modern technology needs to be rebutted. This is one major task of Chapter 7. Specifically four influential substantivist theories of modern technology are examined. They are Heidegger's Ge-stell as a new ontology, Ellul's predominant efficiency, Marcuse's one-dimensional thinking and Borgmann's device paradigm. They all treat modern technology as a substantial part of culture that shapes the whole culture. For each of the theories the feature it picks is explained in the general cultural context. The goal is to show that modern technology is not the real culprit of the various problems in modernity. Instead we need

to find the root cause in the cultural context behind modern technology. Once modern technology is proved innocent it can be whole-heartedly embraced. The main theory of the essay is introduced in the second half of the chapter. It's a technology theory called cultural instrumentalism. Its central claim is that technology is a culture-laden instrument of the core of culture. A key idea is to divide culture into material, lower and higher cultures, so that the subtleties in the relationship between technology and culture can be better captured. It turns out that all the major existing theories become a part of this synthesized theory. Then this theory and the modernity theory are combined to interpret the phenomenon of modern technology. A primary prescription for the modern malaise is also suggested. It's no other than going for an alternative modernity.

Chapter 8 deals with the controlling stance on modern technology. A three step approach is adopted. The first step of control is to recognize the limit of technology. The focus here is the strong Artificial Intelligence (AI) and Dreyfus's critique of it. But they are both put in a larger context. The strong AI, which is supposed to create human intelligence with computers, is put in the materialist worldview of modern science. And Dreyfus's critique of artificial reason is interpreted as an important step on the path leading to a new worldview. That can be called organizational naturalism. In the materialist worldview everything can be reduced to its matter. On the contrary, organizational naturalism recognizes organization as another dimension of the world besides matter. Further natural and cultural evolutions have generated an organizational spectrum containing five major levels of organization. With this organizational spectrum a variety of existing fundamental dichotomies can be reconciled, including that between rationality and meaning, a basic issue in the modernity theory. Generally speaking, the limit of modern technology is due to the materialist worldview it adopted with modern science. Hence it falls short of meaning and high values. The second step of control is to show that even within its limited scope modern technology needs to be further controlled owing to its unprecedented power. Without appropriate control irreversible damage could result. The focus here is the environmental problem. The power of modern technology has greatly increased the scope of human actions. A certain kind of new ethics is needed to cope with this new situation. The third step is about a direct control of modern technology. That is the recent development of technology assessment and regulation. The assessment is performed by professional institutes on specific technologies and the regulation is carried out by the government mostly in the form of established laws. So this is a direct control compared with environmental ethics. When a direct control is carried out properly it can be much more effective and high values may be directly embedded in it.

After the central embracing-controlling-stance on modern technology is defended, it's applied to four cases in Part IV. The cases are traditional China, Chinese modernization, medical technology and information technology. The former two cases are relatively general, whereas the latter two more specific. The four chapters in this part handle these cases in turn. Chapter 9 is about traditional China. The interest in it still lies in its technology. Needham's famous study has revealed the fascinating world of Chinese technology. Although technology was well developed in traditional China, it never dominated culture. What stood in the center of Chinese traditional culture is a unique type of humanism. On the one hand technological innovations were highly encouraged, but on the other hand technology only played a subordinating role. In general traditional China offered a perfect historical implementation of the embracing-controlling-stance. When history entered the Modern Age the situation became quite different. Modern science and technology has overshadowed the once advanced Chinese technology, and China has been forced unto the path of modernization. Chinese modernization is the topic of Chapter 10. The path that has been trodden is apparently dominated by the adoption of modern science and technology. This can be seen in the three major phases. But the modernization of such a unique and enduring

culture cannot be as easy as a direct adoption. Given China's successful past, important elements from Chinese culture are extracted and suggested to be contributive to an alternative modernity. For China itself its modernization can only be a synthesis of its tradition and modernity. Before Western modernity Buddhism had no less impact, but Chinese culture had managed to handle that successfully by adaptation and assimilation. The way to meet the new challenge should be essentially the same. In terms of technology a new implementation of the embracing-controlling-stance in the Modern Age is urgently needed. If China can achieve this new synthesis, it will be automatically an important contribution to mankind.

The last two chapters deal with two specific technologies, medical technology and information technology. They have the same structure. Together they show how the embracing-controlling-stance may be applied to specific technologies. Chapter 11 first makes a historical survey of modern medical technology. Its philosophical foundation is the mechanical view of the human body. Under this view modern medicine has made big progress. Advanced surgical technologies and pharmacy have improved and saved many people's lives. Therefore modern medical technology should be warmly embraced. But on the other hand the overdependence on modern medical technology has made people overlook other factors of health and the abuse of it has even caused more health problems than it actually cures. Further, recent advancement in medical technology, especially in the area of reproduction, has brought about fundamental ethical issues. How to use the technology in an appropriate way is a question worth considering. Similarly Chapter 12 makes a brief review of the several-decade history of information technology first. People have been talking about an information revolution. Although it's debatable to claim that information revolution has a parallel scale with the Industrial Revolution, it does greatly improve automation and communication, which are actually two basic components of the Industrial Revolution. Perhaps only the so-called virtual world generated by software simulation is something new. In this information world made possible by computers a kind of degradation gradually shows up. Books are first turned into magazines and then magazine articles are turned into scattered multi-sentence paragraphs, containing frequent grammatical errors. Another aspect is the out-of-control of information. Under the principle of freedom of speech, all kinds of information are suddenly put on the universal internet and become accessible for everyone. The loss of organization and control represents the core of degradation. Therefore the need of control is more straightforward in information technology.

I Alternative Modernity

"Modernity" is a rather vague word. "Modernism" has been used to refer to an art form in the 20th century. "Modern" is even used as the equivalent of fashionable. But in this essay "modernity" refers to a particular historical period and the thoughts, styles and institutions corresponding to it.

The Modern Age in the West is said in contrast to the Middle Ages or the medieval period. In the Middle Ages Christianity dominated Western life. The Christian dominance permeated in every aspects of human life, in people's world outlook, in politics and in everyday life. Life then could still be divided into sacred and secular, but apparently the former had the absolute upper hand. People's worldview was centered on the Bible. In politics the state was ruled by a monarch, but the power of the monarch had to be granted by the clergy. And God worship was an essential part of people's daily life. After centuries of development since the Roman period the Christian culture finally got into the state of decadence. The Modern Age just grew out of that decadence.

There is no clear boundary between the Modern Age and the Middle Ages. Rather there is a big overlap between the two periods, with elements from both coexisting for about three centuries. The modern elements can be clearly seen as early as the Italian Renaissance. The thought at the core of Renaissance was humanism. Man was no longer regarded as an inadequate, ignorant and impotent being carrying an original sin, but instead an existence who through the mastering of thought and art can determine his own fate. "Independence of mind" was the brand of the age and a "complete man" was the ideal. The Renaissance spirit is perhaps best described by Hamlet's words in Shakespeare's play (*Hamlet* Act 2, Scene 2):

> What a piece of work is a man! how noble in reason! how infinite in faculties! in form and moving how express and admirable! in action how like an angel! in apprehension how like a god! the beauty of the world! the paragon of animals!

As Davies says, "Left to itself, humanism will always find its logical destination in atheism. But mainstream European civilization did not follow that extreme road." (Davies 1998: p. 480) Definitely, from centuries of Christian culture to atheism would be too radical. There needed to be a moderate path.

The Religious Reformation was that moderate path. Ever since Luther posted his 95 Theses the Western spiritual life hasn't been the same. Luther's new doctrine was that of "justification by faith alone." In other words, man could obtain salvation by interacting with God alone. In this way God and the Bible were preserved, but at the same time the clergy became redundant. Although looked from outside the Christian world this is just a reform, it's no less than a revolution from within. And in fact it's not merely a revolution of thought, but a political revolution. Different states shortly aligned with different religious camps, and wars were inevitable.

"The Wars of Religion offered fertile soil for the fragile seeds of reason and science." (Davies 1998: p. 507) The Scientific Revolution next came into scene. Copernicus, Galileo and Bacon were the three heroes at the beginning. While Copernicus challenged the long held Christian geocentric worldview, Galileo and Bacon emphasized the two fundamental scientific methods: mathematics and experimentation. In a sense the Scientific Revolution was a result of the Renaissance humanism and the Protestant attitude. Although science revealed a totally new picture of the world than Christianity, I propose, it aligned itself more with the Religious Reformation than the Renaissance. It's not just because most of its foundation layers were as devout Christians as others, but because the concept of something like God is behind the scientific endeavor (cf. 9.1.1.4). Traditionally it's "the Great Clockmaker" and now it's the Grand Unification Theory. Unity and universality are built-in scientific pursuits.

The Enlightenment obviously built itself up upon the achievements of the Scientific Revolution. With mathematical methods the Scientific Revolution had demonstrated the power of human reason. The Enlightenment hence raised reason to a paramount place. Kant defined Enlightenment as "man's going out of his self-inflicted immaturity. Immaturity is the inability to use his own understanding without the guidance of another." Therefore, everyone already has reason as his potential faculty and the important thing is to use it *independently*. Human reason was deemed to have "natural light", and with this light all the darkness in the world could be enlightened. A little deeper reflection could reveal the problem with this kind of rationalism. Reason is apparently just one of the faculties of human mind. And it plays little or no role at all in many human activities, such as moral judgment and the creation of art works. Romanticism just emphasized the human experience that is beyond the scope of reason. But the dissenting voice of Romanticism soon was suppressed in the Industrial Revolution and especially its material success thereafter. The Enlightenment thought took root. Although Romanticism tried to resist several times later, rationalism dominated the stage.

The Renaissance, the Religious Reformation, the Scientific Revolution and the Enlightenment were mostly movements of letters, whereas in the Industrial Revolution the new ideas and especially the new science bore fruits. The Industrial Revolution featured in the invention of the steam engine and a bunch of power-driven automatic machines. With the invention modern factory was born. The machines required a large number of workers working together and a finer division of labor. Therefore a new production relationship came into being. So did the production motivation and target. Now the production was mainly motivated by generating profit for a certain amount of capital, and it's targeted at the market. As long as it could gain profit, how to produce didn't matter; as long as the products could be sold on the market, what to produce didn't matter. These were capitalism and commercialism. At the beginning the technical inventions seemed to have nothing to do with science. Little Newtonian mechanics was used in the invention of the steam engine and other machines. But later science played a more and more important role in technical advances. Generally the Industrial Revolution deified science and solidified the Enlightenment thought. With the Industrial Revolution almost completed Western Europe was set to conquer and dominate the world.

The Industrial Revolution was an economic revolution. A corresponding political revolution occurred during the same period. The independence of America to some extent triggered a similar political revolution in Europe. The French Revolution shook the European social order and paved the way to liberalism and democracy. Before the revolution France, in fact the whole Europe was ruled by monarchs. The monarch had absolute power over the people, as vividly illustrated by Louis XIV's famous words "L'État, c'est moi!" Hence this kind of polity is called monarchy. In contrast democracy means the rule of the people. In a democracy the government should be constructed based on the will of the people and governs the society based on a clearly specified set of laws. Under this principle the particular form of parliamentary system with power balance was finally established. Universal suffrage and freedom of speech were later development.

We've briefly reviewed the major events in the cultural, economic and political realms during the Western modernization process, roughly in historical order. Now we may come back to the recent time. After over a century of domination Europe finally eclipsed in the two World Wars. The center of world power shifted to the United States. Now the US is also facing unprecedented challenges: terrorism, financial crisis and the rise and competition of emerging powers, to name just a few. Since the Industrial Revolution Western intellects have started to reflect on Western modernity. Marx's *Das Kapital* was a prominent work in the early phase. The two World Wars made the reflection deeper and more comprehensive. The Critical Theory originated in the war

period whereas postmodernism was a major philosophy and art movement in the post-war period. Now even the word "decadence" has been heard. As Barzun puts it: (Barzun 2000: p. xx)

> But why should the story come to an end? It doesn't, of course, in the literal sense of stoppage or total ruin. All that is meant by Decadence is "falling off." It implies in those who live in such a time no loss of energy or talent or moral sense. On the contrary, it is a very active time, full of deep concerns, but peculiarly restless, for it sees no clear lines of advance. The loss it faces is that of Possibility. The forms of art as of life seem exhausted, the stages of development have been run through. Institutions function painfully. Repetition and frustration are the intolerable result. Boredom and fatigue are great historical forces.

As history moves into a new Millennium mankind is standing at a crossroads. New transportation and communication technology has connected humanity as never before. Foreign goods and visitors can be seen everywhere. Enterprises are globalized. And more and more people are playing a more and more important role on the international stage. Mankind is facing many challenges, such as global warming, resource shortage and incessant cultural and political conflicts. But with the decline of the American hegemony it has a chance to build a new world order, an order in which reason still plays an important role, but feelings, emotions, imaginations, intuitions and insights are duly respected at the same time, in which universality is no longer held to be the sole principle, but diversity is also wholeheartedly encouraged, in which tolerance and cooperation are not just spread within a state, a nation, but also internationally, in which personal freedom is still regarded as a fundamental value, but knowledge, cultivation, vision and even some tastes are again deemed as essential parts of freedom.

The construction of this new world order has to be based on Western modernity, for the sheer reason that the West has led mankind into the Modern Age and Western modernity contains many values and institutions that should be inherited in this new order. But the problems that have appeared in Western modernity also make corrections or reforms necessary. The sources of some reforms can be found within the system itself, but in many cases we have to look outside. In fact a more accurate reflection on Western modernity can only be achieved when it is put in its historical and cultural context. The criticism from Western intellectuals has paid enough attention to the historical context. But after decades of comparative cultural studies the cultural context is also becoming clearer and clearer. In this way traditional Western thought and ideas from a different culture may contribute to this cause.

Facing the issues in Western modernity people have started to talk about alternative modernity. The alternative modernity theory was developed out of the Critical Theory, which in turn originated from Marxism. Since Marx Western intellectuals have launched various criticisms of Western modernity. The Frankfurt school played an important role. The Critical Theory they created and maintained not only brought the criticism up to the recent developments of Western society, but also greatly influenced the contemporary criticism. Andrew Feenberg is a prominent advocate of alternative modernity theory. He is a student of Marcuse, and the latter is a key figure in the Frankfurt school.

Feenberg's alternative modernity theory is based on a constructivist theory of technology, which holds that technology is neither neutral nor autonomous, but undergoes social construction just like other institutions. This opens a space for an alternative modernity. By democratizing the technical design we could put technology well under control. I would call this approach a weak alternative modernity. In contrast I propose a strong one. Instead of trying to find an alternative within the framework of Western modernity I cast my sight onto the multi-cultural context.

However Western modernity has priority. Alternative modernity contains two components, modernity and alternative. Correspondingly the priority of Western modernity is reflected in two aspects. First, Western modernity should be treated as a model of modernity. The concept of modernity must be formulated on the basis of Western modernity. Second, Western modernity should be treated as a reference for alternative modernity. An alternative modernity must distinguish from Western modernity in non-trivial ways. Therefore we have three distinct concepts of modernity: modernity in general, Western modernity and alternative modernity. Alternative modernity is parallel to Western modernity and both are a special form of modernity in general. This is the static logical relationship. In terms of conceptual genetics modernity in general and alternative modernity are both derived from Western modernity. The two chapters in this part deal with the two components in turn.

The focus of this essay is on technology, but alternative modernity theory provides the framework within which technology will be discussed. In this part I shall set up a preliminary strong alternative modernity theory. Due to the limit of scope, the ideas brought up may not be supported by sufficient arguments. These have to be left for future development.

1. Modern vs. Premodern: The Essential Features of Modernity

As we mentioned alternative modernity contains two components. First an alternative modernity has to be *modernity*. So as the first step we must determine what modernity is, or the criteria for modernity. Second an alternative modernity has to be an *alternative*. That means an alternative modernity must be different from Western modernity in some important aspects. As the second step we need determine in what respects an alternative modernity must be different from Western modernity. Both tasks have to be based on Western modernity. It's treated as a model in the first task, but a reference in the second. The tasks boil down to grouping the essential features of Western modernity into two groups: the first group that is also essential to modernity in general (hereafter the qualification will be omitted) and the second group that is peculiar to Western modernity. Distinguishing these two sets of features is a fundamental part of my modernity theory.

The essential features of modernity are extracted from the key events in the process of Western modernization. We may list the events as follows, with their key features in parentheses:

Renaissance (Humanism, Independence of mind, Complete man)
Religious Reformation (Private conscience, Justification by faith alone)
Scientific Revolution (Mathematics, Experimentation, Unity, Universality)
Enlightenment (Autonomy of reason, Reason as the paramount tool)
Industrial Revolution (Mechanization, Specialization, Capitalism, Commercialism)
Political Revolution (Democracy, Power balance, Rule of the law, Human rights)

It's safe to assume that these key events and features sufficiently characterize Western modernity. Taking a closer look at them we can find that a general idea is contained in all the events. That general idea is individualism. Individualism gives individual person the first priority.
In Davies' words: "The cultural interest in human beings, the religious interest in private conscience, and the economic interest in capitalist enterprise all put the individual centre stage." (Davies 1998: p. 483) We may look at each of the events in turn. The humanism of the Renaissance is an anthropocentric idea. And the independence of mind and the concept of a complete man are both about an individual. The independence is not just about being independent of the theocratic religious institutions of the Middle Ages, but of other people. A complete man can only be a single man. The private conscience of the Religious Reformation obviously also belongs to an individual. Faith is an individual property too. Science was originally a personal endeavor, and the Scientific Revolution culminated in Newton with his mechanical laws and the law of gravitation. On the basis of the success of science the Enlightenment emphasizes reason, an individual's intellectual faculty. In the economic realm the entrepreneurship in capitalism certainly is also individualistic. Self-interest is glorified as a benign driving force. And finally democracy grants political rights to each of the individuals in a society, while human rights universalize some of the individual rights.

This strongly suggests that individualism is an essential general feature of modernity. In the Middle Ages an individual didn't have much value. What's most valuable was the Bible, thereafter came the clergy, then the monarch. A common person was at the bottom of society. On the contrary, in the Modern Age an average individual is put at the center of the cultural, economic and political realms. A cross-cultural comparison can provide more justification for this claim. Although there were important differences between Chinese traditional feudal society and the Western medieval society, they share some common characteristics. Chinese society was mostly irreligious (cf. 9.2.1.1), but people's mind was influenced by superstition and systematic feudal rules and regulations governed people's relations and manners. Corresponding to these

rules and regulations there was strict social order. A subject had to obey the emperor, a son the father, a wife the husband. Even a younger brother had to obey the elder one. In general an individual was bundled in a web consisting of ethical rules and regulations and political laws. Personal freedom was limited. In this case society had the highest priority, whereas an individual had much less value. As Chinese society is getting more and more modernized, the individual should also obtain more and more freedom.

Individualism is mainly related to spiritual and political affairs. It cannot cover modern economic characters, especially the modern production model. To make the essential feature set complete, besides individualism we have to add industrialization. The modern economy is an industrialized economy and the modern production is an industrialized production. Although machines had been used in a traditional workshop, they had never become as automatic, powerful and efficient as those that were invented in the Industrial Revolution. This new production method distinguishes modern production from the traditional one. This is the case also on the cross-cultural level. Technology had been well developed in the traditional Chinese society and China had been leading in a bunch of technical areas, but compared with modern technology traditional Chinese technology becomes primitive. In this sense we should include industrialization in the essential feature set of modernity.

Historically individualism and industrialization go hand in hand in most of the time, but logically they are mutually exclusive and complementary. Individualism doesn't imply industrialization. It's not reasonable to claim that modern technology and production model necessarily follows from individuals being put at the center of value. The rise of modern science and technology requires a more complex historical context than just individualistic ideas and institutions. On the other hand, industrialization doesn't imply individualism either. In fact the first set of inventions in the Industrial Revolution was done before the French Revolution, when political absolutism still dominated Europe. And once industrialization started to happen in Western Europe, it can be implemented completely in a totalitarian state as the history of Japan and the Soviet Union showed.

In general individualism and industrialization are two *necessary* features to demarcate modernity from tradition. The former outlines the modern cultural and political realms whereas the latter the modern economic realm. I also propose that these two features are *sufficient* to distinguish modern from premodern societies. The arguments should demonstrate that main features of Western modernity are contained in these two general features and other key features of Western modernity are peculiar to it. The first half is the task of this chapter and the second half that of the next.

1.1 Individualism

When we take a general view of human history from the ancient time to the present we may find an overall pattern in terms of human relations. The place of an average person has been gradually lifted. In a sense individualism already existed in the ancient time. The ideal of a sage was the core of Chinese classical philosophy and a sage was no less than a fully realized individual. In ancient Greece there was even a form of democracy, in which important affairs of the city states were decided by people's votes. But on the other hand in the time when Chinese classical philosophy was intensely developed human sacrifice was popular, and when free males voted in the ancient Greek assembly slaves were transported and sold at the will of their owners.

There were improvements in the feudal society. Human sacrifice was regarded as barbarous and slavery was commonly abolished. Human beings were no longer treated as animals. This in effect raised the human productive power, and the economic status was greatly improved. However in the feudal society people were still ruled by a monarch or an emperor, who had absolute power over the people. The thoughts, feelings and wants of an average person didn't count much. Their life and fate were at the disposal of the thoughts, feelings, and even whims of the monarch or emperor. Taxes were levied at will and services were demanded whenever needed. In Europe Christianity controlled people's mind and provided justification for the political order. Similarly in China a system of feudal ethics was developed out of the classical philosophy to maintain the social order.

Only in modern time was the value of an individual seriously considered. This was first embodied in the modern political thought. Although *Leviathan* was essentially a defense of absolutism, Hobbes first treated an individual as the starting point of political theory. The transition from a natural state of war, where everyone fights one another, to the subjection to a government, a monarch is decided by each individual and for the benefit of each individual. The crucial benefit for subjection is the protection from the monarch, the security. Political liberalism came into shape in Locke's *Two Treatises of Government*. At the core of liberalism was the concept of a social contract, according to which an individual grants some rights to the government for his own interest. A very important implication is that when the government behaves against the interest of the governed, thus breaks the contract, the latter have the very right to rebel and throw away the government. At this point an ordinary individual was put at the center of the political stage. Liberalism culminated in *The Declaration of Independence of the United States of America*:

> We hold these truths to be self-evident, that all men are created equal, that they are endowed by their Creator with certain unalienable Rights, that among these are Life, Liberty and the pursuit of Happiness. That to secure these rights, Governments are instituted among Men, deriving their just powers from the consent of the governed, That whenever any Form of Government becomes destructive of these ends, it is the Right of the People to alter or to abolish it, and to institute new Government, laying its foundation on such principles and organizing its powers in such form, as to them shall seem most likely to effect their Safety and Happiness.

Political liberalism only covers part of individualism. Politics is about interpersonal relations, about an individual's place in a society. Political liberalism grants equal rights to each of the individuals in a society, so it's essentially equality. There are also other aspects of an individual. Even when an individual is free of political or social coercion from other people, she could still be under some kind of spiritual restriction, superstition, ignorance, bias, bigotry, fanaticism, let alone all kinds of Freudian subconscious complexes. The Enlightenment glorifies reason for a reason. Reason is an effective cure of most of the traditional spiritual restrictions. Bacon demonstrated this in his *Novum Organum*, where four kinds of "idols" (those of the tribe, the den, the marketplace and the theatre) were revealed and rational methods were suggested to get rid of them. With reason Copernicus was able to topple the taken-for-granted Christian geocentric worldview and Galileo was able to challenge the long held Aristotelian theory of gravity. So the new scientific spirit no less liberated human individuals. While political liberalism liberated an individual from the coercion of political authority, science and reason liberated an individual from the coercion of spiritual authority. Science also declares independence from superstition, ignorance and bias.

Interpreted in this way, individualism seems to be able to capture the essential characteristics of Western modernity in the political and spiritual realms. Three key events in the Western modernization process, the political revolution, the Scientific Revolution and the Enlightenment

have been considered. The Renaissance can be regarded as a spiritual individualism too. The Religious Reformation can be treated as having both the spiritual and political sides. On the spiritual side personal faith was liberated from the authoritative interpretation of the Bible. This is a form of spiritual individualism. On the political side secular political state was liberated from the clergy, a step toward the political liberation of the individual.

Having identified individualism as an essential feature of modernity, next we need to analyze it and put some qualification on it. We have shown that individualism can be divided into two kinds: political individualism and spiritual individualism. And equality is a central part of political individualism. So in the rest of this section we discuss equality, sociopolitical freedom and spiritual freedom in turn.

1.1.1 Equality

In a traditional society there always existed different levels or classes of people. They didn't have to be as different as the Indian castes, but different levels had different political rights and social statuses. The word "order" reflects this fact. When we say "social order" we mean what makes a society a normal, peaceful and harmonious one. But "order" also means a sequence where things are arranged one after another. Where there is difference there is normality, peace and harmony. We may say inequality was a norm in a traditional society. Discrimination against an individual could be based on a bunch of properties, such as birth, wealth, age, gender, race, religion, even physical traits.

The modern society has gradually changed this situation. In the political revolution birth and wealth were first abandoned as the basis of discrimination. The boundary between noble and common finally disappeared. But other kinds of discrimination still existed at the beginning. It's a little ironic that, while "all men are created equal" was written in the *Declaration of Independence*, a modern slavery exited in the United States, women were denied voting rights and religious sects were persecuted. These issues had to wait for later developments, particularly the civil war, the general suffrage and the civil rights movement. The ideal of modern equality is to eliminate all superficial features for personal evaluation that were once used to discriminate people.

But all this is about the *principle* of equality. The principle seems to be straightforward, but not the practice, as the affirmative action shows. The affirmative action in the United States is sort of a correction of racial discrimination. It tries to bring the number of members from a particular race in an institution into accord with the proportion of that race in the general population. For instance, if the proportion of black people in a state is 20%, then the black students enrolled in a state college should also be 20% of all students enrolled. A possible result is that some black students with lower scores are enrolled, while some white students with higher scores rejected. The question is: Does the affirmative action conform to the principle of equality? It does in a certain sense of equality, but not in others. White students have complained that the affirmative action is a different form of racial discrimination, a discrimination against the white people this time. For if they were not whites they would have been enrolled with higher scores. This example clearly shows that equality has to do with fairness under a particular standard. Different standards may result in different states of fairness.

The sentence "All men are created equal" also needs qualification. All men are created equal in certain senses. In other senses no man is created equal. In the most liberal state today a child's fate is still to a large extent determined by his parents. Even though it's not determined by the wealth and social status of the parents, the education level and the skills of education of the

parents still count a lot. As long as a society doesn't raise all children together in a common place once they are born, like the Spartan did, the parents' influence in education cannot be eliminated. Even in Sparta there were still differences among children, as different children were born with different qualities and talents. So selection was still necessary. Therefore considering the fate of an individual we first have different genes and conditions of pregnancy, then different early cares and educations, and then different general educations and higher educations. As heredity and education essentially determine an individual's fate, this makes equality really complicated.

Following the equality principle a society could try to make things as fair as possible. First, the equal right to education is necessary. In this sense equality means equality of opportunity. This implies a tuition free education for all. A significant tuition without effective financial assistance would deprive many talented but poor students from receiving an appropriate education they deserve. Second, for the inequalities a society cannot avoid, such as those in talent, family education, physical properties the society could try to correct them through wealth redistribution.

Apparently there are many issues with wealth redistribution. An extreme case is the communist principle of "distribution according to needs." The problem with this principle is not just that people's needs are vague in many cases, but also that the principle greatly reduces the motivation to work. If the gain is based on a vague principle and no matter how hard one works the gain is the same, then why do people work hard, or even work? So the normal result is the lowered production and finally the decomposition of the commune as history has shown. Perhaps this kind of distribution is only suitable for a community of saints, but nobody is a saint in the strict sense.

Rawls's theory of justice is a social contract theory based on a thought experimental "original position" with "a veil of ignorance". Behind the veil of ignorance a person doesn't know anything about his social characteristics such as class position and social status, nor does she know anything about her personal properties such as abilities, intelligence and strength. The person needs to make rational decision on what principle to follow in order to maximize his own prospects. The result is the difference principle: "social and economic inequalities are to be arranged so that they are […] reasonably expected to be to everyone's advantage" (Rawls 1999: p. 53). "Everyone" means everyone regardless of his characteristics. An implication of the difference principle is that a person is not entitled to the benefits from his talents. This is counter-intuitive to many people. The veil of ignorance strips away every feature from a person except reason. Then do there still exist individuals? If even a person's talents are regarded as social properties, how far is this from communism?

Rawls's theory is certainly in line with a welfare society. In a welfare society a bunch of benefits are provided to anybody in need, such as food stamps, health care, unemployment compensation and pension. There are also issues here. While most industrialized nations including Canada, Germany and many other European countries already have a comprehensive welfare system, there have been hot debates as to what should be included in the welfare system in the US. This is a major battle field between republicans and democrats. The health care debate was the most recent.

My personal stance is that the central part of equality is that of opportunity, i.e., free pregnancy medical care, free child care and free education; social benefits for the naturally weak, such as disabled, old people and natural disaster victims are well justified; social benefits for ordinary people should be limited to the humanitarian very basic needs of life. Generally the society is responsible for granting each individual equal opportunity to realize her potential. But the individual is responsible for doing that herself.

1.1.2 Sociopolitical freedom

Equality and liberty are two aspects of individualism. They both have an individual as the starting point. Equality is about an individual's place in the society and liberty is about removing social and other restrictions on an individual. In this sense equality and liberty go hand in hand. However in a different sense there also exists tension between equality and liberty. A too relax principle of equality could mean a hindrance to liberty. In the extreme case when equality is interpreted as identity there would be no liberty. Communism seems to be an approximation of this.

Liberty is about personal freedom. Personal freedom includes freedom in two aspects: sociopolitical freedom and spiritual freedom. In the sociopolitical aspect, a person is no longer an obedient member of a church, or a subject of a king, or even a property of his parents. She can make decision on her own life and determine her own fate. Sociopolitical freedom is a major fruit of the political revolution in the modernization process. It includes mainly freedom to vote and to be voted, freedom of property, freedom of speech and assembly, and freedom of religion.

The issues with sociopolitical freedom are trickier than those of equality. An inappropriate principle of equality may go against liberty, but an excess in liberty may go against itself. Equality is an interpersonal property. Under any principle of equality a society is always equal. On the contrary, the center of liberty is a particular individual. Since people live in a society except the very rare cases and people's interests often conflict with one another, the liberty of this person may contradict that of another. So in the individualist political theory there has always been the tension between an individual and the society to handle. Unconstrained personal freedom will definitely lead to the destruction of the society and hence the forfeit of personal freedom.

As depicted in the Western films, many people in the American West of the nineteenth century had to carry guns to protect themselves. This had become a rooted tradition which cannot be gotten rid of even in the contemporary society with well established laws and police. In fact carrying weapons is a fundamental right mentioned in the Constitution, because the United States was created by a revolt of the colonial people and weapons among the ordinary people played a crucial role for the success. Even today many people still think that weapons among the society is necessary to prevent the tyranny of the government, although the government has control of the military equipped with all kinds of most advanced weapons while the people have mostly handguns. Other arguments have also been formed to counter gun control maneuvers. One is that the police are not sufficient to protect the people, so when people have guns the crime rate could be reduced. A more straightforward argument is that carrying guns is part of a person's freedom, with which she may enjoy hunting and other sports. But the fact is, being the only country with widespread guns among society the US has the highest crime rate and people don't feel safe to walk on the streets during night in many cities. Mass murder events involving innocent people have happened again and again. Each time a hot debate concerning gun control appeared but shortly everything kept usual.

Mill tried to reconcile an individual with the society. In *On Liberty* he proposed the following principle (Mill 1989: p. 13):

> That principle is, that the sole end for which mankind are warranted, individually or collectively, in interfering with the liberty of action of any of their number, is self-protection. That the only purpose for which power can be rightfully exercised over any member of a civilized community, against his will, is to prevent harm to others. His own good, either physical or moral, is not a sufficient warrant.

With this principle a boundary is drawn clearly between the private and the public spheres. Only when harm is done can the society interfere with an individual's private sphere, otherwise it's none of the society's business. I call this voluntary liberalism, because an individual's will is used as the final criterion. Mill's *On Liberty* is a milestone in the history of liberalist thought. It strongly emphasizes social freedom alongside political freedom. With it freedom of thought, freedom of conscience, freedom of speech and freedom of assembly become as important as freedom from political oppression.

But the question is, does this principle based on an individual's will conform to the genuine spirit of personal freedom? This principle can be used to argue in favor of gun control, as wide spread guns in the society actually cause harm to people. What about pornography? According to some statistics the number of pornography websites in the US is the biggest among all kinds of businesses, and millions of people are addicted to internet pornography. Can we call this addiction personal freedom? If visiting pornography websites is totally a private matter, then what about prostitution? Prostitution involves a different party. Defenders may still say that the party involved willingly sells sexual service, keeping their eyes off from the issue of human trafficking as sex slaves. OK, if willingly selling sexual service still can be regarded as personal freedom, then what about willingly selling an organ, like a kidney? I believe a majority of people would think this last case immoral as it goes against human dignity. When the meaning of a person is in question how can we still talk about personal freedom? We have gradually slid down a slippery slope and reached an end we originally didn't intended. And all these cases conform to the principle of voluntary liberalism.

The latest development of the human rights movement should also be mentioned here. In a sense human rights are a result of liberalism, but it has universalist and egalitarian flavors. Human rights are rights of any human being, not of a citizen of a particular state. So it's an international concept. There are debates concerning what should be included in the fundamental rights of any human being. I just want to show here how the spirit may go astray when human rights are not qualified properly. The first example is about rights of criminals. Many human rights activists think that death penalty violates the criminal's fundamental right to life. So when it's obvious that a serial killer intentionally murder many people probably only for fun, he still doesn't deserve a death penalty. However, if the criminal has right to life, then what about those victims? They also have right to life, and are deprived of it by the criminal. There are hot debates concerning death penalty. Death penalty shouldn't be a way of vengeance in the sense of "an eye for an eye" (in fact in this case it can only be an eye for many eyes), but carrying it out appropriately is an effective deterrent to prevent similar things from happening again, hence in favor of people's right to life. A general principle of universal right to life cannot handle conflicting cases like this. Another thing is the treatment of criminals in prisons. It seems to me some human rights activists would complain about any harsh treatment of prisoners. But a prison is built to punish people. When a prison becomes a vacation village, or a place for criminals to build connections so that they are in a better shape to break the law again, when human rights degrade to criminals' rights, no wonder the crime rate keeps high and prisons run out of place and need to be expanded. The second example is about rights of minors. The recently published book *Battle Hymn of the Tiger Mother* has brought about a hot debate about the education status in the US. Some people realize that the American education is too lenient, permissive to the students. Teachers hesitate to punish students in the school being afraid of complaints from parents and parents hesitate to punish children at home because they are protected by law. Children are smart enough to take advantage of this. When they see a punishment is coming they could threat to call the police. The result is that the children can do whatever they want and the general quality of education slides. This is a consequence of expanding human rights to minors without any adjustment. The interesting thing is that right after Mill proposes the above principle he declares explicitly: "this principle is meant

to apply only to human beings in the maturity of their faculties."(Mill 1989: p. 13) I'm not advocating that children should be educated with the ways described in the book. Activeness, creativity and free development are all important, but an appropriate amount of restriction and guidance are the guarantee. Generally speaking it's an advance that human rights movement extends individual rights beyond borders, but it has to be careful about the scope of human rights.

1.1.3 Spiritual freedom

Spiritual freedom is a different kind of individual freedom. While sociopolitical freedom is freedom from the society, the government, other people, spiritual freedom is freedom from spiritual restrictions. Human mind can be roughly divided into the intellectual and the emotional sides. The intellectual side is about beliefs, knowledge, vision and the emotional side is about drives, feelings, tastes. So spiritual freedom can also be divided into intellectual freedom and emotional freedom. Correspondingly intellectual restrictions include superstition (unfounded belief), ignorance (lack of knowledge), prejudice (belief grounded on partial or one-sided knowledge), etc. Emotional restrictions include low interest (lack of high drives), unpassionateness (lack of drive), irritability (easily annoyed), etc.

Reason and science are powerful tools to remove intellectual restrictions. Logic can reveal that a superstition is unfounded and a prejudice one-sided. Science has made many discoveries of the world and greatly expanded human knowledge. Therefore reason and science are indispensable for spiritual freedom. With their intellectual victory over superstition, prejudice and ignorance of the past and the associated material victory over nature, reason and science have been put on the sacred altar for people to worship. And there have always been many loyal defenders around them. If anybody dares to point his finger at them, those defenders will immediately jump up and launch a counterattack. The counterattack doesn't have to be fierce. Normally after the defenders call the offenders "irrational" or "superstitious", the former may think they have a victory. Only in the recent "science wars" things started to get a little complicated.

It has long been held that reason and science are the only paths to truth, the scientific world is *the* world, and only science is powerful to lift mankind out of the dark ages of the past and able to promise a prosperous future. But a little deeper thinking makes us suspicious. Reason is just one faculty of the human mind, then how can it be so dominant? There are many things in our life that have little or nothing to do with reason. Most of the realm of art and a majority of the realm of morality are beyond the scope of reason. When one is awed by a photo or moved by a piece of music, she just feels it, but cannot tell the reason. She even cannot find the words to describe the feeling itself. We may form arguments in ethics, but the premises of the arguments have to be based on intuition. Ethics is about what one should do. If everything could be deduced from facts then there would be no ethics. If reason cannot cover everything that is important to human life, science has even a less scope. Reason and logic are just part of the scientific principles, empiricism is another, and in the strict sense science also requires quantification and universality. Empiricism greatly shrinks the scope, because there are many things that can be argued but have no empirical evidence as defined by science. Psychology provides a good example here. When awake everybody has intuition about his consciousness, and reason doesn't seem to be able to function without consciousness, but when asked to prove the existence of consciousness in the scientific sense of proof we have to keep silence. Freudian psycho-analysis has well-formed logic within itself, but it has been denied by many people the status of science because there is no satisfying empirical evidence involved. If we add quantification and universality, then not only all the social sciences should be excluded, but even natural phenomena such as the weather of a certain place.

Positivists tried to purify human knowledge by identifying and throwing away all kinds of "metaphysics," but only ended up revealing the limited scope of science. Kuhn's *The Structure of Scientific Revolutions* started a serious endeavor to dethrone science. Before science was pure, detached, objective and accumulative but hereafter it became theory-laden and revolutionary. In the postmodernists' eyes science is just one story of the world among many others possible. The environmentalists and feminists even accuse science of being aggressive, dominant, and the worst word associated with science is "rapist." Some of the attacks on science in the recent science wars may turn out to be too excessive. But one thing is for sure, we need to reevaluate science's place in human life. And this is closely related to spiritual freedom discussed here. If one insists that reason is the only tool useful and only science can provide knowledge about everything in the world, and turns a blind eye to any criticism in this respect, he may be restricted by a new form of superstition, prejudice and ignorance.

Historically science grew out of philosophy. They both share reason as an essential tool. But besides reason science added mathematics and experimentation, whereas philosophy kept intuition and insight. Here is where they diverged. Mathematics and experimentation can be applied well to many phenomena. These belong to areas where science is successful. But beyond those areas we still need philosophy to obtain knowledge. Even with philosophy added we can only cover the intellectual side. As we move to the emotional side art becomes necessary. Art is not restricted by reason and logic, so it's a better embodiment of spiritual freedom. Whereas on one end science emphasizes reason and universality, on the other end art emphasizes imagination and uniqueness. A great scientific theory needs to cover a universal area and can be universally proved. On the contrary a great art work has to be unique and imitation immediately nullifies the value. Philosophy stands in the middle. Although philosophy needs logic in most cases, insight is more important. A great work of philosophy needs to bring up new issues, a new vision, but the resolution of those issues is not as important.

Spiritual freedom needs all three areas. Reason without insight may be still biased, and reason without imagination may be too static. But on the other hand, we cannot do away with reason either. Otherwise we could slip back to the dark ages. For insight without reason will be suspended in the air and imagination without reason could become really blind, even crazy. To borrow Nietzsche's words we need to have both the Apollonian and Dionysian spirits and keep a good balance of them. In fact Western modernity doesn't lack the realization of this ideal. The Italian Renaissance had much focus on a "complete man," with da Vinci as the icon of the age. His interests and achievements spread to over a dozen fields in all the three areas of science, philosophy and art. Many historians think Goethe was the last true polymath. He was mainly a poet, playwright and novelist, but also had achievements in philosophy and science. In the current age of information explosion, the ideal of a complete man becomes impossible to realize. But with the rise of interdisciplinary studies it's still possible and very beneficial for a person to get involved in fields crossing the three areas.

Da Vinci was a Renaissance man and Goethe was a key figure in the Romantic Movement. With the dominance of reason and science humanism and romanticism were rejected from the cultural main stream. And in voluntary liberalism an individual's will is put at the dominating place. In the US we often hear people say, "America is a free country. I can do whatever I want." However, personal freedom probably has more to do with what one wants to do rather than to do what one wants. Under the rule of reason and will combined, many social phenomena today are easy to understand. It won't be a surprise when we find that the icons of the current age are computer programmers, popular singers and sport players.

When we take individualism as an essential general feature of modernity from Western modernity, we have to make careful qualifications and modifications. We have shown in all the three aspects of individualism, that is, equality, sociopolitical freedom and spiritual freedom, there exist issues in Western modernity. The case is the same with the other general feature.

1.2 Industrialization

Individualism interpreted as the combination of equality, sociopolitical freedom and spiritual freedom captures the essential concepts and ideas in the Renaissance, the Religious Reformation, the Scientific Revolution, the Enlightenment and the political revolution, which are the major cultural and political events in the Western modernization process. To make modernity complete we have to consider the economic realm too. There are also essential differences between the modern economy and the premodern one.

In the primitive societies people made a living by taking things directly from nature, by collecting fruits from plants and hunting animals. This is the hunter-collector stage. Then came the agricultural revolution, in which people started to cultivate some selected plants and raise some selected animals. This ushered the second stage of economy. Human beings have been using tools since the very early time. At the beginning tools were mostly weapons for hunting animals and fighting enemies and utensils for daily life, such as cooking and sewing. But later on complex tools were invented and they spread to the areas of housing, transportation and production. According to the material used in the tools historians also divide the ancient history into the Stone Age, the Bronze Age and the Iron Age.

With the Industrial Revolution the history of economy moved into the modern stage. The hallmark of the Industrial Revolution was the invention of the steam engine and other power-driven machines, mainly for spinning and weaving at the very beginning. But all kinds of engines and machines were invented later. After the steam engines there were internal combustion engines and electric motors, and recently nuclear powered engines were also used in power plants and the military. And machines have spread from production to daily life. Machines have since long dominated not only the scene of a factory, but also human transportation and the household. Take a look around our houses. There are cars, washing machines, vacuum-cleaners, refrigerators, stoves and all kinds of cookers, clocks, telephones, radios, TVs and computers. A modern life is impossible without these machines. Engines and machines are just the center of the modern economy. There are also many other features resulted from or related to them. Davies lists about “a dozen elements of ‘proto-industrialization’ that must be taken into consideration,” and “they include farming, mobile labour, steam power, machines, mines, metallurgy, factories, towns, communications, finance, and demography.”(Davies 1998: p. 679)

Compared with the premodern economy we may find the following characteristics of the modern one:

1) **Relocatable sources of strong power**: In the premodern society the sources of power included mostly humans, animals, wood, wind and water. Humans and animals could be easily relocated, but their power was very weak. Burning wood was mostly for heating. Wind and water mills were used in production. Although their power was much stronger, they could not be relocated from the wind paths or rivers. Also wind is not stable. And rivers are seasonal. This state greatly changed in the modern economy. Fossil fuels play a pivotal role. The steam engine uses coal and the internal combustion engine uses products from petroleum, and in rare cases natural gas. Fossil fuels can be easily transported. But with energy conversion, electricity provides a better way to

transfer power. Electricity is also a clean power, so it's the most widely used, especially in the offices and households. These days with the depletion of fossil fuels and the global warming people are paying more attention to the sustainable sources of energy, including solar, nuclear energy, and water, wind again. In general the modern sources of power are much more transferable, stable and stronger.

2) **Wide-spread use of automatic machines**: Machines have since long been used in the premodern society. And there even existed a certain amount of automation. There was an automatic machine to pulverize rice at a water mill in China. But with the limited power source automatic machines couldn't be well developed in the premodern society. Most of the tools were still driven by people and animals, so there couldn't be much automation. Things are different in the Modern Age. In fact the first several machines invented during the Industrial Revolution were automatic spinners and weavers. In using these machines people just needed to monitor them and do limited amount of auxiliary work. All the rest were taken care of by the machines themselves. While the strength and the stability of the power are the basis of the automation of machines, the transferability of the power is the basis of the prevalence of machines. Today machines have permeated into all areas of production, office work and daily life.

3) **Much finer division of labor**: Life was simple in the premodern society and production mostly circled around life. The number of professions was very limited. Besides work in the fields there were also some handwork professions, such as the shoemaker, the tailor, the baker, the butcher, the carpenter, the blacksmith, the doctor, etc. A doctor in a premodern society could probably treat all kinds of diseases. But today even dentists are divided into different professions. When you do a fill you see one dentist, but if you also need to have a tooth pulled you have to see another. On the one hand a finer division of labor is the result of the growth of professional knowledge. In the past knowledge for a certain profession was scarce, so a person could probably grasp all of the whole area. But as knowledge grew, sooner or later it exceeded the ability of a single person. When that happened, the area had to be divided. On the other hand more efficient transportation and expanded market also make a finer division of labor possible. A small town or village didn't need many shoemakers, so a division was not that easy. But today a pair of shoes may be produced by many people, even in several different countries. It's possible due to the scale of the production.

These three features seem to be able to capture the essence of industrialization, while other features are derivative. Among the other features Davies lists, mines and metallurgy are required by the new power sources and machines. Mobile labor and factories are the direct results of the new mode of production with machines. Towns and demography are the indirect results. Finance is required by the new mode of production. The development of communications results from an expanded world. And with the economic history entering a new industrial stage agriculture is also industrialized. There are other things not mentioned. Modern technology which is associated with science certainly is another prominent feature. But as we will discuss later modern technology may not as different from premodern technology as some people thought, so it's not in a position to bear the essence of modern economy. Features like synthetic material also seem to be peripheral, although they are unique to modern economy.

The concept of information revolution deserves separate consideration. People talk about an information revolution in parallel with the agricultural and industrial revolutions. Computers stand at the center of information revolution. They differ from ordinary automatic machines in that they have software. Software consists of programs which can be easily reconstructed. So flexibility is the central feature. But the question is, does this kind of flexibility deserve the name of a revolution parallel to powerful automatic machines in the Industrial Revolution? This

concept of information revolution is to a large extent based on Artificial Intelligence (AI). A really intelligent machine would be essentially different from an ordinary automatic machine. An automatic machine could also be flexible. It just needs an external entity to rewire its hardware, like a programmer reprogramming the software. But it's easier to implement automatic flexibility in the software than in the hardware. This is where AI can furthest get with a computer. For instance, in a neural network the node coefficients can be changed automatically, but the propagation algorithm is still the same. Genuine intelligence would require flexible flexibility. When a human being learns things she can at the same time reflect on her learning and adjust the learning strategy. Reflection is where the mystery is and it's beyond software. A digital computer is not a brain anyways. By obstinately and blindly denying human consciousness one cannot make his artificial toy more intelligent. It's essentially just an automatic machine.

In the three features above the first two may be combined. Power doesn't make much sense by standing on its own. It's used to drive machines anyways. So we may have mechanization and specialization as the two essential features of industrialization. And in the following we discuss them in details.

1.2.1 Mechanization

Machines make production more efficient and life easier. Higher efficiency is based on stronger power and automation. In the premodern society there were also spinning tools and weaving machines, but those machines were driven and operated by human beings. The power of a human body is limited and it cannot do work very quickly. In contrast the spinning and weaving machines invented at the beginning of the Industrial Revolution were able to do the work much more efficiently. Stronger power could drive more operations at the same time and automation reduced human interference and therefore things could be done faster. Thus the first influence of modern machines upon human life was to move work from a traditional household to the factory. The second was upon transportation. Locomotives on a railway suddenly could bring a person hundred miles away in a day, which had never been dreamt of before. Airplanes then could conquer the distance much better. At the same time cars made efficient transportation available in the ordinary private life. And with new communication techniques, telegraph, telephone, radio, TV, and most recently the internet, the world has been made smaller and smaller. The concept of an "Earth village" has become close to a literal reality. In addition, there was the household revolution with all kinds of household electronics.

Behind the glory of modern machines we should also cast our sight on the dark side. The first thing is **the obsession with machines**. The use of cars in an ideal American life provides a good example. An ideal American life includes a big house with a garage. Both the husband and the wife have their own cars, which take them from the stairs at home to the building of work and back on each work day, and to the shopping mall during weekend. So the American life is often called "a life on four wheels." Certainly cars are only one type of the machines people are obsessed with. Clothes are washed and dried with automatic machines. Food is cooked with automatic machines. Brooms are replaced with machines. Even ladders are replaced with Caterpillar machines. When machines are excessively used, people become obsessive. In many cases it seems that doing a work by hand is more convenient than using a machine. And there doesn't lack satires of this kind of situation. The film series *The Gods Must Be Crazy* hilariously put the modern and the primitive side by side. There is a shot in the film in which a man drives the car to drop a letter into a postbox across the street and then back. A more funny satire of American life is a picture which shows people ride on an escalator to get to a gym upstairs to exercise.

Then comes **the dependence upon machines**. In the past a vendor could make multi-digit calculations by heart. With the invention of the calculator few people can still do that. These days primary school students have even learnt to write programs to do their homework. When a patient goes to the hospital, before she could see a doctor she is asked to do a blood test, an ultrasonic scan, or even an X-ray. In this internet age a new type of disease even appeared which is called internet addiction. Millions of people spend hours daily on the social networks to report their trivial everyday life. Some have said they just cannot stop doing that even though every once in a while they are bored. And if they are cut from the internet for just a few days they would feel depressed. Children have been growing up in a virtual world constructed with movies and video games, and once they get into the real world they don't know how to behave. One might wonder how long a modern man could survive when cast away onto an isolated unmanned island. Robinson Crusoe probably has better chance of survival. There is a movie titled *Cast Away*, but the hero survived still with the help of many modern items. Machines are built to serve people, yet now people seem to be controlled by machines.

And finally there is **the environmental print of modern machines**. Premodern machines with their natural power and easily decomposable material had an impact on the environment that can be handled without much effort. Wind and rivers are part of natural processes. Wood and iron decompose in a short period of time. On the contrary modern machines are driven by fossil fuels and made of materials that will hold for a much longer period of time, such as plastic, glass and other synthetic materials. Certainly fossil fuels were formed also in natural processes, but first they were formed in a much longer time span than they are mined now, and second the formation of fossil fuels was often accompanied by geographic and climatic disasters. Now we are mining them out at a much greater pace and burning them out in a much shorter period of time. Simple intuition points to disturbed natural processes and environmental disasters. In fact global warming may be just part of the problem. If the temperature evenly rises by a couple of degrees, that would be a smaller problem. But what we are seeing now seems to be disturbances and irregularities of weather, which is worse.

Here I'm not advocating that we should get rid of all the modern machines and go back to water and wind mills. By listing mechanization as an essential feature of modernity I admit that modern machines are indispensable to modernity. But as all the three features in individualism we should also put qualifications on mechanization. We should use those machines, but at the same time we should treat them as tools and use them consciously and wisely.

1.2.2 Specialization

As mentioned above, the expansion of knowledge and the material world made specialization both possible and necessary. The expanded market integrated the formerly isolated professionals so that they could divide or further divide the labor among themselves. And the expansion of professional knowledge made division of labor necessary, because the knowledge of a whole area later exceeded the ability of a single person to grasp. Hence a previous profession was divided into separate sub-professions. Specialization certainly benefits the special fields, and when the integration of different fields is well organized the general profession also benefits. When the energy of a single person is focused on a smaller field, obviously she has better chance to dive deeper into the field. Hence the knowledge of that particular field is more likely to be advanced. This has been demonstrated by the recent scientific researches. A natural philosopher in Newton's age could be involved in all the major areas of research, but today there are hundreds of scientific fields and very likely a scientist only specializes in one of them. Due to this the traditional major areas have been greatly developed.

With the use of machines the production process becomes more complicated. A single person can only handle a smaller part of it. The division of labor gets finer and finer and people also become more and more specialized. The invention of the assembly line provides an excellent case of how the division of labor can be well organized. In an assembly line the whole production process is divided into a sequence of small sets of operations, and each worker is responsible for only one of them. This has significantly improved the production efficiency. The reasons may be found in two respects. First when one worker only performs a single set of operations the transition effort across different sets has been saved. And second when a worker is focused on the same set of operations she has a better chance to improve skills for the particular job. Certainly another benefit from an assembly line is that the products come out evenly. The key is to divide the production process into sets with similar amount of work and still have an integrated whole.

Specialization benefits the profession and the production in most cases, but it's not true for individual professionals or workers. It narrows a professional's knowledge and degrades a worker in the production. Chaplin's film *Modern Times* vividly illustrates the latter. When a worker's only responsibility is to wrench two bolts, he is basically turned into a part of machine. It's symbolic with the hero's body sandwiched between the big gearwheels. The case is similar with the professionals. It's probably sad when a medical expert only knows how to interpret X-ray sheets. And narrow knowledge in the research area often hinders creativity. Creativity requires abnormal angel of view, and knowledge from a different profession is more likely to offer that.

The rise of interdisciplinary research could provide a way to alleviate the negative effects of specialization and give the researchers a chance to balance deeper knowledge of a particular field and comprehensive knowledge of a wide area. In an interdisciplinary research project, experts from different fields, sometimes quite different fields, work together to achieve a common goal. In the cooperation each member has a chance to obtain knowledge from different fields. And due to the common goal one could probably find knowledge and ideas from other fields that are related to her own research.

And why can't a single person practice more than one profession? It's impossible for a contemporary person to become a da Vinci or Goethe, but it's still possible for her to master more than one field. Some statistics shows that on average an American has three professions in a life time. This is really dynamic. It's very normal for a person to get a new degree in his middle age in the US. Both the profession and the person benefit from this.

A brief summary of the chapter is appropriate here. In this chapter we've identified individualism and industrialization as the two essential general features of modernity, based on a brief historical study of the major events, concepts and ideas that occurred in the Western modernization process. Individualism is divided into equality, sociopolitical freedom and spiritual freedom, and industrialization into mechanization and specialization. The general claim is that these features are both necessary and sufficient to capture the essence of modernity. The necessity seems to be more straightforward and doesn't need much argument. The arguments for the sufficiency in this chapter are based on discussing each of the key features of Western modernity. Arguments in the next chapter will further support the sufficiency claim. When discussing each of the essential features we identify for modernity we also showed that each needs to be carefully qualified when taken from Western modernity. Modernity theory is very complicated. I am fully aware that this is only a framework and more arguments are needed. But for the discussion of technology, which is the central topic of this essay, a framework of modernity theory should suffice to serve the purpose.

2. What Can Be Counted as an Alternative Modernity?

Since problems started to occur with Western modernization, people have been criticizing it. The history of criticism may be roughly divided into three phases. The first phase corresponded to the completion of the Industrial Revolution in Western Europe. The Industrial Revolution brought about social upheaval. While the production was greatly raised, the economy developed, the total wealth increased, and millions of peasants were driven away from their land, had to work in the factories for a low wage, and lived a miserable life. Many people were optimistic at that time with Europe being the powerhouse of the world, except people including Marx, who cared for the fate of the oppressed proletariats. Marx criticized the capitalist system and predicted a proletarian revolution. The second phase corresponded to the period of the two World Wars, which ended the European dominance. Many people started to wonder how Europe could get into such destruction after a century of prosperity and glory. Heidegger, the Frankfurt School and Ellul belonged to this phase. Whereas Marx focused on economy, critics in this second phase got deeper and tried to dig out the philosophical background of the modern malaise. This is demonstrated in Heidegger's analysis of techné and Horkheimer and Adorno's analysis of the Enlightenment. Another difference is that, critics in the second phase didn't seem to be as much concerned with pointing a way out as Marx. The third phase corresponded to the environmental movement, with a new focus on natural resources and the environment. At the same time people were talking about a post-industrial, post-modern society. The criticism of Western modernity in this phase became more comprehensive, involving more areas. Science became defensive while postmodernism and feminism joined force with environmentalism. Critics in this phase were more concerned with finding a solution than those in the previous one, but their solutions seemed to be too specific to their various fields. A general solution was lacking.

As far as I know Feenberg is the first person who tries to set up an alternative modernity theory. In his book *Alternative Modernity* he talks about "coupling the technical design process to aesthetic and ethical norms and national identities through new and more democratic procedures." (Feenberg 1995: p. 14) His basic thesis is the underdetermination of technical design, and that provides a political space for public intervention. With public intervention with technical design an alternative modernity could be realized. Bringing in national identity creates another form of alternative modernity. The underdetermination thesis is also the basis for this form of alternative modernity. His example of national identity is taken from Japan, which is a fully modernized non-Western nation. As more non-Western nations are undergoing fast modernization, they start to talk about alternative modernity too. These include India and China. In the past Western critics of modernity never thought of an alternative modernity, as they held the assumption that modernity could only be Western modernity. A multi-polarized world put Western modernity into a multi-cultural context. Alternative modernity hence becomes more meaningful.

In the previous chapter, we picked a subset of features from Western modernity and regarded them as essential to modernity. Now we need to identify those features which are both essential and peculiar to Western modernity. Arguments are provided similarly. With those features identified, the criteria for an alternative are obvious. At the same time I show that those features are mainly responsible for the problems in Western modern society.

Before we start I want to remind the reader that Western modernity is a theoretical concept. When we talk about Western modernity here, we mean the traditional, "standard" Western modernity. Reforms have been made in Western societies. Those can be treated as elements of alternative modernity.

2.1 The Western Modernity

Now we move from Western modernity as a model to Western modernity as a special instance and a reference. When we use Western modernity as a model in identifying the essential features of modernity, we focus on the comparison between modern and premodern societies. When we treat Western modernity as a reference and try to figure out what an alternative modernity may look like, we put Western modernity in a multi-cultural context and pay more attention to the comparison between Western and non-Western societies. The fact that China is used as a representing case of non-Western societies in this essay is not just because the author is most familiar with it, but because China is so different from the West and in many aspects it's the sheer opposite. When comparing the West with China scholars generally hold that the Western culture is religious whereas the Chinese culture is irreligious, philosophical to be precise. This is the fundamental difference between the two and many other differences are derived from it. To name just a few here: The Western culture is other-worldly whereas the Chinese culture is this-worldly; the former is theistic whereas the latter humanistic; the former is egalitarian whereas the latter elitist (cf. 9.2.1). This cross-cultural comparison could provide us more insight into the peculiarity of Western modernity and show us the possibility of an alternative. It at the same time could suggest a way out for Western modernity itself.

The relation between Western modernity and the Christian religion was well studied by Max Weber in his influential work *Die protestantische Ethik und der 'Geist' des Kapitalismus*. His main thesis in the book was that the new puritan ethics and ideas in more than one way facilitated the development of capitalism. First, the Reformation put more value in the secular work including the most mundane professions. A cobbler had been looked down upon before, but the new religion regarded it as a praiseworthy job. Second, the new Protestant religions no longer treated economic gain as a sin. On the contrary profit became an admirable goal. Third, the new religions also encouraged hard work, self-denial and thrift. All these ethics and ideas are in line with the spirit of capitalism, which is essentially wealth accumulating entrepreneurship.

Scholars have also paid attention to the relation between religion and commercialism. Since it's similar to the relation between religion and capitalism, I don't get into the details. Here I want to say more about the influence of the Christian religion on democracy. The relation between religion and democracy is a frequently discussed current topic. Questions are: what a role did the Christian religion play in establishing democracy historically, say in the US? Is religion still important, or even necessary in today's democratic societies? Is atheism compatible with democracy? On the other hand, there are even people who claim that democracy is a religion. Being a person from an irreligious culture I have the view that some fundamental ideas of democracy are taken from the Christian religion. Democracy is egalitarian and universal, as illustrated in the sentence "All men are created equal." This probably can best be understood under the Christian doctrines. The Christian religion teaches that humans are brothers and sisters, and all are the children of God. That all men are equal perhaps can only be interpreted in this sense. Naturally no man is created equal. People's lives normally start with different genes, then different pregnancy conditions, then different infantile nutritions and cares, and then different educations. Even the lives of identical twins soon diverge. Some people argue against the necessity of religion to democracy by saying that equality before a government cannot be derived from equality before God. Yet the influence of thought doesn't have to be logical or deductive.

In general the egalitarian universalism of the Christian religion has permeated into almost all aspects of Western modernity. In culture with dominating science reason is the universal tool which makes all men equal, in economy with capitalism and commercialism money is the

universal tool which makes all men equal, and in politics with democracy will is the universal tool which makes all men equal. This egalitarian universalism is what I think to be peculiar to Western modernity, in other words, the *Western* part of Western modernity. In contrast, meritorical elitism is an essential part of Chinese culture, which can be clearly identified in Chinese classics and has been practiced in China for centuries (cf. 9.2.1.4). This contradicts egalitarian universalism.

In the previous chapter we discussed individualism and industrialization as the essential general features of modernity. Those two general features cover most of the features of Western modernity, including science as an important element of spiritual freedom of an individual. The features left are capitalism, commercialism and democracy. The general thesis of this section is that these features are both essential and peculiar to Western modernity. "Essential" means that without these features a form of modernity won't be Western modernity. "Peculiar" means that these features are not essential to modernity in general. On the one hand this thesis further supports the sufficiency claim in the previous chapter. On the other hand it also provides the criteria for an alternative modernity.

In the following I discuss these three features in turn and try to provide preliminary arguments for the thesis. Meanwhile I will show that many of the problems in Western modernity are caused by these features. Since science also belongs to egalitarian universalism, I want to say something about science before I proceed with the other features.[1] Science is universal in two senses: method and object. Scientific method is universal because it's built on reason, which is a universal human faculty, and empirical evidences, which must be universally verifiable. Reason provides a universal ground for people's intellectual interaction and experiments have to be repeatable by different scientists. The object of science is the regularities in the phenomena, the unity of the world. The goal of science is to find universal laws which govern the processes. The universal method makes science egalitarian, whereas the universal object moves science closer to religion. Most scientists now don't believe in the Christian God, but this doesn't contradict the connection between the Christian thought and the general scientific assumptions (cf. 9.1.1.4). In many respects universal laws are like the almighty God. Think further about the claim of "a theory of everything". Only in God could Newton find the foundation of his mechanical laws and especially the law of gravity. Even Einstein talks about a cosmic religious feeling, although it's more aesthetic than moral. In Protestant religion everybody has the chance to reach God through private conscience, and in science everybody has the chance to reach universal laws through reason and experiment. There is a clearly discernible parallelism between the Protestant religion and science (cf. 7.2.2).

2.1.1 Capitalism

There is no standard definition of capitalism, but we may list the following key features of a capitalist business:

- The properties are privately owned.
- Production, service and commerce are profit-driven, in other words the aim of business is to gain profit. If a business cannot reach its profit target, it loses its *raison d'être* and should be closed.
- The aim of a business is achieved through selling its products or services on the market.
- The profit belongs to the capital owners, who invest in the business.

[1] Later I shall clearly distinguish science from scientism. Science is an essential part of modernity whereas scientism is peculiar to Western modernity.

- The business needs to employ people for the production or service and they are paid with wages or salaries.

In fact, trade, market and finance had existed in the premodern societies for a long time. And we even can find separate capitalist businesses in some traditional societies. However, the idea of profit-driven production, service or commerce only became prevalent in modern societies. Merchants and usurers were normally looked down upon in a traditional society. With the Industrial Revolution a new form of economy was also established. In the capitalist economy some budding elements in the recent history flourished and started to dominate the economic scene.

Adam Smith is regarded by many as the father of capitalism. Neoclassical economists emphasize the concept of "the invisible hand" in his book *Inquiry into the Nature and Causes of the Wealth of Nations* to support a free market economy. Scholars have disputed whether the advocation of a free market economy is the major thesis of the book, or even whether Smith is really an advocate of it. The term *laissez faire* certainly is not used by Smith. Nonetheless the idea is clear. In a capitalist free market economy everybody pursues his own interest, but with the result of benefiting the whole society. The invisible hand of the law of supply and demand works quietly behind the curtain. The perfect functioning of the invisible hand assumes a free rational choice of production and price. Marx's criticism of capitalism just targets at this free rational choice of each separate business owner. While Smith may claim that the law of supply and demand will optimally maintain a lower price in equilibrium, Marx argues that the self interest of separate business owners will create a big gap between the supply and the demand and finally get the economy into a state of crisis. Then people try to dramatically bring the two sides to match each other, so the economy moves into a new cycle thereafter. Hence the periodical economic crisis is a built-in feature of capitalism. In a sense Marx predicted the Great Depression of the 1930s.

After the outbreak of the Second World War Keynes' economic theory became influential. He provides a solution for the economic crisis, which is government intervention. According to Keynes' theory government could stimulate the economy and decrease unemployment through fiscal policies such as adjusting the interest rate and creating government projects. Thus he is widely considered as the father of macroeconomics. His theory was adopted by major capitalist governments in the 1950s and 1960s. With new economic situation in the 1970s Keynes' theory was under significant attack, especially from Friedman. Friedman refutes one of Keynes' major theses that with the cost of inflation unemployment could be reduced, and asserts that inflation and high unemployment could happen at the same time, which is called stagflation. Stagflation was evidenced by the economy of the 1970s. But there is a Keynesian resurgence after the outbreak of the current financial crisis in 2007. Keynesian policies are adopted again by major economies.

When we talk about capitalism here we mean the capitalist economy. As mentioned above capitalist elements, even separate capitalist businesses already existed in premodern societies. But in a capitalist economy almost all businesses are capitalist, which means that almost all the goods and services in the society are provided by capitalist businesses. And capitalism primarily refers to a free market economy with little government intervention.

The thesis that capitalism is essential to Western modernity doesn't need much argument. Historically capitalism has been there with Western modernity since the Industrial Revolution. Although communism once had some influence in the Western world, capitalism has always been dominating the Western economy. Take a look at the resistance the bailing out of failed major corporations receives in the recent financial crisis, and then we can get a feel of how deeply capitalism has grown into the Western society.

While the essentiality argument focuses more on facts and realities, the peculiarity argument in contrast focuses on logic and potentiality. Although it's proven that capitalism outperforms socialism in economic development, still is it essential to modernity? In a different way we may ask, is modernity without capitalism possible? To answer this question our strategy is to examine whether capitalism is implied by the two general features we picked in the previous chapter. First industrialization doesn't imply capitalism. Industrialization is based on automatic machines driven by strong power and a finer division of labor. Technological determinism is relevant here. Marx writes the following famous statement in *The Poverty of Philosophy* (Chapt. 2): "The hand-mill gives you society with the feudal lord; the steam-mill, society with the industrial capitalist." This has been widely disputed. The steam engine certainly makes the complicated automatic machines possible, and the finer division of labor is a necessary result. But is capitalism an inevitable consequence? It's highly doubtable. In a sense Weber's theory is a direct refutation of this claim. Weber points out that the Protestant religion also played a significant role in the formation of capitalism. Industrialization may be regarded as a prerequisite of capitalism, but it led to capitalism only in a special cultural context. And this cultural context is peculiar to the Western society. In addition we have historical counter-examples in this case. As a matter of fact industrialization was also heavily carried out in the USSR under socialism.

Second individualism doesn't entail capitalism either, although it does entail the owning of private property. Defenders of free market capitalism often cite personal freedom as the primary justification for capitalism. Rand proposes that capitalism represents a new morality code – rational egoism. That is to say, it's a moral obligation to let people freely act in their rational self-interest, and capitalism is the only economic system to allow that. Rational self-interest by its own doesn't seem to be fully compatible with individualism. That could lead to social chaos, and thus go against personal freedom. Hayek's self-organization theory comes into play here. According to the theory, in a capitalist economy entrepreneurs' knowledge and resources and customers' needs are optimally matched through the free profit-price mechanism, so that people's activities are well coordinated and the whole society well organized. So customers can easily have their needs satisfied by paying a price, while the profit provides an incentive on the producer side to offer necessary products and services. In this way, everybody pursues their own interest, but to everybody's benefit. This is the invisible hand in its more delicate form. Another important claim is that economic freedom is a prerequisite of political freedom. The economic power is an essential underpinning of political power. With economic power scattered among the people a repressive political power is unlikely to happen.

To counter these arguments we need first to recall the three elements of individualism. They are equality, sociopolitical freedom and spiritual freedom. In what sense is capitalism equal? Only in the sense that money is universal. The person who has the money also has the power, no matter what her other features are. While this can be counted as equal in a certain sense, it may not be compatible with the equality that is contained in individualism. Let's just consider the capitalization of the education system, say a university. When people have to pay a high tuition in order to get a high education, children from a poor family are greatly hindered. There is a chance that a talented student is denied education due to the economic status of his family. And without an appropriate education she's put in a disadvantageous situation in the social competition. Certainly it's difficult for a society to equalize people's genes, talents and early age care, but equality of opportunity on the basis of free education is possible. Without equality of opportunity the statement "All men are created equal" could only have meaning in the very abstract sense of creation itself. Capitalism has most to do with sociopolitical freedom. But even in this respect there are caveats. Granted that economic power carries political power with it and economic freedom implies political freedom, a free market economy left to its own leads to monopoly,

which is against economic freedom. So the self-organization cannot happen in the literal sense. Without the interference of anti-trust laws a free economy may still become self-organized in a sense, but may not be to the benefit of every playing party. As for spiritual freedom I really doubt the profit-driven capitalism can help achieve much. Spiritual freedom involves high interests. Even if goods and services for high interests can be capitalized, their market is much smaller compared with that of material goods and services. Therefore spiritual businesses stand in a disadvantageous position compared with material businesses. That's why material businesses dominate the capitalist markets. On the other hand the value of high interests is much difficult to measure than low interests. Certainly food has different value when one is desperate for it than when one is not hungry. In an extreme situation one would pay a hundred dollars for a piece of bread. But it's much more difficult to measure the value of a book that changes one's life. So there is a mismatch between its market value and its spiritual value. This is another hindrance for spiritual businesses. When a museum or a theater is turned into a profit-driven business normally its quality is difficult to guarantee. Generally capitalism cannot function well in the spiritual world and economic freedom is not fully in line with spiritual freedom.

It's no accident that all the defenders of free market capitalism aim at collectivism as a target. In a collectivist economy the government controls a major part of it and centrally plans most of the production. It's a valid argument that the planning by a central panel even consisting of experts will always be biased. And central political power always goes with central economic power and hence some form of dictatorship is inevitable. However, free market capitalism is not the only alternative to collectivism. Left to its own capitalism will lead to social inequality, economic crisis and a materialized world. If Keynesian economics provides a way to solve the crisis problem, similar ways are needed to solve social inequality and save the spiritual world.[2] They don't have to be all from the government, but some forms of interference are necessary.

2.1.2 Commercialism

Commercialism is inseparable from capitalism, because a capitalist business uses the market to achieve its profit goal. While the emphasis of capitalism is on the profit-drivenness, the motivation of the production, the emphasis of commercialism is on the market-orientedness, the method to achieve the goal. Commercialism has two aspects: commercialization, the process to turn everything into a commodity, and marketing, the process to influence or even create the market through advertising.

In premodern societies commodities had existed for a long time, but things that were put in the market for sale were limited. In the agricultural society a greater part of a family's life was self-sufficient. People grew their own grains, vegetables and fruits, even raised their own stocks for meat. They grew their own cotton and made their own clothes. They also built their own houses. The Industrial Revolution moved a lot of work from the household to the factory, first spinning and weaving, then clothes making, and then the production of other necessities. When a peasant became a worker, all his life was supported by commodities. In the next phase commodities expanded from necessities to luxuries, and to all kinds of goods and services. With almost everything in life bought from the market, money becomes a universal token and is endowed with universal power. In the traditional society there was a clear line between wealth and nobility. Some social prestige was beyond the reach of money power. It's no longer the case in the modern society where money has universal power. Commercialization has gone far from basic goods and

[2] Based on my personal experience comprehensive social welfare and governmental support of higher culture in the German society are concrete examples of such ways. These conform to the spirit of a social market economy.

services, extended to politics, and even tried to reach the core of the spiritual world. Love and happiness are even posted for sale.

Advertising is as old as the market. But traditionally advertising was mostly informing. “Here is a tailor’s shop.” “You may buy meat here.” These were the messages of the signs or advertisements. Marketing becomes a profession only in the last couple of centuries. Informing is only a small part of marketing. Besides, there are investigating and persuading. Market investigation is a prerequisite step. At this step customers’ needs and wishes should be made clear. The design of the products or services has to be based on the market requirements. Informing is the second step. Customers need to be made aware of the products or services, including what the products or services achieve and how they work. The most important step is persuading. The final goal of marketing is to have the customers buy the products or services. Persuasion techniques are used here. Emphasizing the benefits of the product or service to the customer is one thing. Pointing out the advantages of this product or service over similar products or services is another. Or it could just involve demonstrating that a customer looks cool with this product or has a higher social status using this service.

To this point the essentiality of commercialism to Western modernity seems to be obvious. Commercialization and marketing are both fully developed in Western modernity. Anyways commercialism is just like a twin brother of capitalism. Capitalist businesses are driven by profit and profit can only be realized on the market. The more products and services a business can sell on the market, the more profit it can earn. Commercialization, which makes more things sellable, and marketing, which helps sell more things, both work toward the profit goal. Like capitalism, commercialism is also an essential part of Western modernity.

We may argue for the peculiarity of commercialism to Western modernity in a similar way. First, industrialization doesn’t require commercialism. The former is about the mode of production, whereas the latter the distribution of products. Products from factories can even be distributed to consumers directly without going through the market. This happened during war time and in a socialist economy. Further, even the existence of market doesn’t imply commercialism. As mentioned above the market had existed in the premodern society for a long time, but commercialization and marketing are only developed in the modern economy.

Second, commercialism is not fully in line with individualism. In a sense commercialism favors personal freedom, because it makes more products or services available for the customers to choose. More choices normally mean more freedom. However commercialism in more ways hinders individualism. We may list a few hindrances below.

- The commercialization of politics, such as election campaigns, gives rich people and big companies unequal power to influence political policies to their favor. Thus economic power directly translates into political power. This goes against equality.
- The commercialization of spiritual matters, such as love and happiness, degrades them into material ones. Love is degraded into sex and happiness into the satisfaction of material desires. This is against spiritual freedom.
- The advertising may promote things which are harmful to the customers. Tobacco and alcohol advertisements are good examples. Junk food is another.
- The advertising often creates virtual desires in the customers. Those desires are not part of a healthy life, but have their own lives. They are desires for the desires’ sake. As an article about the culture of commercialism says, “Commercialism does not just promote specific products. It promotes consumption as a way of life.” (Jacobson 1996) The prevalence of one-time-use products is a typical over-consumption. Producers promote

one-time-use products to expand the market. Those virtual desires and over-consumption are not only a burden on the customer, but on the environment. In such a context personal value is degraded into owing material goods and happiness into the consumption of material goods.

Capitalism and commercialism go hand in hand to create a form of egalitarian universalism in the economic realm. The universalism is embodied in the universal power of money. The profit-drivenness of capitalism and the market-orientedness of commercialism cooperate to forge money fetishism. So "money can buy everything" turns into a new faith. It is egalitarian because everyone can own the money no matter what her other features are. And once she owns the money, she immediately has the power that comes with the money.[3]

2.1.3 Democracy

Democracy is a type of political system, in which political power comes from the people. Particularly in modern democracy separate legislative, administrative and judiciary powers come from universal suffrage, in which everybody counts the same, one person one vote. So there are double power balances. Those in power are checked by the people and the three branches of power are checked mutually. But this is just one form of democracy. The central idea behind democracy is that everybody has equal rights in determining common social affairs. Direct democracy and representative democracy are the two major categories. In a direct democracy common social affairs are determined by people's direct vote. A referendum is a typical case. In a representative democracy affairs are determined indirectly. People elect representatives by direct vote and the representatives determine common social affairs. Modern democracy apparently belongs to representative democracy. The power balance based on division of power into three branches is an extra feature.

Modern democracy is a very delicate political system. It has existed only for a short period of time and didn't come into being all at once. But democracy has been there since the ancient time. Athenian democracy was a model in the ancient world. It belonged to direct democracy. The Roman Republic provided another example. And representatives were elected in this case. There were sporadic democracies in the Middle Ages. For instance, the Parliament of England had its root back in the 13th century. Modern democracy originated in the political revolutions in the 18th century. At the beginning voting right was limited to a small portion of the population. Universal suffrage was only achieved widely in the 20th century.

Little argument is needed for the thesis that democracy is an essential part of Western modernity. Although universal suffrage was only reached late in the history of Western modernity, democratic thought had emerged well before the French Revolution. And democracy is the only dominating political system in the West. There do exist variations of political structure and operation among different countries, but they all conform to the central idea of democracy. With the collapse of the Soviet Union and the reunification of Germany it became even more so.

As for the peculiarity of democracy to Western modernity, in the two essential features of modernity democracy only has to do with individualism. It seems obvious that individualism implies democracy. It appears that personal freedom and equality entails democracy. But the truth is that democracy only corresponds to one sense of freedom and equality, freedom and equality of the will. Voluntary liberalism is the basis of democracy. According to this view freedom is interpreted as doing things at will. One is free if she can do what she wants. Certainly what one

[3] This is probably best demonstrated in the case of a lottery winner.

wants doesn't have to be based on instincts or basic desires. Psychologists have divided human needs into different levels.[4] There are lower needs and higher needs. Besides, there is a condition under which this kind of personal freedom can be guaranteed in a society. Everyone must follow some common rules when there is a conflict. Traffic lights are a good example. At a busy intersection if everyone drove through it at will, there would be many accidents. Thus everybody should follow the lights. Voluntary liberalism clearly specifies this condition, but has no qualification of the will. In fact, based on the principle the will itself is not analyzable. Your will and my will cannot be compared. One will and another will of mine cannot be compared either. In fact, the will is so abstract that it can only be quantified as one. Translated into politics, one person should have one vote.

In the previous chapter we've shown that voluntary liberalism may lead to the opposite of freedom. What one wants to do, a person's will is determined by many other properties: interest, knowledge, insight, vision, etc. When these deciding properties are limited the person's will is probably restricted. In that case one may not be really free even though she can still do what she wants, like a bird singing happily in a cage without the chance to test the blue sky. Democracy could to a large extent guarantee sociopolitical freedom, but not spiritual freedom, as the will could represent either low interest or high interest, could be based on ignorance or abundant knowledge, little or deep insight, narrow/short or wide/long vision.

From this the problems with democracy on the social level are derived. First, there is the so called "mob rule." The rule of the people could turn into the rule of the mob in some cases. A prominent example is the conviction of Socrates by the Athenian democracy. And that prompted Plato to advocate the rule of the philosopher king. Even today if we hold a referendum to decide whether we should keep philosophy department, I bet the result would be No, as most people think philosophy is useless. Certainly both cases are direct democracy. Representative democracy greatly reduces the chance of mob rule, but cannot eliminate it. Second, democracy tends to be short-sighted. This is not just because of the short term of the election. As they have to worry about another election before a long term plan may start to take any effect, the incumbents are inclined to only carry out short term plan. Democracy is short-sighted also because everyone has the same say. Long vision is something that needs to be cultivated, hence it's rare. It is diluted in a general voting and short vision dominates. Most people would focus on short-term everyday life. When policies are forced to cater for this kind of interest they also tend to focus on short-term gain. As a result there is the third problem with democracy, the instability of policies. Each time a new administration is formed there are often big changes, even reversal in policies. Part of it is necessary adjustment as required by new situations, part of it is the price a society has to pay for an effective power balance, but part of it is just the result of politics, the influence of interest groups.

Democracy is closely related to science and capitalism. Science is built on reason. When reason dominates will is more likely to dominate. Reason is universal, so will is universal on the basis of reason. When a person turns 18, it's assumed that she becomes mature, has independent reason and so her will counts politically. Voluntary liberalism typically starts with a rational individual.[5] Capitalism needs free workers and free markets. Both require free individuals with free political rights. Therefore in a sense capitalism requires democracy. All of them conform to the egalitarian universalism of the Protestant religion. In the case of democracy the will is universal because all the particularities of an individual don't matter, and everyone is equal because they have the will that is counted the same politically.

[4] Maslow's hierarchy of needs is a representing theory.
[5] The dominant contractual theories are based on contracts among rational individuals.

Before we move on, an important distinction has to be made concerning science. In the previous chapter we include science as an essential part of spiritual freedom, but now we talk about science in parallel with capitalism-commercialism and democracy as the three embodiments of egalitarian universalism. To make things clear we need to distinguish science as a way to obtain knowledge of certain areas and the philosophical view that science is the *only* way to obtain *any* knowledge. The latter is often called scientism. Science contributes to spiritual freedom, but scientism doesn't. Scientific practice embodies egalitarian universalism, but when limited to its appropriate scope it doesn't have any bad effects. Problems arise only when it tries to transgress its boundary. IQ tests, mind readers are good examples.

A central part of my modernity theory is to distinguish two feature sets in Western modernity. The first set, including individualism and industrialization, is regarded as the essential features of modernity. The second set, including scientism, capitalism, commercialism and democracy, is treated as peculiar to Western modernity. Due to the scope limit of this essay the arguments have to be kept preliminary. The focus is put on differentiating these two feature sets.

2.2 An Alternative Modernity

With the distinction of two feature sets the notion of alternative modernity becomes clear. The existence of a peculiar feature set of Western modernity first supports the *possibility* of an alternative modernity. Further, the peculiar feature set of Western modernity and the essential feature set of modernity jointly specify the *criteria* of an alternative modernity. Specifically, an alternative modernity needs first to be modernity. In other words, it must have *both* individualism and industrialization as two of its features. In this sense a totalitarian society even with industrialization cannot be counted as modern. Second an alternative modernity must differ from Western modernity in some essential aspects. Scientism, capitalism, commercialism and democracy are the most important diverging points. Depending on the distance from Western modernity alternative modernities can be divided into weak alternatives and strong alternatives.

In this section I show that the two forms of alternative modernity brought up by Feenberg are both weak ones. And just because they are weak alternatives they cannot get rid of the problems that Western modernity is facing. In contrast I also try to outline a possible strong alternative modernity. In a strong alternative modernity scientism, capitalism, commercialism and democracy with their cultural foundation egalitarian universalism will all be challenged.

2.2.1 Weak alternative (Feenberg)

Feenberg's alternative modernity is based on the social constructivist theory of technology. Social constructivism regards technology as an institution under heavy social construction. The relationship between technology and culture will be handled in details in the next part. But here we need to briefly talk about the thesis of underdetermination, because Feenberg's alternative modernity is based on it. Underdetermination is a concept taken from philosophy of science. It's normally called the Duhem-Quine principle there. Following Duhem's holism Quine argues that logic and empirical evidence alone cannot determine whether a scientific theory is better than another or not. "In the realm of technology, the thesis holds that technical principles are insufficient by themselves to determine design."(Feenberg 1995: p. 3-4) This underdetermination of technical design provides a space for politics to play. It gives the people who are in control of the technical design a chance to choose designs in favor of their own interests. Certainly in a market economy arbitrary dictatorship is impossible, as the producers and service providers have

to follow customers' needs in order to gain maximum profit. And better technology in most cases leads to more profit, so progress won't be hindered either. Here is Feenberg's view in terms of the politics in technical design: "I *do not* argue that these currently dominant groups obstruct technical progress to further their own interests. It would be more accurate to say that they channel progress in a particular direction compatible with those interests."(*ibid.*: p. 5) This can still be called technocracy. Feenberg apparently adopts a weaker form of technocracy than former critics, such as Marcuse.

With scientific-technical rationality dominating the modern world critics of modernity face a dilemma. They either have to despise modern technology with all the benefits it brings or accept its negative consequences. This is based on a substantivist view of technology, which holds that technology is value-laden but autonomous. According to this view the development of technology has its own rules and can dominate culture. Feenberg's social constructivism goes against substantivism. For him technology is also value-laden, but not autonomous. While it's difficult for former critics to find a way out for Western modernity, with social constructivism Feenberg can clearly see some possible alternatives. In particular the scientific-technical rationality could be influenced in two ways, through aesthetic and ethical norms and national identities. The underdetermination of technical design makes technocracy possible, but it at the same time also provides a chance to fix that. By democratizing the technical design through public intervention we could put technocracy under check. By bringing in national philosophy and values from non-Western cultures we could make adjustment in the universal scientific-technical rationality. So concludes Feenberg in the Introduction to *Alternative Modernity*: "Coupling the technical design process to aesthetic and ethical norms and national identities through new and more democratic procedures is no utopia."(*ibid.*: p. 14) And these are the two forms of his alternative modernity.

To me Feenberg's alternative modernity theory is still under the great influence of substantivism. The core of substantivism is the view that modern technology constitutes the substantial part of Western modernity. So modern technology to a large extent determines others aspects of modern society: capitalism, technocracy and popularized, materialized culture. Therefore we have to put our sight on scientific-technical rationality in looking for an alternative to Western modernity. And if we could influence scientific-technical rationality in a different way then we would have an alternative modernity. In my opinion alternative modernity formed in this way can only be a weak one, as it doesn't hit the core of what's peculiar to Western modernity. And hence it cannot resolve the fundamental issues Western modernity is facing. In the following we discuss his two forms of alternative modernity in turn.

In one of his case studies Feenberg talks about AIDS patients' participation in medical experiments. Using humans in experiments was prohibited on ethical ground. Generally it was deemed immoral to test unproved drugs on patients and there were strict regulations to prevent this from happening. The AIDS crisis changed this situation because many AIDS patients would like to participate in clinical research thinking their disease incurable. This brought up the whole issue of participant interests. Soon it's clear that not only patients with incurable disease have this interest, but also other patients. Participation in the research has become a way of caring for the patients even when it has no curing effect. Sometimes psychological effects are more important than medical ones. This case demonstrates how the patients' need may change the physicians' "technical code." Another case concerns the French experience with Videotex. Videotex was originally designed for data delivery. Big chunk of data is put on a host computer and users may access the data with a terminal and modem. When the French version of Videotex Teletel was established users quickly turned it into a communication service. The use of data delivery was overshadowed by that of messaging among users. Then there were companies who made

improvements in the system toward the communication purpose. This example further shows how the ordinary users of a technology could have an influence on its design and function.

These two case studies suggest possible ways of democratizing technical design. The main actors in changing the "technical code" are not experts, but ordinary customers or users of a technology. Hence it's democracy against technocracy, where technical experts dominate the technical design. For Feenberg this promises a form of alternative modernity.

Although democratizing technical design is intended to fix an important feature of Western modernity, i.e. technocracy, it still works within the essential features of Western modernity. In fact technocracy is a symptom rather than the disease. It's to a large extent caused by the profit-driven capitalism and the market-oriented commercialism. These two work together to create a materialized world where money dominates. Only in such a context can technology be put in a dominating role and technical experts endowed with special power. Technology dominates the modern society and culture only because money dominates and technology is an important tool for earning money. Capitalism and commercialism in more than one way shape the development of technology. Efficiency is not a built-in feature of technology and certainly it's not the only benefit technology can provide. But in capitalism efficiency has become the first value, because higher efficiency means gaining more profit in the same time period. And so efficiency also becomes the primary goal of technology. In a society with a different value system technology won't be developed in this way. In a society where technology cannot help to achieve the primary value, it cannot dominate either, let alone technocracy. Democratizing technical design targets technocracy, but keeps capitalism intact. It tries to alleviate the symptom, but ignores the disease. An alternative modernity based on this can only be a weak one.

To a less extent democracy also helps create technocracy. In a traditional society people's minds are controlled by various beliefs, customs, rules and regulations. Technology never had a chance to dominate. Democracy wipes out all these constraints and put millions of free wills on the market. Once people's minds are cleared of those traditional restrictions, they become easy targets of advertisements of material goods. Again technology is good at providing these. And when even technology itself becomes a thing admirable for the customers, the dominance of technology is inevitable. In this sense whether democratizing technical design can really fix technocracy is in doubt. When millions of users have changed the social network websites into a place where they spend hours daily to spew out their trivial everyday life reports, should we call this a fix or support for technocracy?

Another form of alternative modernity Feenberg discusses is based on national identities, which he calls "multicultural modernity." This time the example is taken from Japan, a fully modernized non-Western nation. The reason for the choice is straightforward. When Germany followed England and France to modernize itself there wasn't much cultural conflicts, because they both share the same Christianity. But it's not the case for Japan. Even science needed much effort to absorb into the traditional culture. Philosophers tried hard to reconcile elements taken from the West and those from the traditional culture. Particularly Feenberg discusses Nishida's philosophy of experience and place, which are based on Japanese culture and aimed at offering a new paradigm of historical understanding, comparable to science in terms of potential achievements. Then he analyzes Kawabata's novel *The Master of Go*. The novel depicts a symbolic match between the master and his challenger and illustrates the conflicts between the traditional and the modern playing strategies. While etiquette with values of self-realization and aesthetics plays an important role in the traditional way, the modern way emphasizes fairness and equity among players. In summary Feenberg writes: "In a sense, what the novel describes, perhaps without entirely intending to, is two alternative types of rationality, each of which is a candidate for

modernity, although only one is triumphant, only one actually organizes a modern society." (*ibid.*: p. 219) Technology, capitalism and democracy are all rational systems. The Japanese could play them in a different way, and thus have an alternative modernity.

As we mentioned above, this kind of alternative modernity assumes that the dominance of scientific-technical rationality is an essential feature of modernity. So an alternative modernity must keep this feature and provide different ways to either influence it or reinterpret it. But the truth is that, once a nation takes scientism, capitalism, commercialism and democracy all together egalitarian universalism soon dominates. Traditional values quickly retreat in a couple of generations and may only leave some elements which are compatible with the new value system. Japan is no exception. Feenberg talks about the importance of ideals of belonging, service, quality and vocation in Japanese economy. These ideals remain only because they are in line with entrepreneurship. Politically, economically, and to a large extent culturally Japan now is just like a Western modern country. It has the same general characteristics and the same issues. And in some respects it even exceeds the US. For instance, the obsession with machines. The automatic bathing machine and the automatic paperless toilet are both popularly used in Japan. If the special "enterprise culture" can make an alternative modernity, it is at most a weak alternative.

We can see both democratizing technical design and national identity in the frame of Western modernity can best help construct a weak alternative modernity.

2.2.2 Strong alternative

Then what can be counted as a strong alternative modernity? First, a strong alternative modernity must also have the two general essential features of modernity, i.e., individualism and industrialization. The three components of individualism are equality, sociopolitical freedom and spiritual freedom. And the two components of industrialization are mechanization and specialization. These features are conjunctive. So a totalitarian state even without freedom of speech cannot be counted as a strong alternative modernity, although it has achieved industrialization. Second, a strong alternative modernity has to go beyond scientism, capitalism-commercialism and democracy, the three features that have been closely interwoven in Western modernity. We've shown that egalitarian universalism, which can be derived from the Protestant religion, is behind all these three features. The three features correspond to the cultural, economic and political realms, respectively. Egalitarian universalism weaves them into an integrated whole. So generally a strong alternative modernity must transcend egalitarian universalism.

A strong alternative modernity still doesn't exist, but it becomes very urgent to construct one. With the dominance and wide spread of Western modernity, and especially with the current globalization, egalitarian universalism is posed to normalize the whole humanity. Under the big wheels of this juggernaut traditional cultural heritages are lost, lives are materialized, and people are degraded into technology awed and consumption addicted abstract free wills. If this tide is not curbed in time, in the near future when we pick any two human beings on this planet we won't be able to find any big difference between them. Even if we only admit that diversity has survival value, this is not a good sign for the future of humanity. As human history enters a new millennium, it's high time for us to reflect more deeply on this and work together to find a way out. A strong alternative modernity becomes very meaningful in this context. But the first question is, is this kind of strong alternative modernity possible? Is it possible that we have modernity but without scientism, capitalism or democracy? Before we could answer this question some clarifications are necessary.

As for scientism, again we need to clearly distinguish science from scientism. Science as a modern path to truth works quite well in certain areas, mostly those substances and processes that are easily analyzable and quantifiable. But beyond those areas science is at a loss. Something like a person's intelligence is neither easily analyzable nor quantifiable. An IQ test is at most an entertainment technique. The AI claim in the strong sense is also at best a trick to get more funding (cf. 8.1). Scientism just claims that science is the only path to truth and every phenomenon can be studied by scientific method. With the distinction between science and scientism, the dilemma of whether we should accept scientific-technical rationality in an alternative modernity disappears. Science should be accepted whole-heartedly, but at the same time we should be fully aware of its limit. When reason is put at its right place, other human faculties could have a chance to flourish again.

We don't mean to get rid of profit and market altogether in an alternative modernity. Like science profit and market are effective tools to match people's resources and needs. Profit effectively motivates the producer, while market effectively satisfies the consumer. Hayek's theory of self-organization certainly has some point in it. In many areas profit and market can work together to create a prosperous and harmonious society. Like scientism, capitalism and commercialism deify profit and market, and let them not only dominate material life, but also the whole life. And because profit and market work the best for material goods and desires, capitalism and commercialism have jointly created the materialized world. In such a world human life centers on material needs, most of which are virtually created by advertisements. Money becomes the almighty God. Happiness turns into boundless consumption of material goods. So the problems with capitalism and commercialism do not lie in profit and market themselves, but the universalization of profit and market. Therefore the solution would be similarly to limit profit and market to their appropriate areas, mostly material goods and services. The areas beyond have to be run with different rules and principles. Most spiritual causes cannot be run as a profit-driven and market-oriented business.

And finally in the political realm we totally support the rule of the people. In fact individualism implies the rule of the people. But the question is, the rule of what kind of people? Plato advocates the rule of a philosopher king. Although a philosopher king could be really wise, but still one man's power is limited. His knowledge has a boundary and his view is biased in some respect. This is the biggest problem with monarchy. Modern democracy on the other hand gives each adult the same say in determining social affairs. But this principle may not be appropriate for every affair. When colleagues go out to eat lunch together, it's proper to vote and decide where to go. On the contrary when a development team determines the development strategy of a product, certainly experienced developers should have more say. This is not just for the benefit of the whole team, but also for the sake of fairness among team members. Some social affairs undeniably are like the former case. But a majority of them, especially those that require vision and insight are like the latter. Democracy is based on voluntary liberalism, which interprets personal freedom as freedom of the will. Yet this abstract free will is easy to manipulate. Even if this is not true, democracy still just means the rule of an average person. Although in a representative democracy citizens don't directly decide social affairs, but the representatives are still elected by direct votes. With the principle of "one person one vote" even in a representative democracy political power is based on an average person. To avoid the problems of dictatorship freedom of speech, open debates, the rule of law and power balance are necessary. But there are better solutions than democracy. The method of plural votes is an alternative, but the difficult part is to set up the criteria. In fact the method of plural votes was once adopted by some countries in history. However the criteria of plural votes in those cases didn't seem to be appropriate. Better criteria need to be used.

With these clarifications I hope a strong alternative modernity doesn't seem self-contradictory. Individualism and industrialization could live well without scientism, capitalism-commercialism and democracy. In a strong alternative modernity we could have science and modern technology without scientism and technocracy, put profit and market to proper use without the problems of capitalism and commercialism, and have an equal, open and free society without democracy. The key is to transcend egalitarian universalism.

In fact strong alternative modernity is not meant only for non-Western nations, although Western modernity is used as the reference. The Western nations are very conscious of their own problems. This has been reflected in all kinds of criticisms of Western modernity. The West and those Westernized nations need a way out of the problems. Those that are still undergoing modernization need an alternative development strategy to avoid similar problems. Since the Second World War, while the US has pushed almost all the features of Western modernity to their extreme, the European nations apparently have reflected on modernity deeply and taken a different path. In particular, besides critical philosophers from Marx to Habermas, several features of the German society interest me. These are the social market economy, a clear environment consciousness, and a comprehensive welfare system with free education and generous support of higher culture. In my opinion all these features point toward a strong alternative modernity.

So much for alternative modernity. Alternative modernity is the background on which the discussion of technology in this essay will unroll. It's also the framework in which modern technology will be analyzed. Since it's just a framework it has to be a skeleton. I have greatly extended the alternative modernity theory and so a lot more arguments are necessary to fully support it. But I hope the discussion in this part is enough for this essay.

Some main theses of this essay are the following: For the problems of Western modernity modern technology is not to blame. The dominance of modern technology is formed in a special cultural context. Only in an alternative modernity can modern technology be put at its right place in human life. But before we move to the main theses, we need next to analyze the interplay between technology and culture.

II Technology and Culture

The discussion of the relationship between technology and culture is the next step toward a theory about technology in an alternative modernity. Since both concepts are vague, we need to make some clarifications of them. We start with culture.

According to König there are hundreds of culture concepts. He particularly discusses the following three (König 2010: p. 73):

- "culture" as all the arts
- "culture" as meaning system and
- "culture" as all the human creation

The first culture concept contains some elitist elements. In the German language there is a dichotomy between "Kultur" and "Zivilisation". As Janich writes, "with 'Kultur' an educated German thinks of Bach, Goethe and Dürer, in other words, of the fine arts; with ('technical') civilization on the contrary of asphalt street, central heating and toilet flushing." (Janich 2010: p. 93, author's translation) Basically culture in this sense is higher culture in the broad sense. The corresponding Chinese word *Wenhua* has similar elitist flavor in the narrow sense. Literally it means literate, and in the traditional society it's a prestige of the elites. In particular, higher culture in China has to do with literature and philosophy, and to some extent also history, generally the area of humanities. So Goethe in traditional Chinese society would still belong to higher culture, but not Bach or Dürer.

For the purpose of this essay I am concerned also with three culture concepts. They overlap with the above list, but with important differences. The first is culture in the narrow sense discussed above. And for higher culture I would combine the German and the Chinese connotations, in other words higher culture include both fine arts and humanities. So to the list of Bach, Goethe and Dürer I would also add Kant. The second culture concept corresponds to the spiritual world. Culture in this sense is said against economy and politics. Economy is mostly related to material life and centered on relations between human beings and nature. It's about food, clothes, housing and transportation. Politics is related to a society and centered on relations among human beings. It's about norms, ethics, laws and regulations. Culture in this sense is related to spiritual life and centered on the relations between human beings and themselves, or God. It's about entertainment, science, philosophy, art and religion. The third culture concept is identical with the third one in the above list. In this sense culture is all that's created or produced by human beings. So the using of knife and fork or chopsticks is part of culture. We even say "a later Stone Age culture," although most part of the items included are everyday tools and utensils. Culture in this broad sense is said against Nature. Hence, the three culture concepts adopted in this essay can be similarly listed as follows, with the corresponding boundaries in parentheses:

- Culture-I: fine arts and humanities (higher culture vs. lower culture)
- Culture-II: spiritual world (culture vs. economy & politics)
- Culture-III: artificial world (culture vs. nature)

The relations between the connotations and denotations of these three culture concepts are those between supersets and subsets. With respect to connotation culture-I is a superset of culture-II and culture-II a superset of culture-III. With respect to denotation culture-I is a subset of culture-II and culture-II a subset of culture-III. Culture-II has been used in the discussion of Part I, and culture-I will be used in Part III to elaborate my cultural instrumentalism. When I discuss the relationship between technology and culture in this part, the concept culture-III is in my mind.

Apparently technology belongs to culture-III (When I talk about culture hereafter in this part I mean culture-III, except specified otherwise). Based on etymological analysis the word "culture" originally means goal oriented human activity, as in the Latin verb *colere*. In modern languages

there are only few words which still bear this original meaning. The English word "agriculture" is a good example, probably because it originated from Latin. *Ager* is the Latin word for land, so agriculture is the cultivation of the land. The German word "Obstbaumkultur" has similar meaning. Janich says, "what was originally meant with culture is what we today call technology (Technik)." And a more interesting thing is that the word "technology (Technik)" originated from the Greek word *téchnē*, but that means art. It seems that to some extent the meanings of "culture" and "technology" have been switched. This might be also an indication of the complicated relationship between technology and culture.

This brings us to next clarifying technology. What is technology? According to some authors including Grunwald, Julliard, Janich and Hubig, this is an incorrectly raised question. The general concept of technology doesn't denote anything. There only exist specific aspects of specific technologies. They call the general concept of technology a reflection concept. In Grunwald's words, "Who talks about technology in the general singular form, is interested *in certain aspects* of technology *in a generalized view*. In using the general technology concept we reflect on one or more perspectives, from which we discuss about the technical aspect of actions and objects *as general technology*, or the corresponding generalized properties of this technology, such as the technology-nature-relation or the technology-art-relation." (Grunwald 2010b: p. 117, author's translation) This certainly reveals an important characteristic of technology. But I want to point out here, in light of this view first we may still talk about technology in general, and second this doesn't prevent us from discussing the general features of technology. General features could be seen as generalized features of particular technologies.

In clarifying technology we adopt a different approach. We specify the key features of technology instead. The primary feature of technology has been suggested in the etymological analysis above. **Technology has to be created by human beings.** Creation implies intention, and intention involves a purpose. In other words technology is brought into being intentionally, for a purpose. In the old time people kept track of time only through sunrises and sunsets, and at most the location of the Sun in the sky. The clock was invented to keep more precise track of time during the day. It's called an artifact because it's created by human beings. Technology doesn't have to be carried in an artifact. When people in the Stone Age used a piece of sharp rock to cut meat, that piece of rock became a tool, and hence bore a technology, although it already had existed in nature. Technology can even reside in things which are not tangible, such as computer software. Certainly software is not the only intangible technology bearers. They could be a method to handle certain matters, e.g. time management, or a procedure to achieve something, e.g. a recipe. However, all have to be created. In the case of the rock, what's created was the way of use.

Second, **technology has to involve certain function.** Function needs further clarification. Generally function is related to the working of a system. The function of a part is what it does in relation to other parts in the system. When the part does what it's supposed to do, we say it functions well. So function is a relative thing. The function of technology is related to human needs. To say technology must have a function is to say that it must be able to meet certain human need, directly or indirectly. In other words, it should have some use or utility. Two things need to be pointed out here. The use or utility of a technology is said from the perspective of its user. In the case of weapons, they are created to do harm to people. But they still satisfy the need of their users, which is to harm other people. On the other hand, it's fairly possible that a technology is created with a certain utility in mind but ends up being harmful. But even this case doesn't contradict our general statement. For function doesn't have to be the actual function. We will do further function analysis later.

The above two features combined still just demarcate technology in the original sense. For modern technology we have to add a third feature. **Modern technology is closely related to science.** This greatly reduces the scope of modern technology. Generally modern technology is contained in the scope of science. In this way art and philosophy cannot be regarded as technology, although they both have the above two features. Correspondingly we have to further restrict the function of technology. In a sense both art and philosophy have a function. Art has impact upon human emotions and pleases people's mind. Philosophy trains critical thinking and offers insight and vision. Modern technology doesn't seem to have these functions. Its focus is still on the material life. It certainly provides advanced tools for art creation, but these are not the core of the creation. It apparently has influenced philosophical thinking, but philosophy needs to go beyond technology. The relations among technology, art and philosophy will be further discussed in the next part. Here I just want to clarify the scope of modern technology.

Now we can move on to the relationship between technology and culture. Based on the clarifications so far, technology is part of culture. So when we talk about the relationship between technology and culture we actually mean the relations between technology and other parts of culture - economy, politics, philosophy, art, etc. And also the discussion in this part still focuses on culture in general. All the other parts of culture are mostly treated as a whole, except science. We won't get into specific cultural areas till the next part.

Concerning the general relationship between technology and culture there are various theories. The most obvious is instrumentalism, which regards technology as a normal tool. A technology is created to meet some need and also works that way. Beyond the satisfaction of the need it means nothing. Then there is technological determinism, which claims that technology has determining power over culture. When a new critical technology is introduced, many aspects of culture are automatically adjusted to fit it. Technological determinism still regards technology as a tool. On the contrary, substantivism no longer holds that technology is just a tool, but claims that it carries a value system with itself. In other words, technology doesn't determine culture, but it *is* culture. And finally comes social constructivism, which holds that technology is neither neutral nor autonomous, but under social construction. That is to say, technology is to a large extent determined by culture.

In *Questioning Technology* Feenberg tries to classify the above major theories concerning the relationship between technology and culture with two separate dimensions: neutrality ↔ value-ladenness and autonomy ↔ human-controllability. He locates the theories in a two dimensional table (Feenberg 1999: p. 9). Technological determinism resides in the neutral-autonomous quadrant, whereas instrumentalism belongs to the neutral-human controlled one. Feenberg interprets neutrality as "complete separation of means and ends." Certainly separation doesn't mean having nothing to do with. Value-ladenness is described as that "means form a way of life that includes ends." Thus, substantivism and constructivism are put at the lower half of the table. The difference is, while substantivism focuses on the autonomy of technology, constructivism emphasizes the human-controllability.

My personal view is that the relationship between technology and culture is complicated and not one directional. On the one hand an adopted technology has impact on culture, but on the other hand technology has to be created and function in a certain cultural context. To reach this point we have to analyze technology first. If we keep viewing technology as a whole, none of the above theories is perfect. But when we analyze technology into its different elements, we will find each theory captures an important aspect of it. So after an analysis of technology into its scientific, design and functional elements I discuss major theories about the relationship between

technology and culture along the neutrality and culture-ladenness dichotomy, in light of those three elements. My own theory will be proposed in the next part.

3. Different Elements of Technology

Classical philosophy of technology treated technology as a whole entity, a black box. After the empirical turn authors began to pay more and more attention to specific technologies and specific aspects of technology. While the black box of technology is opened two risks emerge: First, excessive attention to the particular features of specific technologies makes a general theory of technology hard to reach. When differences are emphasized, generalization is difficult to make. Second, a certain particular aspect of technology tends to be generalized and hence other aspects overlooked. This may easily lead to a biased view of technology. In both cases attention to details seems to move the whole picture out of sight.

In this essay I also try to open the black box, but meanwhile I want to keep the whole picture in sight. To achieve this goal some strategies have to be adopted. First, when we look into the box of technology we should not be distracted by the particular features of specific technologies. This helps us retain generality. Certainly specific technologies can be used to illustrate general properties. Second, when we look at the contents of the box we should not restrict our sight to a particular corner. Instead, we should look around and take a complete view. The box may become transparent now, but we still have a box to deal with. These two strategies are intended to reduce the two risks above. The first strategy is supposed to avoid getting lost in specific technologies, while the second to avoid getting lost in specific aspects of technology.

I open the black box of technology through analyzing it. This is the task of the current chapter. The above strategies are adopted. In particular, I analyze technology into different elements. On the one hand, these elements are general elements. They apply to all specific technologies. On the other hand, these elements are interwoven. Together they constitute an integrated whole. This analysis sheds light on understanding the existing theories and provides a solid foundation for us to build a general theory on, a theory that incorporates both micro details and macro relations. After a general discussion of the analysis the elements are elaborated.

3.1 Analyzing Technology

The understanding of technology has undergone significant development. In premodern society technology was just treated as a tool. What's salient was its function to serve a certain human need. With the unprecedented power of modern technology the tool became so dominant that people started to wonder whether it still could be regarded as a tool. As modern technology was more and more dependent upon modern science, given its enormous power, it had not been treated seriously until recently. For a long time it had been widely held that modern technology was just an application of modern science. In the past several decades scholars have tried to move away from this simplified view and given modern technology its deserved notice.

In this section I start with the standard view and then discuss an effort to move away from it toward a richer characterization of technology. Further I show that this effort itself needs to be expanded, in order to do justice to all the aspects of technology.

3.1.1 Technology as applied science

Once the standard picture of technology was that, science discovers the laws of the world, whereas technology applies scientific theories and method to achieve a certain end. In this sense

technology becomes applied science. Bunge plainly distinguishes pure science from applied science (Bunge 1966: p. 329):

> The method and the theories of science can be applied either to increasing our knowledge of the external and the internal reality or to enhancing our welfare and power. If the goal is purely cognitive, pure science is obtained; if primarily practical, applied science.

And he writes explicitly that "technology" and "applied science" are taken as synonymous. He further distinguishes two kinds of technological theories (*ibid.*: p. 331):

> Substantive technological theories are essentially applications, to nearly real situations, of scientific theories; … Operative technological theories, on the other hand, from the start are concerned with the operations of men and man-machine complexes in nearly real situations; …

Substantive technological theories are direct application of scientific theories, but operative technological theories are not. The latter may be developed by people with little scientific training. However, Bunge argues, even the latter can still be counted as an application of science. Although they are not based on substantive scientific knowledge, they employ the method of science.

This standard view has been more and more challenged later on. Critics point out that modern science depends more upon technology than technology upon science. Evidences have been collected from both the early and advanced stages of science. In the Industrial Revolution the steam engine was invented with little application of science. The Newtonian mechanics was not that important for the construction of the steam engine. And at that time thermodynamics hadn't been well developed. Boyle's law didn't play any significant role either. On the other hand, these days science, especially physics, cannot advance without huge devices like the CERN Large Hadron Collider. People started to talk about Big Science along with big technology decades ago. Science is now even called technoscience. And on the way of its development many achievements of modern science were made on the basis of technological breakthroughs.

What's at issue in the debate concerning the relationship between science and technology seems to be their relative status. The central questions appear to be, which is fundamental and which is derivative? The claim that technology is applied science grants science fundamental and technology derivative status. The criticism tries to reverse the relation. First it plays down the intellectual dependence of technology upon science and second it emphasizes the practical dependence of science upon technology.

My interest in this once standard view is that it represents a monic characterization of technology. From the claim that technology is applied science we may infer that what technology is all about can be explained by science. Although the use of technology is paid due attention to, it doesn't play any significant role. In fact the use just constitutes part of a special situation, which can be subsumed under general scientific knowledge. In this way a technology with its use can be fully explained by science. As we will see, this is a very simplistic characterization of technology.

3.1.2 The dual characterization of technical artifacts

Focusing on technical artifacts, some authors try to show that science cannot explain all aspects of technology. Kroes is a prominent advocator of the dual nature of technical artifacts. In various papers (including Kroes 1998, 2001 & 2003) he tries to argue for the view that technical artifacts, or technological objects, have a dual, physical-functional nature. He writes (Kroes 1998: p. 124):

> A technological object such as a television set or screwdriver has a dual nature. On the one hand, it is a *physical object* with a specific physical structure (physical properties), the behavior of which is governed by the laws

> of nature. On the other hand, an essential aspect of any technological object is its *function*. A technological object has a function, which means that within a context of human action it can be used as a means to an end.

What's critical in the dual nature claim is not merely pointing out the functional aspect of technical artifacts (this is in fact also part of the previous view), but the position that the functional aspect cannot be reduced to the physical one. One of Kroes's basic ideas is that the functional properties of technical artifacts have to do with human intention, which is beyond the scope of physics. His major argument lies in analyzing the function of technical artifacts and demonstrating its reliance on human intention in design and its irreducibility to physical properties. For instance, the function of the Newcomen steam engine to move the pump rods up and down cannot be explained by its physical structure alone. The engine's physical structure also explains its property of generating heat, but the function of the engine is not that of a heater. The function of the engine is jointly determined by its design, an intentional action. Particularly the engine is designed to move the pump rods up and down.

A major approach to reduce functional properties to physical properties is to classify the former as dispositional properties. Properties such as length and mass are absolute, but it's not the case with fragility and solubility. Usually philosophers interpret them as dispositions, tendencies to behave in such and such a way under certain circumstances. Fragility and solubility are undoubtedly physical properties. If functional properties can be classified as dispositional like fragility and solubility, then they are successfully reduced to physical properties. Apparently Kroes needs to argue against this approach. His major argument is that the dispositional approach cannot discriminate between proper and accidental effects of functions. Both proper and accidental functions can be equally handled in dispositional terms. Without the distinction between proper and accidental functions at least the phenomenon of malfunctioning cannot be appropriately dealt with. When a copying machine malfunctions it's still called a copying machine, although it now cannot perform its proper function. The dispositional approach would straightforwardly deny that it's still a copying machine. With this approach malfunctioning even doesn't make sense. Kroes further points out, a fundamental difference between functional properties and physical properties is that the former appear to be inherently normative.

Along with Kroes Krohs also advocates a dual characterization of technical artifacts. Similarly he writes (Krohs 2009: p. 150):

> A technical artefact may be described in physicalistic and in functional terms. The physicalistic description accounts for structure and dynamics of the entity, while the functional description is based upon a design-and-use-centered view of the artefact.

While Kroes promotes a dual nature Krohs pleads for two-model-descriptions. The physicalistic model and the functional model are complementary. "Neither of them alone covers all that can be known about a technical artefact." (*ibid.*: p. 152)

Although their focus is on technical artifacts, the dual characterization can be expanded to technology. When the difference between technical artifacts and technology is made clear the expansion needed will become obvious. An artifact may be understood as a man-made object, most people would say, a tangible object. Certainly technical artifacts are the primary bearers of technology. But a technology doesn't have to involve technical artifacts. First, a technology may be carried in natural objects. Using leeches to clean the wound in medicine is a technology, but leeches are not technical artifacts. Second, a technology may be carried in an intangible object. Computer software is a good example. Technical artifacts are physical objects. When we talk about technology only considering physical objects is not enough. So in expanding the dual characterization to technology physical properties or physicalistic description has to be expanded to scientific properties or description. "Scientific" covers physical, chemical, biological and

logical. Therefore, the dual characterization of technology becomes a scientific-functional characterization.

Further I would argue that this dual, scientific-functional characterization is still not sufficient to cover all the aspects of technology. As mentioned above, Kroes is well aware of the difference between proper function and accidental function. The proper function of a hammer is to hit some object, in order to change its shape or position. The hammer is designed for that purpose. But it sometimes is used as a door stopper. To stop the door is an accidental function of the hammer. It's accidental because the hammer is seldom used that way. Accidental function in this sense still involves human intention. The hammer is intentionally used as a door stopper. Here we see a proto-type of redesign. Cases of full-scale redesign definitely exist. Houkes and Vermaas give the following example (Houkes & Vermaas 2009: p. 127):

> Aspirin, for example, is nowadays produced, marketed and used for two different purposes: to alleviate pain by taking an incidental, high dosage, and to prevent cardiovascular problems by taking a daily, lower dosage. These ways of using Aspirin involve different use plans, because they have different goal states. Consequently, on our useful-material characterisation, a tablet of Aspirin is a painkiller when it is swallowed in the context of executing the more traditional use plan to alleviate pain. But the very same object is a blood thinner when it is swallowed in the context of executing the recently designed and communicated plan to prevent blood clots.

In this case of full-scale redesign both functions, to alleviate pain and to thin blood, are proper functions of Aspirin. This example further demonstrates the discrepancy between artifacts and technologies. What's essential to a technology is a particular way of use, not a specific artifact. The new technology is based on an existing artifact. It's similar to the case where a natural object is used in a technology.

Redesign complicates the characterization of technology, but the dual characterization seems to be able to handle it. If we regard accidental function as the result of a degenerated redesign, then for each technology we still have the scientific and functional aspects, although two different technologies may share the same scientific basis. This appears to be just what Krohs proposes. He also talks about the redesign of transistors from amplification in an analog circuit to switching in a digital circuit. (Krohs 2009: pp. 158-159)

So far the function in the dual characterization is intended function based on design. This includes the proper function in the original design, the accidental function in accidental use and the new proper function in redesign. What cause real problem for this characterization are unintended functions. Malfunction is one type. No matter what the function actually looks like malfunction is definitely a function. But by definition it's not proper function. And it's not intended either. Then where should we put it in the picture of dual characterization? If malfunction is still logically dependent on proper function, then another type of unintended function causes more problems. It's side effect. A side effect is an unintended function that logically has nothing to do with proper function. For instance, a car is designed to transport people and belongings, but it also pollutes the air. The proper function of a car is transportation. Air pollution is a side effect, which is unintended. A characterization of technology that leaves out side effects would be incomplete. Directly incorporating unintended functions into the functional aspect of technology is not viable. With intended and unintended functions undiscriminated, theoretical chaos would result.

Therefore my proposal is to further distinguish between design and function. Design is driven by intended function, but the actual function of a technology could be unintended. Design determines the proper function of a technology. The proper function has some priority, but once a

technology is adopted it has its own life and thus may have other functions. In this way we've separated three elements of technology: the scientific, design and functional elements.

3.1.3 The three elements of technology

We've talked about the three key features of technology. To recapitulate, modern technology is created, it serves a function and it is closely related to science. Our analysis of technology corresponds to these three key features. First, it's undeniable that modern technology contains prominent scientific element in it. People have pointed out that modern science played little role in the invention of the steam engine. But as modern science grew mature, it also became almost indispensable for technological advancements. This has turned into a sure thing these days. Second, when a technology is created, it's done intentionally. That is to say the creators have specific design in their mind. Depending on the complexity of the technology, the design doesn't have to be complicated. It could be just a certain simple function to achieve. Even in the so-called "accidental invention," the inventor still has the related functional idea in mind. Otherwise, even if the accident happened, he wouldn't have seen the meaning of it. Third, the function a certain technology serves constitutes another element of technology. The functional ideas contained in a design are just intended functions. When a technology is applied its actual functions could be different from the intended ones. Generally the scientific, design and functional elements of technology correspond to its foundation, creation and actual effects, respectively.

We've already seen the relations among the scientific, design and functional elements of technology are not simple. Although they represent three important aspects of technology, they are not independent of or parallel with one another. In fact they penetrate into one another. An overview is like this: Science plays a role in both the design and the actual function of technology, though in different ways. What's effective in the design is scientific knowledge, whereas what are effective in the actual function are scientific (natural) laws. This is one of the bases for the discrepancy between design and function. On the other hand, design and function are closely related. The intended function guides the design, while the design in large part determines the actual function.

The major task of this chapter is to discuss the three elements of technology in details and clarify the relations among them and more importantly the relation between technology and culture with regard to these three elements. In the rest of the chapter we handle each of the three elements in turn.

3.2 The Scientific Element of Technology

The scientific element of technology will be discussed in the context of the relationship between science and technology in this section. As we mentioned in the previous section, it's once the standard view that technology is applied science. But recently this view has been under attack. This belongs to the general trend of deconstructing science. When science is put on top of technology, the standard foundational and pure view of science cannot hold any more. For technology with its design and function, certainly has more connections with society and culture. Other things aside, the funding of the Big Science immediately brings in political and economic issues. I focus on Ihde's instrumental realism. With this theory he tries to bring philosophy of science and philosophy of technology together. He calls science's technology the interface between the two fields. Instrumental realism assumes the priority of technology over science. He particularly proposes a technological lifeworld theory based on phenomenology. And

Heidegger's philosophy is also used to support technology's priority. In this way scientific realism is revitalized with a new interpretation.

In my opinion Ihde's theory pays unbalanced more attention to the function of technology than the design. While agreeing with his technological lifeworld theory in terms of the function of technology, I also want to emphasize the role of science in technology from the perspective of the design of technology. When we consider science in a broad sense it plays an essential role in the design of technology. This constitutes one part of the scientific element of technology. Besides this epistemological role science also plays an ontological role. Science as laws of nature is also the foundation of the actual function of technology. This is the other part of the scientific element of technology.

3.2.1 Zuhandenheit and Vorhandenheit

Heidegger's analysis of the use of a hammer in *Sein und Zeit* is all too familiar since it's been widely recapitulated. As I understand it, the general task of *Sein und Zeit* is to base space and time on the human existence. In particular, space is based on the Being-in-the-World (In-der-Welt-Sein) of Dasein (a human existence), and time is based on the Care (Sorge). So for Heidegger human existence has priority over space and time. In the analysis of the use of a hammer Heidegger explicitly distinguishes two kinds of human-tool relations: Zuhandenheit and Vorhandenheit. In the former a person uses a hammer without noticing it. Only in this way a hammer, or generally a tool, functions perfectly. In this case the person uses the hammer in the way how it's intended, but the intention, or the function of the hammer, is at the moment not in the user's mind. In fact, a hammer is not the best example to demonstrate Zuhandenheit. A better one is a pair of glasses. One can still use a hammer well when realizing its existence. By contrast, when one wears a pair of glasses, realizing their existence itself is disturbing, and hence an obstacle for their function. A pair of glasses function the best when one is looking for them while wearing them. In this case the existence of a tool is absent from the mind, let alone the function of it. Everything is OK when a tool functions well. But there are chances when a tool is broken. When a tool is broken it cannot function as it's supposed to, that is, it cannot serve its purpose any more. At this point the function of the tool becomes apparent to the user. Without a well functioning hammer one cannot hit in the nails. This directly demonstrates the function of a hammer. Heidegger calls this the mode of conspicuousness (Auffälligkeit), one of the three modes of Vorhandenheit. The second mode is that of obtrusiveness (Aufdringlichkeit), where a thing totally cannot be used. And the third is the mode of unruliness (Aufsässigkeit), where a thing is even not realized, still not belongs here. (Heidegger 2006: pp. 73-74)

For Heidegger Zuhandenheit of a tool provides the basis for Dasein's Being-in-the-World. When a tool functions, it does so not independently, as function is a relative concept and it involves other things. Function presupposes a purpose and a purpose points to something else. This is a referral relation (Verweisung). And referral relations may be chained, that is, a referent could further refer to a third thing. In this way there is a web or system of referral relations. Being-in-the-world is Dasein's being taken up in this system. This being-taken-up has two distinct characteristics. First it's unconscious (unthematisch). Dasein is taken up without realizing it. Second it's circumspect (umsichtig). Dasein looks around while being taken up. Dasein's Being-in-the-World makes the world possible, especially the world in the sense of an outside existence. Following Descartes Husserl still starts with an abstract, independent human experience and tries to construct the outside world through the projection of intentionality. By contrast, Heidegger starts with the human existence with a built-in world character. In this way the outside world is easier to interpret. Just because Dasein's existence already has a world character built in it, the

concept of a world independently existing outside is possible. In other words, Vorhandenheit is based on Zuhandenheit. The latter has ontological priority over the former.

Some people point out that the concept of a lifeworld in Husserl's later philosophy was under the influence of Heidegger's Zuhandenheit. And the scientific world is regarded as the correspondent of Vorhandenheit. While people treat and interact with things in a natural, normal way in the lifeworld, in the scientific world scientists separate objects from their natural context and analyze them by splitting them into parts. So abstraction and analysis are the two fundamental scientific methods. With these methods objects are taken away from their natural habitats in the lifeworld, the system of referral relations, and put under particular attention, before the eyes, under the microscope, twisted, or even broken apart. A hammer stops being a tool to hit in the nails, with which one may get a piece of furniture installed. Now it has a particular shape, a certain color, and it's built with a metal head and a wooden handle. In this way science seems to be the perfect embodiment of Vorhandenheit. So we are justified in drawing parallelisms between Zuhandenheit and the lifeworld, and between Vorhandenheit and the scientific world. However, it seems that the ontological priority of Zuhandenheit over Vorhandenheit cannot be easily transferred to the relation between the lifeworld and the scientific world. Which one has priority, the feeling of pain or the C-fibers firing? There is a hot debate in philosophy of mind concerning this issue. It's not an appropriate place to get into the debate here.[6] Instead another parallelism is more relevant.

This parallelism is between technology and Zuhandenheit. In Ihde's words, "The realm of the praxical—ready-to-hand—is thus the founding stratum of human-world relations in *Being and Time*, and entails a *technological* relation to the environment. The present-at-hand, which falls within science as a mode of knowledge, is founded upon the praxical relation."(Ihde 1991: p. 55) According to Ihde, Heidegger achieves an inversion in the relation between science and technology: "if the dominant view claims that technology is applied science, then in Heidegger's version of the relationship science may be said to be a peculiar kind of 'applied' technology."(*ibid.*) The parallelism between technology and Zuhandenheit is confirmed in Heidegger's central article about modern technology "The Question Concerning Technology." There modern technology becomes "a way of revealing," a dominant world outlook, the foundation of the modern lifeworld.

In my opinion, while the parallelism between science and Vorhandenheit is well founded, that between technology and Zuhandenheit pays attention to only one important aspect of technology, i.e. function, but misses others. Technology is created by human beings to serve a function. Function is a fundamental aspect of technology, but we shouldn't forget design is another one. When a technology functions well, it gets into a state of Zuhandenheit. However Zuhandenheit cannot capture all aspects of technology. In fact, the function of a technology is possible only after it's created with a certain design. In this sense we may say, design has priority over function in technology. In the case of Heidegger, ignoring the design aspect of technology may well be the major reason for his technology substantivism. This will be handled in the next part. In the case of Ihde, overlooking the design aspect of technology makes him overemphasize technology in the relation between science and technology. Both the once standard view that technology is applied science and the inverted one that science is applied technology are oversimplified. The interaction between science and technology is more complicated than what either view depicts. It calls for a more balanced view.

[6] The issue is further discussed in Section 8.1, where a reconciliation of the two worlds or cultures is attempted.

3.2.2 The role of science in technology

When a technology well functions the human-technology relation belongs to Zuhandenheit. When it malfunctions the relation becomes Vorhandenheit. But when a technology is invented, or created, the human-technology relation is neither Zuhandenheit nor Vorhandenheit. When the technology is still in the inventor's mind, it can neither well function nor malfunction. This belongs to the realm of creation. In this respect technology invention shares much with art creation, but they have quite different principles. The major difference is that technology invention aims at certain practical functions, whereas art creation has no such limitation. And this determines the different relations between science and art and between science and technology. Although science may be used in the process of art creation, but the essential part is beyond science. A great piece of music cannot be just acoustics, and a great painting cannot be just about the chemistry of paint. Art creation aims at beauty, emotional expression, etc. So it's well beyond science.[7] However, it's not the case with practical functions.

As we have said before, function is essentially relation. The function of a thing is always said relative to another thing. The function of a part in a system is its relation with other parts. Further technology's function has a more restricted meaning. This kind of function has to be finally related to human needs. So the function of technology is utility. Every technology must directly or indirectly meet certain human need, serve some purpose. Finally modern technology has put much more emphasis on material utility. All this has put technology more and more under the influence of science. The primary task of science is just to study material relations between objects. Science aims at revealing the regular relations in the phenomena. These regularities certainly provide guidance in technology invention. Generally speaking, after a certain technology is invented and people get accustomed to using it, it retreats into unconsciousness and moves out of people's attention. This is the state of Zuhandenheit. When a technology malfunctions it moves back into people's attention again. Now it turns from a tool into an object. This is the state of Vorhandenheit. When a technology is then repaired or originally invented, it's treated as neither a tool nor a disinterested object. It's not a tool because it doesn't function as intended yet. It's not a disinterested object because the intended function is in the technician or the inventor's mind. In this case the intended function is the end, but people have to start with certain means. And science just plays an important role in filling up this gap between means and end.

A concrete example is helpful for illustrating the general ideas. Automobile is a familiar and very illustrative example. When a person learns to drive a car, the car is a recalcitrant object for him. For a long time even after he gets a driver license, he cannot move his attention away from the car while driving. But this will be achieved sooner or later. At a point the car retreats into unconsciousness when he drives it, just like he is not conscious of his legs while walking. But when he gets a breakdown on the road, the car suddenly becomes a dead object and attracts his attention again. Then the car is towed to a garage and the technician starts to investigate the cause of the breakdown. Now that the engine cannot be started, there could be a bunch of reasons. The most obvious is running out of gas. The battery could be dead. The spark plug could be bad. The timing belt could be broken. And so on. All these are based on the understanding of the structure and functioning of an auto engine. And the structure and functioning are based on science. If for a technician, especially an experienced one, the diagnostic procedure seems very straightforward, in some cases we could even say unconscious, it can't be the case when Benz invented the automobile. Due to familiarity a technician doesn't need to apply science explicitly all the time. By contrast an inventor deals with something new and so needs to keep trying hard to consider

[7] For further discussion about the relation between science/technology and art cf. Chapt. 6.

every detail. In other words, he needs to explicitly apply science to fill the gap between the intended function and possible means.

In the debate about the relationship between science and technology science is understood in a very narrow sense. It's mostly modern theoretical physics. If we expand the scope of science, such as to include chemistry as Schummer does (Schummer 1997), then we can reach a different view of science. In talking about the scientific element of technology I also understand science in a broad sense. Science in this sense is knowledge about regularities. So it doesn't have to be about fundamental, universal laws of nature. The so-called "engineering science"[8] is also science, although it deals with very specific fields. With this understanding the view that technology is applied science captures an important aspect of technology. As a general characterization of technology it's simplistic. But when we focus on the reparation and especially invention aspects of technology, it still makes much sense. We have shown that the priority of Zuhandenheit over Vorhandenheit in Heidegger's philosophy can at best complement this view, but not invert it. Next I handle the two prominent counterexamples against this view.

The first counterexample says that no science is used in inventing the steam engine. This is true if science is understood in the narrow sense. But science in the broad sense is about regularities in the phenomena. Certainly general scientific laws like Newtonian mechanical laws are regularities. But they are model science, not all of science. The property of the steam and the motion conversion mechanism are the two key foundations of a steam engine. Apparently general scientific laws are not involved here. However it involves regularities. When water is boiled steam is generated. Continuous generation of steam causes it to expand, so it could drive a piston in a closed chamber. The piston needs to oscillate instead of always moving to the same direction in order for its motion to be practically used. The way to turn an oscillation into a continuous one-directional motion is to convert it into rotation. In fact inertia plays a role in this conversion. The inertia of rotation guarantees that it's a continuous rotation instead of a swing. All these are regularities involved in the invention of the steam engine. And they belong to science in the broad sense.

The second counterexample is about Big Science. Big Science cannot move forward without big technology. While granting this claim we need to take a closer look at big technology. We may take the CERN Large Hadron Collider for an example. First, the general design of the collider is based on particle physics, especially the collision theory. Without this scientific knowledge people would never think of building a collider. Second, the detailed design of all the collider components is also based on science, electro-magnetic field theory for one. The magnetic field is used to accelerate the particles. Third, when a breakdown of the collider happened in 2008 scientific knowledge again had to be used to investigate the problem and then fix it. We can see big technology is still based on science in an essential way. And in fact the knowledge used in big technology has less doubt to be counted as science. One may argue that the knowledge used in designing the steam engine cannot be counted as science proper. By contrast, the particle collision theory and the electro-magnetic field theory are science par excellence.

So far we've been talking about the role of science in technology from the epistemological perspective. From this perspective scientific knowledge in the broad sense plays a crucial role in technology design. From the ontological perspective science is also the foundation of the function of technology. From this perspective science is not knowledge but laws of nature. The actual functions of technology, intended or unintended, have their basis in laws of nature. This view needs little further argument. I mention it here to make the discussion complete.

[8] Further discussion about engineering science can be found in Boon 2011.

3.2.3 Instrumental realism

Ihde presents instrumental realism not as an independent theory with a set of clearly stated claims, but as a general character of a bunch of authors' philosophy of science. These authors include Hacking, Ackermann, Dreyfus, Heelan and Ihde himself. Although these authors' views diverge in a few major aspects, they share some common characteristics. Ihde generally characterizes instrumental realism as follows (Ihde 1991: p. 99):

> The focal point at which instrumental realism emerges is the simultaneous recognition of what I have called the *technological embodiment* of science, which occurs through the instruments and within experimental situations; and of the larger role of praxis and perception through such technologies.

Based on the standard view, science is regarded as a theoretical, prepositional endeavor. So there exist gaps between theory and reality and between prepositions and facts. And further there is the realism based on correspondence between the two sides of the gaps. This is called naïve realism and it has been challenged by many philosophers. Instrumental realism has a totally different starting point. With the emphasis on the technological embodiment of science, science is no longer treated as a theoretical activity, but a practical one, a praxis with science's own technology. From this starting point realism has a totally new meaning. What is real now is not independent reality or fact, but is mediated through technology. Observation becomes a seeing through instrument. Since instruments are real, what's observable through them is also real. Ihde calls this "the heart of the 'realism' of instrumental realism."(Ihde 1991: p. 107)

So far the difference between naïve realism and instrumental realism is very clear. They have quite different interpretations of reality. Another comparison with instrumentalism in philosophy of science is also illustrating here. Instrumentalism in philosophy of science is closely related to pragmatism. It regards science as an instrument to explain and predict observable phenomena, and claims that that's all it does. So reality has little to do with science. From the view of instrumentalism, realism is not wrong, but meaningless. The "instrument" in instrumentalism is said of science, whereas that in instrumental realism is said of technology, particularly science's technology. These two views apparently also have different interpretation of reality.

Instrumental realism is based on the phenomenology of the function of technology. When a technology well functions it creates a lifeworld. In the case of a thermometer we read out the surrounding temperature on its scale. Mediated through the thermometer as a technology the scientific property of temperature (average kinetic energy of particles) is observed as numbers on the scale. According to Ihde this could close the gap between the lifeworld and the world of science. Science's technology seems to connect the world of science with the lifeworld. The world of science with all its abstract theoretical entities, especially those subatomic particles, looks so untouchable, unobservable and mysterious. But with the corresponding technology such as detectors (Geiger counter, cloud chamber, etc.) the theoretical entities become observable with the naked eyes. In a sense we may say that science's technology converts the scientific world into the lifeworld.

An implicit assumption of instrumental realism seems to be that the lifeworld has the title to reality and the function of a technology as a practice cannot be false. I grant the first part although some people would argue against it. The second part is more problematic to me if we again pay due attention to the design aspect of technology. A technology is designed on the basis of some scientific knowledge, from the simple quicksilver thermometer to the complicated cloud chamber. The former is based on the relation between the volume of quicksilver and its temperature, while the latter is based on the ionizing effect of radiation. Although when a technology well functions

its scientific foundation retreats into unconsciousness in the user, it's still there. When we consider technology as a whole, we cannot keep staying in the aspect of function and pay no attention to the aspect of design. And if science plays an essential part in the design of technology, especially science's technology, then to some extent technology is theory-laden. For a technology in everyday life, such as a washing machine, whether it works is obvious. If it can make clothes clean then it works. But it's not the case with a sophisticated scientific instrument. The working of such an instrument is normally based on certain theories. Therefore science's technology cannot provide a solid ground on which we may put science. In other words, science's technology cannot bring more reality to science.

Generally the relationship between technology and science is an interdependent one. This interdependent relationship can be viewed from the two major aspects of technology, design and function. From the design perspective technology can be regarded as an applied science in the broad sense and from the functional perspective scientific activities are performed in the technological lifeworld. From one perspective technology is on top of science, but from the other science is on top of technology. Hence we have a circle of reliance here. Based on this general view, if science's technology could really close the gap between the lifeworld and the scientific world, it makes life more scientific rather than moves science closer to life. In the two aspects of technology design has some priority over function. For one reason, design is prior to function in terms of time. A technology is always first designed, created and then functions. For another reason design also has logical priority over function. Design to a large extent determines actual function, but not the other way around.

We have seen that the relationship between technology and science is intertwined with technology's two major aspects. But science doesn't cover everything in those two aspects. Beyond science is where other cultural factors come into play. That's the content of the next two sections of this chapter.

3.3 Technology as Design

Science in the broad sense aims at discovering the regularities in the phenomena, but technology needs first to be created. Specifically technology is created following some intentional design. The designer must have some purpose in mind. And the purpose is function oriented. As we've discussed before (3.1.2), a technology doesn't have to involve a created artifact, but to put an existing item into certain use also involves a design, i.e. the way of use. A technology can even be embodied in an abstract, intangible entity. In this case both the design and functional aspects of technology are strongly emphasized.

Computer software is a model of such an abstract, intangible entity. The technologies that can be carried in computer software are abundant and diverse. Software engineering is the process to produce software products. The analysis of software engineering could reveal various subtleties in technology. It constitutes a good illustration of the engineering process. So next we take a closer look at the software engineering cycle. This will provide a good example for us to talk about the design and functional aspects of technology in details.

3.3.1 An illustration of the engineering process

The software engineering process contains several typical phases. These phases generally go one after another and then repeat themselves. That's why they are called cycles. Normal cycles correspond to releases of a software product, whether they are major releases or minor releases.

In a special development model, such as the iterative model, there are more than one light weight cycles (iterations in this case) for a single release. A normal software engineering cycle consists of the following phases: requirements, design, implementation, testing and maintenance. The testing phase usually overlaps the implementation and maintenance phases. Also the maintenance phase of a cycle may overlap the requirements, or even the design phase of the following cycle.

In the requirements phase the product manager figures out the list of requirements for the new product or the new version of the product, based on market analysis or customers' direct requests. A typical requirement for a software product is about a particular function. A function could be small or big. Another font support in a text editor is a small function, but a grammar check tool is a big one. A big function is also called a feature in a software product. A list of requirements is the starting point of software engineering. These small or big functions are the target of later phases.

With the target functions specified developers can next start the design phase. Software product design can be divided into two parts: higher level architecture design and lower level component design. Architecture is the general structure of a software product. A product is divided into various components in its architecture. The structure is represented in the functional specification of each of the components and the interactions between the components. On the basis of the architecture design each of the components is designed. A component of a software product is also called a module. Although it serves as a part of a whole, it has self-contained functionality and interacts with other modules only through the interface. Certainly a module could further be divided into sub-modules. This modularized design follows a typical divide-and-conquer strategy. It also facilitates division of labor and maintenance.

The implementation is based on the design. With clear functionality and interface specifications the components could be assigned to different developers to implement. Implementation in software engineering is actually coding. The platform (operating system, Windows, Unix, etc.) and the programming language (Java, C/C++/C#, etc.) are two major factors to consider in coding. Before any code can be written the platform and the language have to be determined. Then comes the algorithm choice. Algorithm directly influences the product performance (efficiency). Finally the procedures (the smallest functional units) can be written. When all the components have been implemented, they are put together to build the whole product. This is called integration.

The testing phase usually begins in the middle of the implementation phase. Testing is divided into unit testing and quality assurance. Unit testing is performed by developers and aims at testing basic functionality. When a component is implemented, its basic functionality needs to conform to the design. Unit testing is a necessary step toward this goal. The reason why this kind of testing is called unit testing is that it involves components only. Quality assurance is performed by dedicated testing team. In quality assurance the software product is tested as a whole, just like how the customers will see it. Quality assurance is not only an integration testing, but also a really thorough testing. All aspects of the product and all possible ways of using the product need to be tested. So quality assurance has to happen after the integration. Once a problem (bug) is found it needs to be resolved by the developer responsible and retested.

After the product is integrated and thoroughly tested, it can be released to the customers. Then the software engineering cycle enters the maintenance phase. Even if quality assurance is well performed before the product release, it's normal that customers find more bugs in the product in a real situation. These newly found bugs certainly need to be resolved. This is the central task of

maintenance. Software product maintenance could take a long time, such as in the case of Windows XP. Or it may be ended with an improved version.

Normally a software product is improved many times. A major improvement corresponds to a major release, and a minor improvement corresponds to a minor release. For a new release the engineering process gets into a new cycle, with the same sequence of phases.

The choice of computer software as an illustrating technology in discussing the elements of technology is based on not only the fact that the author has first hand experience of it, but also that computer software prominently demonstrates the most important elements of technology. First, science (logic and mathematics) is frequently used in software engineering. Second, software design is the center of the engineering cycle. Design exists not just in the design phase, but is involved in the implementation phase too. When a piece of hardware is designed it's handed to the factory workers to produce. But computer software has to be produced by well educated engineers. Third, function becomes prominent because computer software doesn't have dedicated hardware bearer. A piece of software may be installed on various kinds of hardware. This separation from material makes function much more salient.

3.3.2 Design factors

Further software engineering demonstrates all kinds of design factors. In the previous section we've seen science plays an important role in the design of technology. But apparently science is not the only design factor. As we will show various other factors also play a part in software design. They include usability, economics, aesthetics, even ethics and politics. The analysis of design factors can help to expose important aspects of the interaction between technology and culture.

We first start with **scientific factors**. Science is about causality, space and time, and other natural properties.[9] People say science only involves truth, but not value. Yet when science becomes a factor in technology design it's endowed with value. In technology design we need to reach some end through some means. There is always a gap between means and end. Scientific causality just fills the gap. If there doesn't exist causality between a means and the intended end, the means won't work. Viewed from this perspective the causality involved gains some value, as it's now related to a certain purpose. Space also gains value when it's regarded as a property of a technology. And the value of space is context dependent. For a house the bigger the better, but for a portable music player the smaller the better. Efficiency is a valuable time factor, but it again doesn't apply to every case. When transportation is the goal, one wants to get from place A to place B more efficiently. But when sight-seeing is the goal one wants the vehicle to go more slowly. The cases with other natural properties are similar. In software engineering logic and mathematics are the major science involved. The logic of the conditionals must be correct in order for the product to behave as intended. Memory and disk space usage and the processing efficiency are two of the most important properties of a product. Smaller space usage and higher efficiency are always preferred. Algorithm is dedicated to the study of the space and time properties of various programming algorithms.

There doesn't exist a clear-cut boundary between usability and science. Some usability considerations are based on Psychology and behavioral science. But from the perspective of technology design, **usability factors** can be easily distinguished from scientific factors. While

[9] Here we only discuss several fundamental scientific factors. Although people also talk about social engineering, when modern technology is the topic natural science is more relevant and is the focus.

scientific factors are related to the main function of the technology, usability factors are focused on the use of the technology by the user. When a technology is originally invented its main function is the focus. But as it gets mature usability also becomes important, especially under intense competition. When automobile was invented, people only cared about its ability to transport. Now convenience to drive is sometimes more important than the functional characters when people choose a car to buy. Most technologies involve user operations. Certainly computer software is not an exception. Every software product has a human interface, on which the user interacts with it. Depending on the function, the interaction can be divided into control and informing. Control consists of instructions to initiate certain actions and informing is about providing information, whether it's the result of the actions or just a status report. Normally control goes from the user to the product and informing goes in the opposite direction. In a simple web search interface, a search request is given to the product by the user and then the product displays search result. But a more complex product has more complicated interactions on its interface. In such a case a workflow becomes important. A workflow is a sequence of operations. The design of the product needs to guarantee a smooth workflow. Strictly speaking this has little to do with science. Pragmatic issues rather than truth are involved here.

The implementation of a technology in most cases happens in an enterprise, and even when it's funded outside an enterprise it still needs to happen in some economic environment. The product is produced by people using necessary material and tools. All these generate costs. So **economic factors** are another consideration in technology design. On the one hand the product should be designed in such a way that the production needs as little labor as possible. On the other hand the cost of the material or building blocks of the product should be controlled without loss of general quality of the product, and the tools used should also be as cheap as possible. In software engineering modularization and open source are two major endeavors toward cost reduction. Software modularization not only facilitates division of labor, but also greatly improves the chance of software reuse. When a module is standardized into an API package or a part of library it can be reused in many products, so that modules with the same functionalities don't need to be implemented again and again. The open source movement just makes software reuse much more widespread. Modularization often happens within the same company. Open source is intended to break the company barrier. The ideal is that a piece of software implemented by one person may be used by any other. Open source API packages or libraries have been widely used in small companies, where cost effectiveness is most important.

Although there is an essential difference between technology and art, aesthetics also plays a role in technology design. Compared with the scientific factors, the **aesthetic factors** are also closely associated with the product itself, but they are independent of the main function. Strictly speaking aesthetics has little to do with function. But this doesn't prevent technology designers from trying hard to make the product look beautiful. Certainly scientific factors have priority over aesthetic factors. The shape of a car or an aircraft has to follow fluid dynamics first. Then there is little space for aesthetic design. By contrast, the painting on the vehicle has no bearing on its function. This can be totally left to aesthetics. In software engineering, a company with sufficient size usually has dedicated interface designers. They are in charge of creating interface component graphics and advising on the interface layout. The goal is to make the product interface look beautiful.

Ethical and political factors come into play when a technology has influence upon interpersonal relations. A technology is created in a society and also functions in the society. So it has a chance to have some impact on social relations. Two examples in software engineering should be sufficient to illustrate the ideas. Microsoft tried to release its main Windows product with bundled applications such as Internet Explorer and Media Player. This design is not out of any functional

considerations. The main purpose is to have monopoly of those products. It certainly has ethical and political bearings. Another example is the so-called "Section 508 Compliance". It's about Section 508 of the American Rehabilitation Act of 1973, as amended in 1998, which requires that all the electronic and information technology used in the federal government agencies should have no discrimination on individuals with disabilities. This directly applies to software interfaces. Whichever company wants to sell its software product to the American federal government needs to design the interface in such a way that people with disabilities can use it in full without big hindrances. To some extent this is function related, but the major issue here has more political flavor.

I worked on software localization for quite some time. Here we need to consider **cultural factors** in the common sense of the term. Software localization is the process of turning a software product developed for one local market (locale) into a product that can be used in another market. For instance, converting an English version Windows into a German version. Obviously the first thing to do is to translate all the displayable messages from English into German. But language is just one part of the conversion. Another thing is about non-linguistic locale specific symbols or formats, such as the currency symbol, date-time format, number format, time-zone, etc. And when we convert to a quite different culture, say from Western culture to Asian culture, or Arabian culture we even need to examine all the graphics and see if they could be offending.

In this context the concept of value sensitive design becomes straightforward. Friedman, Kahn and Borning define it as follows (Friedman et al. 2002: p. 1):

> Value Sensitive Design is a theoretically grounded approach to the design of technology that accounts for human values in a principled and comprehensive manner throughout the design process.

They also propose a tripartite methodology to carry out value sensitive design. The tripartite methodology consists of conceptual, empirical and technical investigations of the value impacts of a certain technology design. Value sensitive design is directly built on the idea that there are non-technical, value sensitive factors in technology design.

In this section we take computer software as an illustrating example of technology first to show vertically the whole process of technology creation and second to show horizontally a comprehensive set of aspects of technology design. The first subsection emphasizes the central place of design in technology creation. Requirements or target functions are the starting point of design and implementation is the realization of design. Testing and maintenance can be regarded as the guarantee of design realization. The second subsection demonstrates the complexity of design. Although science plays a pivotal role in technology design, now we can see the statement that technology is applied science only reflects part of the technology creation. Besides science there are many other design factors, including usability, economics, aesthetics, ethics, politics and culture in the common sense. All these belong to the culture concept we are adopting in this part of the essay, which refers to the artificial world and is said against nature. With all these different design factors sometimes trade-off is inevitable. But I don't want to get into details here. For the general purpose of this essay we've already located technology creation in the cultural context.

3.4 Technology as Function

When we say technology is created to serve some purpose, this seems to be too general a statement. Creation and purpose without careful qualification cover a large area of human activities. In fact, everything in the artificial world may be said to be created. In a sense even science is a human creation, as scientific theories themselves don't originally exist in nature. But

it's inappropriate to say that scientific theories are designed by scientists. Design assumes a sufficient amount of freedom of creation. With the observed phenomena as restriction, the creation of scientific theories doesn't have much freedom. At the other extreme there certainly exists design in art creation. Art creation has the least restriction. It doesn't need to conform to reality, it doesn't follow logic or causality, and it often puts the whole realm of reason aside. In contrast it lives in the realm of imagination and dreams. Technology design apparently is not like this. Technology creation has explicit restriction and the restriction is actually its intended or target function. Besides, technology belongs to the realm of reason. So technology creation is not as free as art creation. But given the fixed target function (the end) and the causal connection between means and end, the freedom of technology creation resides in the choice of means.

We can see both the creation and the purpose in technology center on its function. But we need also to qualify the function of technology. Generally function always involves a relation, an aim, a what-for. In this sense the function of the bark of a tree is to protect inner tissue and transmit nutrient from the root to the branches and leaves. But the bark cannot be called a technology. So the function of technology is more restricted. We may say it's related to human needs and aims at meeting the human needs. In other words the function of technology is utility. When we think further this qualification still doesn't seem to be sufficient to demarcate technology. Philosophy, art and religion all have some kind of utility, but these are not technology. Further qualification of the function of technology needs to be based on the distinction between the material and the spiritual world. The material world is generally related to human body, whereas the spiritual world to human mind and soul. The material world includes food, clothes, housing, transportation and health. The spiritual world includes entertainment, feelings, thought and faith. The spiritual world normally has its material bearers. These bearers also belong to the material world. If we restrict the function of technology to **material utility**, then we seem to have a rather accurate demarcation. So we have food technology, weaving technology, heating technology, transportation technology, medical technology, and also music recording technology, book printing and binding technology. However we don't have music composing technology, book writing technology, or even photographing technology or fashion design technology.

On the basis of this qualification of the function of technology we can next investigate some important aspects of it. The aim is still to reveal the interaction between technology and culture in the respect of function.

3.4.1 Intended function vs. actual function

Function dominates technology since it's created. Technology design is already guided by a certain function. After a technology is created it normally functions in a certain way. However the way it finally functions doesn't have to conform to what guides the design. We may call the former actual function and the latter intended function. The discrepancy between the actual function and the intended function could take different forms. In the first case the intended function is just not achieved. The actual function is accordingly non-function or malfunction. In the second case the intended function is achieved, but the technology is put to a different use, thus actually has a different function. In the third case the intended function is not achieved, but the technology ends up with an unexpected different function. In the fourth case the intended function is achieved, but it's accompanied with unintended functions. These unintended functions are side effects. This is not a complete list, but should serve our purpose. We handle each case in turn in the following paragraphs.

The intended function directly guides the technology design, but between the intended function and the actual function there are a couple of intermediate nodes. The design could be wrong and

the implementation could also be wrong. These can both cause function failure. Scientific knowledge fills the gap between adopted means and the intended function in design, but it could be false. Sometimes function failure even led to new scientific discovery. Another possibility is that important real world factors are not taken into account during design. When these factors are introduced in the real world, they could break the function of the implemented architecture. Scalability issue in software engineering is a typical case. A flimsily designed web server could break down when a great number of users start to access it. Even when the design is flawless, the implementation could still be problematic. Every software product inevitably contains more or less defects in it. These are implementation mistakes and should be fixed in the maintenance phase.

Even a successful technology may be put to different use. "Successful" is used in the sense that its intended function is achieved. The MiniTel example used by Feenberg is also a good example here. MiniTel was originally designed to transmit data, but ended up to be used as a communication tool. The evolution history of computers in a few decades better illustrates the drama of alternative function. Shortly after being primarily used in the Second World War to decode military messages, computers were used to perform scientific computations. That's why they are called "computers." Then people found that computation was not the only task a computer could perform. It could also do all kinds of information manipulations, such as sorting and searching. So the function of information processing was added to computers. Recently with the popular use of PC's and the network computers were more and more used for entertainment and communication. But at the same time both of the computation and information processing functions were still kept.[10] We can see alternative function plays an important role in technology evolution.

The third case is kind of a combination of the first two, with both function failure and alternative function. Here a technology is designed to achieve an intended function, but it finally fails. However, different from the first case where the technology turns out to be useless, it finds an alternative use. Examples for this case are not rare in the industry. The so-called "failed products" often are sold to serve a different function than its intended one. As this is a combination case we don't need to spend the same amount of space to discuss it.

The case where intended and unintended functions coexist seems to be the most common. Many technologies have unintended side effects besides the main intended function. Flu medicine makes people drowsy. Cars pollute the air and create noise. Hydraulic dams disturb the ecosystems. Even a piece of application software could cause side effects in the system. Side effects could be desirable or undesirable. In most cases they are undesirable. In those cases side effects are part of the price we have to pay for the intended function. When side effects become well-known certainly they may be taken into account in the design. In such a design the target functions are complicated. Besides the main function reducing side effects is also an integral part. Electric cars are the result of such a design.

From the cases of the discrepancy between the intended and the actual functions of technology we may draw a couple of philosophical conclusions. First, while scientific knowledge is used in technology design to fill the gap between means and end (the intended function), scientific (natural) laws determine the actual function. The discrepancy between the intended and the actual functions could reveal the falsehood of certain scientific knowledge. Second, the actual function of technology is realized in a cultural context. Alternative function shows how the context shapes

[10] For a detailed discussion of the history of information technology cf. 12.1.

the actual function. Certainly the alternative function must also have its scientific foundation, but the actual realization (choice) of the function is still based on the cultural context.

3.4.2 Technological lifeworld

When a technology well functions, it becomes part of human life. Since human beings started to use tools, the human-world relation has been shaped by different kinds of technologies. So human life is essentially under the influence of technology. If we can say tool using is a fundamental character of human beings, then we may say human life is a technological life.

Ihde carries out a very interesting analysis of the mediation of technology in the human-world relation in his "phenomenology of technics." The general intentionality relation involved may be formatted as follows: Human-technology-world. Here technology stands in between human and the world and mediates their relations. What's more interesting is not this general format, but three of its variants. The first variant is called embodiment relation, in which a technology essentially functions as a part of the human body. The second variant is hermeneutic relation, where a technology essentially functions as a symbol of the world. The third variant can be regarded as derived from the second. In this case a technology shades out the world and functions as if having its own life. So the technology itself becomes the other. Therefore this variant is called alterity relation.

The embodiment relation has abundant examples, from the blind man's cane, through glasses and hearing aid, to even a car. When a blind man uses a cane to walk, the cane helps him experience the road situation ahead, road surface, obstacles etc. When the cane well functions, it retreats into unconsciousness and becomes a sense organ of the blind man, like eyes of an ordinary man. In this sense the cane functions as a body part. The subject-object boundary should be drawn between the cane and the world, not between the man and the cane. The case of glasses and hearing aid is a little different. They are both corrections of existing senses, vision and hearing, respectively. When they well functions they also retreats into unconsciousness. Telescope and microscope are similar. The difference is that they are extensions of an existing sense instead of corrections. A car is more complicated. Its main function is to provide mobility. When one's driving becomes skillful, the car also retreats into unconsciousness. She may steer, speed up and slow down at will. She can control mobility just like through the limbs directly. Experienced drivers can even use the brake to test the slipperiness of the road surface. Generally a car functions like an extension of the limbs, with both mobile and sensory abilities. But all these examples share a common character: a technology functions essentially as a part of the human body. So the general intentionality relation may be revised into the following format:

(Human-Technology) → World

The hyphen "-" is a connector. The arrow "→" represents an intentionality projection, and so it also indicates the subject-object boundary.

The hermeneutic relation mostly resides in measuring, detecting and scanning instruments. Quicksilver thermometer is a simple example. A thermometer measures temperature, but the temperature is read out from the scale. The difference between the embodiment and the hermeneutic relations lies in whether the observation and the object are isomorphic. The embodiment relation corresponds to an isomorphic relation between the observation and the object, but the case with the hermeneutic relation is the opposite. Obviously numbers on the scale and the temperature are not isomorphic. Another example is radar. A fleet of aircrafts is represented as a dot on the radar screen. There is correspondence between the air space and the radar screen, but they are not isomorphic either. The ultrasonic scanner is a third technology that demonstrates the hermeneutic relation. In these examples the users see the world (the surrounding

temperature, the aircrafts in the air space or the tissue in the body) through the interface of the corresponding instrument (the scale, the radar screen or the computer screen). In this case the technology and the world are closely connected. The intentionality projection is from human to the technology. So we have the following format:

Human → (Technology-World)

Here the technology is a symbol of the world, just like a word is a symbol of an object, a property or relations in the world.

The alterity relation as Ihde discusses it, is not as clear as the two relations above. He talks about a word processor having its characters and a robot's senses. His format suggests that in alterity relation technology becomes independent of the world and seems to have its own life. So technology actually becomes the other. The alterity relation is depicted in this format:

Human → Technology-(-World)

I cite Ihde's own explanation. "I have placed the parentheses thusly to indicate that in alterity relations there may be, but need not be, a relation through the technology to the world (although it might well be expected that the *usefulness* of any technology will necessarily entail just such a referentiality). The world, in this case, may remain context and background, and the technology may emerge as the foreground and focal quasi-other with which I momentarily engage." (Ihde 1990: p. 107)

In my opinion mediation is just one general type of technology function. In other words, technology doesn't have to stand between human and the world. It may well function as *part* of the world. Just think about a modern apartment, with its electric lights, air conditioning and heating, and all kinds of appliances, stoves, the refrigerator, the washing machine, etc. None of the technologies listed mediates between human and the world. They all stand on their own and people living in the apartment interact with them. Artificial light has the same phenomenological status as natural light, and the difference only lies in the fact that it's controllable. Air conditioning and heating adjust the room air temperature. They don't stand between human and the air. Most of the appliances meet a life need, but they don't function like glasses or the thermometer. Stoves, the refrigerator and the washing machine act on life material (food and clothes), but again they don't stand in between. People interact with life material directly, and also with these appliances directly. In this way these appliances with different technologies add to the original world and become a part of the new world. We may similarly format this relation as follows:

Human → Technology (World)

Here the arrow has the same meaning, but the parentheses are used as a way of explanation. Basically it says that the intentionality relation happens between human and the technology, where technology in fact becomes (part of) the world.

The direct relation in technology function is not meant to replace the mediating relation, but it's a significant complement. If we consider technology as a whole, only a small part involves mediating relation. Most technologies interact with human beings by themselves. However in both types of relations technology constitutes an important part of the human lifeworld. We may call this technology related lifeworld technological lifeworld. In the broad sense of technology human lifeworld is more or less a technological lifeworld. Most animals just live by instinct. Human beings got out of the animal kingdom by using tools. In the broad sense any tool can be counted as a technology. Even a stone knife is a creation although that piece of stone is taken directly from nature. The creation lies in the way how it's operated. And a stone knife definitely serves a human purpose. Nature still takes a great part in an agricultural life. By contrast, in a modern life technology dominates. So the modern lifeworld is much more technological.

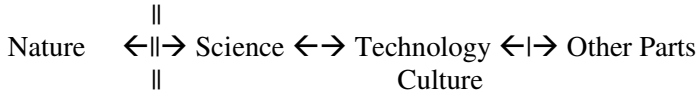
The analysis of the actual technology function compared with the intended function reveals how science and culture determines or influences the function of technology. The analysis of the technological lifeworld on the other hand shows how technology can have an impact upon science and culture, as scientific and cultural activities all take place in the lifeworld. This is apparently a co-constructive relation.

Based on the analysis of the elements of technology, this is the general picture we get at the end of this chapter: Science, design and function are the three major elements of technology. Scientific knowledge is used in the design and scientific laws determine the actual function. The intended function guides the design. Besides science there are also a bunch of other factors being taken into account in the design. The actual function is finally realized in a cultural context. It may deviate from the intended function due to design or implementation failure or alternative use. Unintended side effects often accompany the intended function. Once technology well functions it constitutes part of the lifeworld, in which science and culture act. With this picture in mind we can take a closer look at some influential theories about the relationship between technology and culture.

4. Traditional Theories

The subject of this part is the relationship between technology and culture. We've said that the culture concept adopted in this part is equivalent to the artificial world. But under this concept technology apparently belongs to culture, so when we talk about the relationship between technology and culture we are actually considering the relations between technology and other parts of culture. In the analysis of technology in the previous chapter we to some extent demonstrated the complexity of the general relationship. But the focus there is technology. Technology is kind of put under the microscope and the relations with other parts of culture are reflected in the three major elements of technology. From now on we step back and have the whole culture in our view. This allows us to see the relations directly. However, this is not a change of subject. With the anatomy of technology in mind the relations between technology and culture can be more easily understood.

Normally when people talk about the relationship between technology and culture, they always put science together with technology on the same side. So the relationship ends up being one between science-technology and culture. But as we showed in the previous chapter there are essential differences between science and technology. In a sense technology stands in the middle of science and art. It has the creation side of art, but at the same time the restriction side of science. On the other hand, since technology contains scientific element as an important part, putting science and technology together is also justified. Further justification can be found when we take a wider view including the relationship between nature and culture. Science and technology lie near the boundary between nature and culture. They in a certain sense are the interface between the two general realms. They represent the natural restraint of culture and the cultural impact upon nature. The relations involved may be preliminarily depicted in the following schema:



The double bars "‖" represent a major boundary between nature and culture. The single bar "|" indicates a minor boundary within the realm of culture. The double arrows "←→" stand for a bidirectional relation. The first relation is the subject of philosophy of science. The second relation has been discussed in the previous chapter. The third relation will be further discussed in the next two chapters.

In the above schema technology is put in the middle of science and other parts of culture. The two ends constitute the opposite poles in terms of value involved. Value is based on free choice and goal. There can be value only if there is free choice or goal.[11] Nature is governed by blind causal laws, so there can be neither goal nor free choice in it.[12] Therefore there can be no value in natural processes. Science is mostly directly concerned with natural laws, so the standard view about science is that it's also independent of value. This standard view was challenged recently, but the natural restraint on science is a fact that cannot be denied. Scientific activities may be value-laden, even scientific theories may be influenced by pragmatic factors, but empirical evidence

[11] The value concept adopted here has medium denotation. It refers not only to ethical values, but also aesthetic, religious values and more. The value of a person is based on free will. The value of a thing is based on a goal or purpose. The value that is just based on a function, such as in the case that wings are good for flight, is excluded.

[12] This is based on the notion of a spontaneous nature. Supernaturalism is not shared in this essay.

and mathematics are still the dominating elements in science, and these are value-neutral. By contrast the other parts of culture are value-laden. In those parts people's needs, emotions and desires are involved and people's activities have more freedom.

Major theories in philosophy of technology are concerned with the relationship between technology and culture. But they are all based on some general assumption about technology and the value-ladenness of technology is a very important one. This assumption has direct influence upon the relationship between technology and culture. Some theories assume or claim that technology is value-neutral, whereas others assume or claim that it's value-laden. Based on the discussion above, it boils down to where to put the minor boundary bar in the schema. By putting the boundary that way one actually supposes that technology is value-neutral. In the discussion of this part major theories in philosophy of technology are grouped according to this assumption. It coincides with the historical grouping. Traditional theories which assume the value-neutrality of technology are discussed in this chapter and contemporary theories which assume the value-ladenness of technology will be discussed in the next. For each theory I try to identify its foundation in the anatomy of technology. The general view is that each theory captures an important aspect of technology, but when excessively generalized it becomes inevitably biased. The relationship between technology and culture is really complicated, as the analysis of technology has preliminarily shown.

4.1 The Value-Neutrality of Technology

Before we get into the two predominant traditional theories of technology, their common assumption, the value-neutrality of technology, will be examined first in this section. With the recent revelation of the culture-ladenness of technology, the general claim that technology is value-neutral can no longer hold. However, we should not move to the other extreme and deny all the autonomy of technology. Generally the relationship between technology and culture is a co-constructive one. Culture shapes technology development, but technology also influences culture. The latter part of the relationship requires us to defend a partial neutrality of technology. With the analysis of technology we can further base the partial neutrality on the scientific element of technology. The scientific element grants technology certain amount of autonomy and enables it to influence culture. A discussion about the relation between science and value helps elaborate this idea.

4.1.1 Science and value

Traditionally science was deemed as accumulative, rational, objective, pure and detached. This standard view was first seriously challenged by Kuhn's historicism, in which science was studied from the historical perspective. Through the historical study of scientific revolutions Kuhn reveals that scientific development is not accumulative as the logical-empiricist view assumes. Instead paradigm shifts happen in scientific development, in which observations are influenced. This so-called theory-ladenness of observation is a direct challenge to the objectivity of science. But to this point value has still not been introduced into science. There is an essential difference between theory-ladenness and value-ladenness. Scientists in fact don't have much choice in paradigm shift. When more and more evidence points toward a new paradigm, a paradigm shift is inevitable.[13] To say observation is influenced by theory doesn't mean observation is influenced

[13] This is said from the perspective of scientific community. From the perspective of individual scientist she may align herself with either the old or the new paradigm, but again this is not based on value sensitive considerations.

by value. Even the pragmatism in theory building doesn't involve value in the strict sense. Although the simplicity principle carries certain value with it (simple is useful, simple is beautiful), again under the simplicity principle scientists don't have much choice. This is a principle every scientist would follow. And there is common standard of simplicity.

Value is introduced into science in the sociological study of science. Here scientific activities are moved away from the Ivory Tower and put in the real-world social context. Now people clearly see that scientists are not emotionless, disinterested saints. Instead they also have love and hatred, they also need to earn a living, and they are also eager for fame. And this sometimes does influence their professional activities. As scientific research turns into more and more organized group activities, its sociological characters become more and more prominent. Scientific research can no longer be carried out by a single person with simple instruments. When many people are involved in the same project the organization itself shows many social characteristics. When big funding is necessary the research has to be carried out in a larger economic-political context. Under these circumstances value definitely comes into play. In the recent Science Wars social constructivism, post-modernism, environmentalism, feminism and multi-culturalism all launched attacks on science. Science was damned as a racist, sexist and rapist endeavor that is influenced by many social factors and offers a world narrative without any special status, even no better than a fiction.[14] All these attacks primarily target at the social characteristics of scientific activities. Here is the place where value plays an important role. And it's also the place where the attacks bear force.

However, there is a fundamental difference between scientific theories and scientific activities. Given the value involved in scientific activities we still have good reasons to defend the neutrality of scientific theories. Although scientific theories are created in activities that involve all kinds of value, the theories themselves have restrictions that are independent of value. Specifically scientific theories are restricted by mathematics and empirical evidence, both of which are universal. Mathematical proofs should be understood by all people in the related field and empirical evidence should be verifiable cross labs. Hence personal interests, emotions and preferences have little chance to take effect in setting up the theories and having them accepted by the scientific community. And scientific theories are what science is essentially about. In this sense we can say neutrality is a dominating character of science. It should be pointed out here that the neutrality claim doesn't require commitment to realism. A theory doesn't need to be real in order to be value-neutral.

This leads us to the third theory of science we need to consider. It is Janich's cultural constructivism.[15] His basic observation in this respect is that science comes out of lifeworld practice. In a hunter-gatherer society the science of distance measurement could be developed, but not geometry, which is the science of area measurement. Geometry is only possible in an agriculture society, where land measurement becomes necessary. Two theses are drawn from this basic observation. First, scientific concepts, such as distance and area, don't exist in nature for humans to discover. Instead they are invented based on lifeworld practice. Second, scientific knowledge is not pure and disinterested. They clearly serve human purposes. Compared with historicism and the sociological study of science, cultural constructivism makes a more serious challenge to the neutrality of science. Historicism challenges the objectivity of observation

[14] Gross and Levitt's book (Gross & Levitt 1998) contains comprehensive discussion about all the major attacks, and their counter-attacks.

[15] I call Janich's theory "cultural constructivism" in order to distinguish it from social constructivism of science. The latter's focus is on the social characteristics of scientific activities, whereas the former is primarily concerned with the cultural foundation of science.

through disclosing its theory-ladenness, but value still doesn't play a role in observation. The sociological study of science reveals the value-ladenness of scientific activities, but it has difficulty in going from the value-ladenness of scientific activities to that of scientific theories. In contrast, cultural constructivism seems to claim that scientific theories are shaped by culture.

We need to take a closer look at the theory. The first thesis above goes directly against realism, which holds that scientific theories are about reality. Realism implies the value-neutrality of science, but not the other way around. If scientific theories are about reality of nature, then they must be value-neutral. Yet, if scientific theories are invented as cultural constructivism claims, they could still be value-neutral. I show this through examining the second thesis above. It's an undeniable fact that science is developed to serve some human purpose. Anyways science is a human endeavor. However, lifeworld practice only provides general motivation and background. Agriculture fostered geometry, but geometry was not particularly determined by agriculture. It can be applied to many other fields. Janich talks about the notion of high-stylization (Hochstilisierung). He maintains that to become science lifeworld practice has to be high-stylized. He describes high-stylization in this way (Janich 1997: p. 26, author's translation):

> Going from the example of measuring art the *high-stylization* of lifeworld practice to science is now generally understood as this, *terminologies with universal concepts* are developed and proved action rules are converted into explicitly described and *as practical identified methods*.

We can see universality is an essential feature of high-stylization. The language of science must be "theory capable." Scientific terminology should consist of "a coherent and consistent concept system." This requirement excludes the influence of value factors. With the universality requirement not all lifeworld practice can be high-stylized. Moral and art practices are good examples. If we make this distinction in lifeworld practice then cultural constructivism in fact is not incompatible with the value-neutrality of science. Generally we can say, science is based on the value-neutral part of lifeworld practice. Scientific theories are constructed, but they are constructed according to value-neutral principles.

I've tried to briefly defend the value-neutrality of science against historicism, the sociological study of science and cultural constructivism. Defending the value-neutrality of science doesn't contradict denying its universal scope. The analytical and empirical method of science only works for a limited set of phenomena, but within this limited scope science has universal rules and restrictions to follow. These rules and restrictions give value no space to play. Looked from the view that value constitutes an essential part of human life the value-neutrality of science just implies its limitation rather than universality.[16]

4.1.2 The scientific element of technology is value-neutral

Now we move to technology. The analysis of technology in the previous chapter has demonstrated that technology is a very different endeavor than science. They have different starting points and also different targets. Science starts with phenomena in the world[17] and targets at theories[18] that can interpret them. By contrast technology starts with design and targets at functions that can meet certain needs. However, science and technology are closely related. On the one hand science has to use technology to build instruments in its experiments. On the other

[16] For further discussion of the limitation of science cf. 8.1.

[17] The scientific world has to be extended beyond the traditional human-independent "outside" world. So here the phenomena include human generated phenomena and the world includes artificial world. Some authors have pointed out the prejudice of traditional philosophy of science in this respect. Cf. Schummer 1997.

[18] And the theories don't have to be universal theories, like the fundamental physical theories.

hand science plays important roles in both the design and function of technology.[19] Through this close relationship the neutrality of science is transferred to technology.

Hence we may look at the neutrality of technology from both the design and the functional perspectives. In the full set of design factors science seems to only take a single slot among many others, but the importance is not divided evenly among the factors. Any of the usability, economic, aesthetic, ethical and political factors could be ignored without essential loss of the technology. But if we take away the scientific factor there won't be the technology in consideration. We said scientific knowledge fills the gap between the means and the intended function in technology design. Obviously without this gap filled the intended function cannot be achieved. Therefore science is an essential design factor. There is value involved in other design factors, but not in this essential one. So we can say in this respect the design of technology is neutral. The case with the function of technology is similar. Whereas scientific knowledge plays a deciding role in the design of technology, scientific laws play a deciding role in the function. When a technology is created it functions in the real world, but primarily the material world. And scientific laws govern the material world. So the actual function of technology has to conform to scientific laws. This is true even when a technology is put to a different use. A different use is possible only when scientific laws allow it. A hammer can be used as a door stopper, but not as a float.

Due to the prominent scientific element in technology, traditional theories of technology often talk about science and technology together and assume the neutrality of technology. Only recently did people pay much attention to the culture-ladenness. Although we don't want to generalize the neutrality character of technology, it definitely has a solid foundation. The two theories we will discuss in this chapter both assume the neutrality of technology, but with this shared assumption they hold quite different views about the relationship between technology and culture. In a sense we could even say they are just opposites, with one emphasizing the dependence of technology on culture and the other the dependence of culture on technology.

4.2 Technological Determinism

Technological determinism has a short history. In traditional society technology never had a chance to dominate, even in the case where technology was well developed. In the traditional value system technology didn't occupy a central place. This might be a major reason why technology had developed relatively slowly in the traditional society. Things have been different since the Industrial Revolution. Technology more and more became the driving force of social development. Inventions after inventions in a short period of time had greatly changed all aspects of human life. At the end of the 19th century people became so optimistic about technology that they believed technology was the only path to progress and happiness. However, only two decades later that dominant optimism turned into pessimism. People witnessed that the same technology which had improved human life on an unprecedented scale was used to slaughter humans also on an unprecedented scale. The ensuing Great Depression and another major war made the situation even gloomier. Although the general mood turned from optimism into pessimism, the general view about the status of technology didn't change.

[19] On the basis of the close relationship the traditional notion of the boundary between science and technology has been outdated. For one thing there is no clear-cut boundary between the two human endeavors. Scientists are not disinterested saints living in the ivory tower. Engineers don't disregard theory building either. The two endeavors are interwoven and penetrate each other. Despite this fact conceptually distinguishing the two is still very important.

Technological determinism holds that technology is neutral and autonomous, and to a large extent determines human life. Marx is the classical proponent. His historical materialism is embodied in the famous statement "The hand mill gives you society with the feudal lord; the steam-mill, society with the industrial capitalist." Marx divides the human society into three major parts: the productive forces, the relations of production and the superstructure. The productive forces represent the capability of production. Technology is apparently a major component of them. The relations of production refer to the economic relations among the parties involved in the production. In the capitalist economy capitalists and workers are the major parties involved. The productive forces and the relations of production combined constitute the mode of production. This generally covers the economic realm of the society. The mode of production is called the economic foundation, on top of which the superstructure of the society rests. The superstructure then includes the political and the cultural realms of the society. In Marx's picture there are two levels of determining relations: the productive forces determine the relations of production and the mode of production (the economic foundation) determines the superstructure. That famous statement only illustrates the first determining relation. All in all technology is put at the bottom of the architecture. So this is a standard form of technological determinism.

To many Marx's determinism appears too simplistic. We can list straightforward counterexamples against the first level of determination, let alone the second level, which is more complicated. Industrialization was in fact performed in the socialist society of the Soviet Union. The deduction from steam-mill to capitalism apparently doesn't hold. This prompts defenders to construct different kinds of soft determinism. Heilbroner brings up several interesting revisions. The first revision is to reduce the determining range. Instead of claiming that technology determines the relations of production, he only states that technology determines the composition of the labor force and the hierarchical organization of work. So he corrects, "Had Marx written that the steam-mill gives you society with the industrial *manager*, he would have been closer to the truth." (Heilbroner 1967: p. 341) The other two revisions are to admit the social and historical context of technology development. For one, "The general *level* of technology may follow an independently determined sequential path, but its areas of application certainly reflect social influences." (*ibid.*: p. 343) Here the level or capacity of technology is distinguished from its application. Finally technological determinism is even put in a particular historical context, where capitalism, the market system and modern science all play important roles. To cite Heilbroner again, "*Technological determinism is thus peculiarly a problem of a certain historic epoch* – specifically that of high capitalism and low socialism – *in which the forces of technical change have been unleashed, but when the agencies for the control or guidance of technology are still rudimentary*." (*ibid.*: p. 345)

This revised soft form of technological determinism obviously is more convincing. But I would further soften it in some respect. I would argue that even the general level of technology doesn't follow an *independently determined* sequential path. The actual path A→B→C could turn out to be A→B1→D. In other words the actual path is not determined by technology itself. Technology only determines the possible order, but not the actual sequence. Nonetheless the determination of technology is an undeniable fact. So next we do some analysis of its foundation.

4.2.1 The foundation of determination

The determination of technology obviously is related to its neutrality. Certainly a thing doesn't need to be neutral or independent in order to be a determinant. But neutrality enhances determination. This again points to the scientific element of technology. The science involved in the design and function of technology makes its development follow some kind of internal logic.

This logic enforces a certain order of development. The invention of later technologies has to happen on the basis of some previous ones. For instance, the invention of the steam engine is impossible without advanced iron casting technology, and the invention of the airplane is impossible without the invention of the internal combustion engine. Every invention creates a new potential. A set of things could be built on top of it. This potential set is still based on logic and science. However potentiality is not reality. On a certain level of technology what's possible next is determined by science and the internal logic of technology, but what's actually realized is not determined by technology itself. In this case other factors play a role. We can see science and internal logic even cannot determine the actual sequence of technology's own development. In other words, technology has autonomy, but this autonomy is partial.

Neutrality, independence and autonomy certainly add to the power of determination, but the foundation of technology's determination on culture needs to be found mainly in the realm of culture. Marx's thesis that the economic foundation determines the superstructure to some extent reflects a truth in the cultural realm. A simple fact is that humans have to satisfy physical needs first and then get involved in spiritual activities. In this sense material life has priority over spiritual life. Every significant natural disaster (earthquake, flood, famine, pandemic etc.) always has a big impact on material life first and then influences the social and spiritual lives. For instance, Black Death once wiped out over half of the population in Europe. This definitely had greatly changed the social structure and religious life. Material life also provides the background on which human relations and ideologies may develop. Transportation and communicate are good examples in this respect. Modern transportation (with train, automobile and airplane) and communication (with telegraphy, telephone, radio, TV and the internet) have greatly expanded the lifeworld and reduced the distance. So a community is no longer based on a village or a town. People from different corners of the globe may interact with one another on a daily basis. In this new life scope new relations among people are formed and new thoughts and feelings are inspired. In this way material life also creates potentials and conditions. Without the modern transportation and communication the lifeworld is restricted to a local area, and as a result the modern human relations and world outlook is impossible. But again the possibilities on the basis of a certain set of conditions are many. An actual realization is beyond the scope of the determination of material life.

The determination of material life in human relations and spiritual life demonstrates the natural restrictions of culture. Culture exists in nature and is limited by it. Material life is the overlap between nature and culture. On the one hand material life has to follow natural laws and on the other hand it's to a large extent shaped by culture. This is the general frame in which technology comes into play. Technology is the major way through which culture shapes material life and in doing that it has to follow natural restrictions. Therefore the determination of material life is the major foundation of the determination of technology. Modern technology has dramatically improved material life and in turn greatly influenced other parts of culture. In this sense technology determines culture. Besides, following natural restrictions (scientific laws) makes technology autonomous to some extent. That gives the impression that technology was an independent determining power.

4.2.2 Determinism as the common ground of both utopia and dystopia

Technological determinism captures the scientific element of technology as the dominating aspect. The way technology determines human life is mostly through its scientific element. The steam-mill is different from the hand mill mostly because it provides much more power much more efficiently. In this particular case, physics counts. Certainly in most technologies the advancement doesn't lie in straightforward physical properties. An obvious example is the

writing technology. The writing technology has gone through at least four stages: the carving knife, the brush or pen, the typewriter and the word processor. Originally characters were carved on wood or bamboo bars. Then people wrote on cloth or paper with a brush or pen. Typewriters were mostly used in writing Western languages. Word processors were the most recent invention. The advancement in writing technology resides not only in the convenience of the writing itself, but also in the convenience of editing. Ihde points out that this advancement has greatly influenced people's writing habit, even style. With paper and pen people tend to think carefully before they start to write, because the revision of one sentence may mean rewriting the whole page. In this case the editing happens mostly in the mind. On the contrary, with a word processor people can write spontaneously and then do the editing. Some even claim now the text becomes a malleable existence under endless change. Ihde doesn't claim that the writing technology determines the writing style. But a new technology does create certain new inclinations on the single-user level, and when projected to the large-scale social level some definite patterns are predictable.

While admitting that technological determinism captures some important aspects of the relationship between technology and culture, I have to point out its crucial problem is that it generalizes technology's determination. The generalization happens in two respects: the exaggeration of technology's autonomy and the exaggeration of technology's determining scope. Both are related to the scientific element of technology. So the exaggeration in these two respects boils down to the exaggeration of the scientific element. Granted science plays a dominating role in both the design and the function of technology, but science is not all that matters in either the design or the function. We've clearly shown this in the analysis of technology. And in the next chapter we will discuss some representing theories that emphasize this aspect. When technology is characterized solely with science, it first becomes completely autonomous, because in this case it's only restricted by scientific laws and so develops with its own logic. This together with scientism, which holds that the scientific method could discover the regularities and laws in all the phenomena, then leads to the idea that technology determines all aspects of human life. With these two respects combined, technology is regarded as an autonomous power that has full scale determining force. This is the central claim of technological determinism.

Technological determinism first was associated with the utopian view which grew out of the impact of the Industrial Revolution and culminated at the end of the 19th century. The historical fact in the 19th century Western Europe was that technological advancement fundamentally changed personal and social lives. Modern technology greatly lifted people's material living standard and brought about a new world outlook. Many people believed that technology was equivalent to progress and it's the only path leading to prosperity. A utopia was waiting for people in the near future. Technological determinism apparently lies at the foundation of the utopian belief. The main assumption of the utopian belief is that technology can solve all the problems in human life. Even today this is still an influential idea among people, because new technologies keep being invented and lifting people's living standard. As long as this situation remains the same, there are always people who would extrapolate and advocate technological determinism, one form or another. At the moment there are even people who claim that nanotechnology could cure all the diseases in several decades.

It's a little ironic that the same thought could be behind a directly opposite view. With the outbreak of the two World Wars the utopian view of the 19th century turned into dystopian. Now technology was identified with destruction, instead of progress. People suddenly came to the idea that all the modern malaise was caused by modern technology. Different kinds of nostalgia for the past golden age were direct results. This dystopian view about technology is still based on technological determinism, because it still assumes that technology determines all aspects of life.

The difference from the utopian view lies in the different view of life. While the utopian view sees a bright and progressive life, the dystopian view sees a gloomy and retrogressive life. But both find the final cause in modern technology. In the dystopian view technology is still autonomous and determinative. But substantivism goes a step further. Technological determinism holds that technology is neutral. By contrast substantivism claims that technology provides the framework of modern culture and all aspects of cultural life are shaped by modern technology. In this sense technology is no longer a determining power standing outside of culture, but becomes the core of culture. Obviously the dystopian view is also still influential in the current age. It's just that the destruction of wars is replaced with resource shortage, pollution and climatic change.

Therefore in the post-war era the utopian and dystopian views coexist with each other and constitute the opposite poles in technology evaluation. While one side emphasizes the benefits that technology brings to mankind, the other focuses on damage, harm and even degradation. For many this becomes a dilemma situation. The dilemma is that, one either embraces modern technology and accepts all the negative effects of it, or abandons modern technology and forfeits all the benefits of it. However, as we discussed above, both the utopian and dystopian views are based on technological determinism. If we refute this theory, both the utopia and the dystopia of technology disappear. And the dilemma goes away with them. That's just what I shall argue in Part III. In order to have a complete theory of my own I need next to consider another popular one.

4.3 Common Sense Instrumentalism

Common sense instrumentalism is the oldest theory of technology. It's so straightforward that we may say it's sheer common sense. But when we say common sense here we must add a historical qualification. It's not common sense in all the historical periods, but only in the premodern age. It's common sense when the technological evolution was slow and the change of life caused by technological advancement was not dramatic. Under these circumstances a technology is regarded just as a tool, created by humans to serve a function in human life. A hammer is just a tool to hit some object. A pair of scissors is a tool to cut something. A more complicated weaving machine is just a tool to weave cloth. Certainly all tools make human life easier and that's actually the essential character of a tool. But besides that a tool can have no other meaning for life. In a premodern society life and culture constituted a system that followed its own values and principles. Technologies were just separate objects that fit into this system. They were also purposely created to fit into certain slots.

Like technological determinism, common sense instrumentalism also regards technology as neutral. That is to say technology's value is only represented in its function. But at the same time common sense instrumentalism holds technology is human-controllable and used as an instrument to serve human needs. Hence the name instrumentalism. In this respect instrumentalism is just the opposite of determinism. Another difference is that autonomy doesn't make much sense for instrumentalism. An instrument is created to serve a certain function, so it cannot be autonomous.

4.3.1 The foundation of instrumentation

Common sense instrumentalism denies the autonomy of technology, so its interpretation of neutrality is different from technological determinism. For determinism technology is neutral because it has its own logic. For instrumentalism technology is neutral because it has no other

influence other than its function. All in all the foundation of instrumentation cannot be found in the scientific element of technology. We have to look into the other two elements.

An instrument or a tool is a means. For every means there exists an end. To argue that technology is an instrument one first has to show the corresponding end. This is not a difficult task. In fact, any successful technology starts with certain human need and ends up with some satisfied need. The satisfaction of certain human need is the end of a technology. Or to say it in a different way, technology is a means to satisfy certain human need. This is the function of a technology. In the analysis of technology we've seen, a technology is created with a design process, and an intended function stands in the center of the design. When the technology is created, some actual function is implemented. It's possible that the actual function deviates from the intended function. But in any case a function is involved. And this provides sufficient ground to regard technology as an instrument.

Controllability is another central claim of instrumentalism. For instrumentalism a technology is not just an instrument, but also controllable. The foundation of controllability apparently lies in the design element of technology. A technology is created with a purposive design. So the design is under direct human control. As we discussed before, the actual function of a technology doesn't match its design all the time. But the actual function converges on the design in most cases, with either the unexpected function fixed, or the design adjusted. This is clearly illustrated in a software development cycle. First we make the list of requirements, and then we design according to the requirements. As the design is implemented (coded), we find bugs in the code, and then we fix the bugs. Sometimes we have to adjust the design if we find some aspect of it inappropriate during implementation. In this sense the function of technology is also human-controllable.

As the oldest theory of technology common sense instrumentalism captures some basic aspects of technology. It emphasizes the human freedom in technology design. Although the design has to be based on logic and science, it is at the same time driven by some human purpose. The design process is not just intentional, but has a space of freedom. Logic and science demarcates a scope of possibility, but within the scope there are different choices. Very often we have multiple designs to serve the same purpose. The control of technology is based on this freedom. As technology gets much more powerful in the Modern Age people tend to lose sight of this basic aspect.

4.3.2 The problem with common sense instrumentalism

With the advantages of common sense instrumentalism also come its shortcomings. It grasps the important basic aspects of technology, but at the same time oversimplifies the situation. This oversimplification results from a limited view of technological and social development. As we mentioned above, in the premodern time both technology and society developed slowly. In the life span of most people technology and society looked close to static. In this general picture a technology seemed to be just an instrument created to satisfy some human need. The great influence of technology upon human life can only be seen more clearly in a more dynamic picture. This dynamic picture is reached in two ways. As the Modern Age got mature both technology and society became more and more dynamic. Inventions were made one after another and human life changed day and night. Now people could see the interaction between technology and society more dramatically. Given the 19th century history of Western Europe, technological determinism would be closer to common sense. The other way is through studying the history of technology. In the history of technology long period of time is put together side by side. In this

way the technological development is made more dynamic by sort of compressing the time axis. By so doing we can also see more clearly the impact of technology on society.

So the first problem with common sense instrumentalism lies in the fact that it has no sight of the impact of technology on culture. Once a technology is created and functions in human life it has its own life. We've discussed the technological lifeworld mediated through, or on top of various technologies. We don't need to say much about how modern technologies influence modern life. This is not restricted only to modern technologies. Even the most primitive technologies, such as spears, bows and arrows, also create a lifeworld. With spears, bows and arrows people could fight animals in a distance. This greatly reduces the chance of injuries in hunting compared with using sticks. While sticks extend people's arms a little, spears, bows and arrows do the same thing to a much larger extent. This improvement in quantity has qualitative effects. A culture with spears, bows and arrows has much more power of survival than one with only sticks. In this respect there is actually no big difference between premodern and modern technologies. Premodern technologies are simpler, but premodern life is also simpler. So the impact is comparable. Common sense instrumentalism regards a technology as a mere tool, in the sense that it only fills a simple slot in culture. In this sense culture dominates and a technology can in no way change culture.

According to the same general view of technology, common sense instrumentalism also holds that technology is neutral. But this neutrality is not based on the autonomy of the scientific element of technology. Technology is neutral is still because a technology is a mere tool. Besides serving a function it can have no other meaning in culture. On the other hand, the only way that culture can have any influence on technology is also through the function it serves. So function is the sole connecting point between technology and culture. With this simplistic view all the subtleties in the interaction between technology and culture are out of sight.

Put on the background of our analysis of technology, this view looks more simplistic. First, common sense instrumentalism doesn't seem to have a clear recognition of the scientific element of technology. Science doesn't matter much for instrumentalism. Only design and function count. But second, the design of technology in the view of common sense instrumentalism is merely function driven. No other cultural factors may take a part. And third, the function of technology is just a slot in culture. On the one hand, the function of technology may not change culture, as we mentioned above. On the other hand, culture may not have any influence on the actual function of technology either.

Given all these important problems with common sense instrumentalism I will still adopt its core concept of instrumentation in my own theory. In Part III I will defend a special sense of the view that technology is a mere tool. But that sense is very different from that in common sense instrumentalism.

5. Contemporary Theories

Common sense instrumentalism and technological determinism are two traditional theories of technology. Based on a static view of technology, common sense instrumentalism regards a technology as a mere tool to satisfy a certain human need. So culture follows its own rules of development and technologies just fill in certain slots in culture. This is a naïve premodern theory of technology. With the rapid development of technology since the Industrial Revolution, a dynamic picture of technology was displayed before people's eyes. Now technological determinism became widely accepted because people directly saw the great impact technology had on human life. So a technology is not a mere tool, but can change the course of culture. However these two theories share a common assumption. That is, technology is a neutral entity which interacts with culture only through its function.

In a sense the culture-ladenness of technology starts with substantivism. Substantivism is closely related to technological determinism, but arrives at the opposite outlook. The latter is optimistic about technology, but the former pessimistic. Substantivism is also based on a certain kind of determinism. However, the determination of technology is not through its function, but some aspect of technology (turning nature into a reserve, efficiency, one-dimensional thinking or device paradigm) has become a substantial core of culture. So in a different sense we can no longer talk about the culture-ladenness of technology here, as technology is already regarded as part of culture.

The culture-ladenness of technology in the strict sense only caught people's attention and was well studied in the last several decades. It's associated with a new philosophy of science. In the view of this new philosophy, science is no longer a pure epistemic theoretic endeavor, but becomes a normal social institution, existing in a social/cultural context and being under the influence of various social/cultural factors. Since technology has long been deemed as a close partner of science, it's also brought under the same scrutiny. The traditional view that technology is a culture neutral entity can no longer hold. Social constructivism is an influential new theory of technology, according to which technology is just like other social institutions and under incessant social construction. Social constructivism focuses on the creation of technology, whereas other theories pay more attention on the functional aspect. The function of a technology neither just fills in an explicit cultural slot as common sense instrumentalism holds, nor just directly shapes some aspects of society as technological determinism claims, but is actualized in a subtle cultural context. In both ways technology is moved away from a standalone autonomous status and put back into its real-world context.

While still recognizing some elements of instrumentalism and determinism and identifying the partial neutrality of technology in its scientific element, I think these recent theories carry the study of technology further. At the same time philosophy of technology becomes subtler and more delicate. It has gone from a general grand view to particular attention to concrete aspects and specific details. Our analysis of technology has clearly revealed the culture-ladenness of technology. Although science plays important roles in both the design and function of technology, these two elements are also greatly influenced by many cultural factors. In this chapter I first discuss the culture-ladenness of technology on the basis of the analysis. This discussion provides a general background on which three specific recent theories of technology will be elaborated in turn. These are Feenberg's underdetermination thesis, Ihde's ambiguity thesis and Winner's politics of artifacts thesis. I show that these theories capture the culture-ladenness of the design, the function and both the design and function, respectively.

5.1 The Culture-Ladenness of Technology

In the analysis of technology we identify three major elements of technology: science, design and function. These three elements don't stand separately, but are intertwined. Science dominates in both design and function, design is guided by the intended function and the actual function is to a large extent determined by design. But this doesn't prevent us from distinguishing these three elements of technology. And they provide the foundation for us to understand the different aspects of technology. In the last chapter we've shown that the scientific element is the foundation of the partial neutrality of technology. Similarly the foundation of the culture-ladenness of technology can be identified in the design and functional elements. Just like the three elements of technology are intertwined, the partial neutrality and the culture-ladenness of technology are also intertwined. They are just different aspects, different ways we look at the same integrated whole.

5.1.1 Design, function and culture

Technology is created with an explicit purpose, so there must be a design involved, small or big, simple or complicated. Technology design is guided by the intended function. Although a function satisfies a certain human need, so in a sense we may say it has value, we don't call this value-laden in the normal sense. A function can be clearly defined within a local relation without invoking a big context. For instance, the function of a car is to transport people and belongings. This is understandable in the relations among the car, the people, the belongings and the locations of them. However, as shown in the analysis of technology design, the intended function is just one of the design factors. Besides, we also listed the following: usability, economics, aesthetics, ethics and politics and culture in terms of language and nationality. We may consider each of them in turn.

Usability is different from function. The function of a car is to transport people and belongings, but the usability of a car is how easy it is to drive it. A car is still a car even if it's hard to drive. However when a car loses its function we see a crucial problem in it. So function is essential to a technology, whereas usability is auxiliary. Yet in terms of value usability is similar to function. Usability still just involves the relation between a technology and its user. And most of it can still be interpreted scientifically. So the criteria of usability are mostly cross-culture, or culture-neutral, just like that of function.

When we move to economics the situation is different. A technology needs to be created and applied in an economic system. Even though the activity is not profit driven and market oriented, it still needs to be funded, obtain equipment and sustain human resource. Generally a technology has to be realized in an economic context. When we say context we already imply that it's not local. The relations involved are not just between the instruments and the engineers, or even the users. It also has to do with many other social entities, the fund provider, the equipment provider, the living standard of the engineers, etc. Value is inevitably included in these various social entities. In other words, the economic system is culture-laden. And since economic factors are part of the technology design, the design is also culture-laden.

What is beautiful seems to be a personal judgment and based on psychology. It's undoubtable that some aesthetic judgments are shared across the whole mankind. Everyone feels popular flowers, such as tulips and roses, beautiful, the round shape beautiful, the sunset beautiful, and so on. But human beings diverge in more cases on what's beautiful. Color is a good example. Different people have different favorite colors. Clothes are another basic one. Aesthetic judgments are

under the influence of inherited personality and personal life experience. But on top of personal diversity we could find some cultural regularity, as the same ethnic group shares the same gene pool and the same nation shares the common history and life experience. So people from the same culture tend to share some common aesthetic standards. In this sense we can say aesthetics is also culture-laden. This shows another aspect of the culture-ladenness of technology design.

Ethics and politics are about inter-personal relations. They are directly based on the value system. Because a system is involved the relations cannot be local. Even if a specific ethical relation only happens between two people, still the relation cannot be understood without the social context. When we move the relation into a different society it may have quite different interpretation. Politics is closely related to ethics. Political relation is also a social relation and has to be interpreted in a political system, including political thoughts and institutions. In fact, ethics and politics constitute an essential part of culture. Most culture-ladenness theories of technology are particularly focused on ethics and politics. When people say value they usually mean ethical or political value. This is about what is good or bad, right or wrong.

Finally the cultural factors in terms of language and nationality involved in software design need to be further analyzed. Factors like the currency symbol and the decimal symbol are just customs. They are based on convention and carry no value. Whether to use comma or dot as the decimal symbol doesn't matter. As long as everybody follows it, as long as there is no ambiguity, either can be used without problem. So these factors are culture neutral although they are part of culture. By contrast language is culture-laden, as the meaning of language carries value. This is one major reason why the messages have to be translated by humans. Machines translate word by word, or at best phrase by phrase. But in this case even translating sentence by sentence sometimes is not enough. The same sentence may need to be translated into different ones in different contexts.

We can conclude that most of the design factors we've talked about are related to culture. A technology is not just created to fill an explicit functional slot in culture as the common sense instrumentalism holds, but is designed in a cultural context, with many cultural factors in mind. This is true at least in the case of modern technology. We use software engineering as an illustrating example, but the design factors we talked about apply to many other modern technologies.

The function of technology is certainly related to culture. A function meets a human need and most human needs are part of culture. But when we consider the culture-ladenness of the function of technology we should also put our sight on the cultural context. For common sense instrumentalism the function of technology is local. A human need can be interpreted by itself, or the local relations involved. A hammer is to hit something. A knife is to cut something. The function is very clear on the basis of the relation between the technology and the target object it operates on. In these cases a cultural context is not needed. Even in technological determinism, which holds that the function of technology to a large extent shapes culture, the cultural context is not in sight. In this case culture is treated as a whole under the great influence of technology. So we say both theories assume the neutrality of technology.

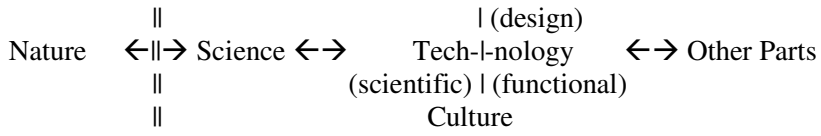
The cultural context becomes important for the function of technology in at least two cases. In one case the function of a technology transcends the local relations and has long range effects. We've discussed the ethical and political factors in technology design. When such a design is successfully implemented the actual function of the technology certainly carries ethical and political meanings beyond the function itself. The ethical and political meanings can only be understood in a culture context. In the other case the actual function of a technology is determined by the cultural context. When a technology is created and used as intended in a

certain culture, its function looks just normal and obvious. So the function doesn't seem to need any further interpretation. The determination of cultural context becomes apparent when there is a discrepancy between the intended function and the actual function. This reminds people that the function of a technology is not that straightforward. The cultural context finally shapes the actual function. The determination of the cultural context becomes more salient in the phenomenon of cross-cultural technology transfer, in which a technology created in one culture is transferred to a different one. In this case a technology could be put into an unexpected, quite different use than the intended one. And this can only be interpreted in the large cultural context.

Normally when people pay enough attention to the design aspect of technology they tend to think technology is not autonomous, because the design is under people's purposive control. But when they focus on the function aspect of technology they are inclined to regard technology as autonomous, because the function gives the impression that it works by itself. Now we can see that the function also works in a cultural context, just like the design is performed in a cultural context.

5.1.2 Technology as design and function is culture-laden

So far we've identified the foundation of the culture-ladenness of technology in its design and functional elements. Combining the discussion about the neutrality of technology we may modify the general schema of culture in the following way:



In general the culture discussed in this part is said against nature. Science lies at the boundary and has different characteristics than other parts of culture. So the realm of culture is further divided into two sections: one value-neutral and the other value-laden. The relation between technology and culture mostly refers to the relation between technology and the value-laden parts of culture. In this sense value-ladenness is also called culture-ladenness. Based on our discussion I've moved the minor divider ("|") into the middle of technology and the three elements of technology are put on both sides of the divider: the scientific element is on the value-neutral side and the design and functional elements are on the value-laden side.

Although technology is an integrated whole, basing its culture-ladenness on its different elements helps us better understand the culture-ladenness. The design and the function of technology are closely related, but they are quite different aspects of technology. The design focuses on creation and the function on application. Culture-ladenness in different respects may have different implications. The culture-ladenness of technology on the basis of design suggests possibilities of technology control through cultural measures. The culture-ladenness of technology on the basis of function advises people to consider the cultural context for technology application and transfer.

This also helps us better understand different theories with regard to the culture-ladenness of technology. Specifically we discuss three popular culture-laden theories in this essay. They are Feenberg's theory of underdetermination of technology design, Ihde's theory of ambiguity of technology and Winner's theory about the politics of artifacts. For each of the theories I first explain its main thesis and then discuss the implications of the thesis for both the corresponding philosopher's whole philosophy and the relationship between technology and culture. Here I

point out again that the three theories capture the culture-ladenness of technology in design, function, and both design and function, respectively.

5.2 Underdetermination (Feenberg)

Underdetermination is said against some kind of determination. In this case it's still technological determinism. According to Feenberg, technological determinism is based on two premises: unilinear progress and determination by the base. Unilinear progress is a development following a single sequence of necessary stages. The internal logic of technological development seems to enforce such a development pattern. A later stage seems to be necessarily based on an earlier one in the sequence. While the first premise has to do with history and can be regarded as a vertical determination, determination by the base has to do with a society, the different components of a society, and therefore is a horizontal one. Technology is deemed as the base of a society and all the other components are determined by it.

Feenberg's underdetermination thesis is targeted at the first premise of technological determinism. It's under two direct theoretical influences. One is the underdetermination thesis in philosophy of science, which is also called the Duhem-Quine principle. The principle states that logical reasons alone cannot determine which scientific theory to choose. In other words, two logically consistent scientific theories could explain the same set of empirical evidence and have the same set of empirical prediction. This is apparently a direct criticism of logical empiricism. Moving this underdetermination to the field of technology we get the underdetermination thesis in philosophy of technology. But it has to be supported by another theory of technology, social constructivism. Social constructivism is a rather recent theory. It argues, in Feenberg's words, "*that the choice between alternatives ultimately depends neither on technical nor economic efficiency, but on the 'fit' between devices and the interests and beliefs of the various social groups that influence the design process.* What singles out an artifact is its relationship to the social environment, not some intrinsic property." (Feenberg 1999: p. 79) Pinch and Bijker are two prominent advocates of constructivism. They illustrate the key idea with the history of the bicycle (Pinch & Bijker 1987). There are mainly two design approaches in the early phase: one has high front wheels and the other two equal-sized low wheels. The former is fast and preferred by sportsman, whereas the latter safe and preferred by ordinary people who want to use it for transportation. Obviously the second approach finally wins the competition.

Feenberg states the underdetermination thesis in this way: Technical principles alone are insufficient to determine the design of actual devices. It's isomorphic to the underdetermination thesis in philosophy of science. Technical principles correspond to logical principles and the choice of technology design to that of scientific theory. The underdetermination thesis has a stronger claim than social constructivism. The latter only claims that technology design is determined by social factors, whereas the former further claims that some social factors which determine technology design is not technical. Although there are no clear-cut criteria for what's technical, it roughly corresponds to science and rationality. So the factors involved in the bicycle example are still technical. Both speed and safety can be defined scientifically, and so do the connections between the designs and their corresponding target properties. Therefore this example cannot be used to illustrate the underdetermination thesis. The example Feenberg uses is MS Windows. MS Windows replaced MS DOS not because it's more efficient, but easier to use. Efficiency is one of the most important technical principles. But usability is different. Some aspects of usability may be interpreted rationally, whereas others are about preferences, or are too complex to analyze. Actually in software engineering user friendliness is often more important than performance. Sometimes we even trade user friendliness with performance.

Feenberg uses the underdetermination thesis to counter the unilinear progress premise of technological determinism. But an assumption is needed. We may call it the assumption of multiple realizability. It basically states, the same target function can be achieved through different technical methods, or realized in multiple ways. In fact multiple realizability is a key concept in functionalism. Thus, at a given stage of technological development, how the technology will proceed at the next is not determined by technical factors alone. Non-technical social factors first influence the general direction of technological development and second play a role in determining the actual realization. So looked from the technical perspective, at each stage of technological development there are always different possibilities for the next stage. Non-technical social factors jointly determine the actual development path. But since those social factors do not follow definite laws as much as the technical factors, the general progress cannot be unilinear.

The underdetermination thesis plays a pivotal role in Feenberg's whole philosophy of technology and modernity. Generally speaking the underdetermination thesis is the foundation of democratizing technology and it in turn supports a form of alternative modernity. For Feenberg usability is just a basic type of non-technical factors. Besides, a whole array of social factors could take a part in technology design, politics, ethics, etc. He is particularly interested in users' rights. He cites user's rights mainly in the fields of medical and information technologies, including women's right in childbirth, AIDS patients' right in attending experiments, ordinary users' right in transforming the actual function of a particular information technology, and so on. All these cases demonstrate the power of public intervention in technology design. Feenberg regards this as a feasible way of democratizing technology. Democratizing technology gains much significance on the background of technocracy. Technocracy is a political system where technical principles and experts dominate the whole society. It's the main target of the dystopian critical theory and culture revolt of the 1960s. And apparently it has long lasting impact. Democratizing technology provides a way out of technocracy. The contrast between the two is obvious. Democratizing technology gives ordinary people the power to influence technology design and very often what they consider are not technical factors. So in democratizing technology we have ordinary people against experts and more importantly meaning against rationality. The latter contrast has deeper implications for modernity as a whole. From the rise of modern science through the Enlightenment Movement to technocracy reason has become more and more dominating the modern society. With the greatly improved material life many people have realized and lamented that some precious value in the premodern society has been forfeited at the same time. Hence to get back the traditional value and recover the meaning of life become the core endeavor of the critics and reformists of modernity. However throwing away modern science and technology is obviously not viable. The key seems to be to find an appropriate form of combination of technology and meaning. Feenberg's purpose is explicit, as expressed below (Feenberg 1999: p. xiv):

> Real change will come not when we turn away from technology toward meaning, but when we recognize the nature of our subordinate position in the technical systems that enroll us, and begin to intervene in the design process in the defense of the conditions of a meaningful life and a livable environment.

Put in the general context of this part Feenberg's underdetermination thesis captures the culture-ladenness of the design of technology. The function is the focus in some of his examples, such as the one in which MiniTel is put to different use. But the general focus of his philosophy of technology is on design. This is consistent with the reformist tone of his philosophy. When one wants to reform technology he has to pay attention to how technology is created. A different design could mean a quite different technology. On the basis of our discussion about the culture-

ladenness of technology the underdetermination thesis is easy to understand. Science is the major factor to consider in technology design, but there are many other factors which are beyond rational calculation. Science and rationality can only determine technology design to some extent, and the rest is left to the culture-laden factors.

Feenberg's philosophy provides much inspiration for this essay, but it definitely tries to go further. I have the impression that Feenberg is still under the great influence of the substantivist view that modern technology plays the paramount role in modern society. So technocracy is almost equivalent to Western modernity and an alternative can only be realized by reforming technocracy. The reform is like a revolt from a subordinate position. Even though the reform can be achieved, it still doesn't seem that the subordinate status can be changed. In this way we may be able to regain some meaning of life, but this meaning appears to exist only in the gaps within the paramount architecture of rationality. In contrast, I would step back and put technocracy in a larger context. As we will discuss later, technocracy is just the symptom but not the root of the problems in Western modernity. It's mostly caused by scientism, capitalism, commercialism and to some extent also democracy. So a thorough alternative modernity can only be achieved by reforming those deeper issues, but not just technocracy. When those deeper issues are resolved technocracy would probably go away automatically. Anyways modern technology is not the real problem of Western modernity. But it is put in an inappropriate (paramount) place in modern society under a new value system fostered by scientism, capitalism, commercialism and democracy. When this fundamental problem is solved, when modern technology is put at its right place, meaning will be recovered as the core of life. But at the same time we don't need to give up rationality, because modern technology is still a necessary instrument in an alternative modernity. We also arrive at a kind of reconciliation between meaning and rationality, but now meaning is the core and rationality is subordinate, not the other way around. This view will be defended in Part III of the essay.

5.3 Ambiguity (Ihde)

In his phenomenology of technics Ihde does meticulous and thorough analysis of the technological lifeworld. We have discussed this in Chapter 3 when we talked about the functional element of technology. In his own words that shows how culture is embedded in technology. Now in what he calls "cultural hermeneutics" he tries to do just the opposite, that is, to show that technology is also embedded in culture. The ambiguity thesis stands in the middle. Ihde's ambiguity thesis can be expressed as such: Technological artifacts are ambiguous by themselves. They only become meaningful artifacts in a certain cultural context. This is not to say that technology is neutral and gets its function in the cultural context, because a technology is nothing without its function. "The technology is only what it is in some use-context." (Ihde 1990: p. 128)

Ihde uses many examples to illustrate this idea. In one of his examples, the oval sardine cans left behind by the Australians were used as centerpieces of ornament by the New Guineans. It's truly "one man's trash is another man's treasure." In modern life a can is a way of preserving food. After a can is opened and the food eaten the can has served its function and becomes a piece of trash. However the disposed can is endowed with quite a different meaning in the New Guinean culture. Since it has a different function we may say it turns into a different technology. Now if we take that can away from any cultural context, it becomes really ambiguous.

Technology transfers across different cultures could reveal more layers of the cultural context. Clocks provide a good example here and the transfer is from the West to China. Since long before the clock was invented in the West Chinese had been using an accurate calendar and had good

ways of keeping track of time.[20] But this timekeeping practice was mostly limited to the imperial house and at most the officialdom. Ordinary people didn't need to tell the time exactly. This situation is very different from that in the West when clocks were introduced. The popular presence of churches already made public timekeeping a social norm. So clocks soon spread out in the society once they were introduced. On the contrary, when missionaries first brought some clocks to Emperor *Qian Long*'s court, they were treated as toys, instead of being used to keep time. For a long time clocks had never reached the public society. This example of technology transfer demonstrates that we may need to distinguish two levels of cultural context. "The cultural interface, however, takes place at two levels: the level of instrumental involvement, which we see has many overlaps at daily levels, and the more complex level of higher cultural values and their attendant complexes." (Ihde 1990: p. 129) The instrumental level is local and function relevant. Even for a clock to be treated as a toy some local context is necessary. The emperor happened to be fond of collecting toys and the design of the clocks was attractive to him. Otherwise the clocks would be directly put aside. The level of higher cultural values is more extensive and deeper. In this case it's related to the whole structure of the society and people's way of life.

Few people realized this kind of ambiguity of technology before Ihde distinctly pointed it out. For common sense instrumentalists the function of a technology can't be clearer. A technology is designed to server a function and it functions that way after it's created. Technological determinists don't doubt the clearness of the function of a technology either, although that function could have profound impact on culture. Even in the camp of culture-ladenness people can easily see that the design of a technology is influenced by various cultural factors and so its function has cultural bearings. But the dependence of the function upon a cultural context is a reverse relation. The reason why the ambiguity of technology is difficult to discern lies in the fact that the cultural context needs to be a variable to demonstrate the ambiguity. But normally people think within the same cultural context. Cross-culture technology transfer offers the perfect window to showcase the ambiguity of technology.

As an application case of the ambiguity thesis Ihde discusses neocolonialism as the failure of transfer. India is the location of this case. As a full colony India was greatly influenced by the British culture. Even after independence English was kept as the official language and Nehru's modernization path got upper hand over Gandhi's more conservative direction. As part of modernization several advanced institutes of science and technology were set up. But due to lack of infrastructure graduates from those institutes soon found out that they couldn't find a suitable job in India. The result was that most of them ended up in a graduate school in the US. In this case the failure of transfer is caused by the lack of infrastructure, another demonstration of the importance of cultural context.

Ihde further uses the famous Necker cube to illustrate the ambiguity of technology. The Necker cube is a favorite example for psychologists when they talk about perception. It's also used by Kuhn to illustrate paradigm switches in scientific revolutions. But what's different here is that Ihde shows the cube is not just bi-stable. Besides two differently oriented cubes, it could be seen as an insect in a hole and a gem with a special shape. So the Necker cube is in fact multistable instead of bi-stable. And according to Ihde multistability is the essence of the ambiguity of technology.

Both Ihde's discussions about the technological embeddedness of culture and the cultural embeddedness of technology are thought provoking. Although cross-culture technology transfer is the best example to illustrate the ambiguity of technology, the cultural context of a technology

[20] Chinese invented the water-driven clock long before the modern clock. Cf. 9.1.2.1 for further discussion.

doesn't have to exist in a different culture from the one where it's created. It also needs a context to function in its native culture. The context in the native culture is implicit and cross-culture transfer makes it explicit. Therefore these two kinds of embeddedness coexist in the same culture. But logically a technology has first to find the cultural context to function, and when it functions it could have an impact on culture. In fact we can image these two opposite relations could even be chained and create a spiral effect. The successful introduction of a new technology could follow this pattern. Take electric cars for instance. Global warming and the depletion of fossil fuels provide the cultural context for using electric cars. At the beginning people always have all kinds of doubt about a new technology. Is it safe? Will the battery explode at high temperature after a long time of driving? Is the battery power enough to let the car reach a high speed? How long could the battery last before the next recharge? How long does it take to recharge? Is it easy to find a recharge station? How much is the cost? Actually putting some electric cars into use definitely dispels some of the doubt. This creates more favorable cultural context for electric cars. Then more people would buy this new type of cars. This further improves the context. And so on. We have a rising spiral here as a result of the interaction between technology and culture.

Viewed in the general picture of this part, Ihde's ambiguity thesis captures the culture-ladenness of the function of technology. When analyzing the function of technology we discussed the possible deviation of the actual function of a technology from its intended function. In that case the new function is to some extent determined by the cultural context. The ambiguity thesis further reveals that any function of technology requires a cultural context. Even the intended function is based on a certain context, although it may not be explicit to the designer. In comparison, the underdetermination thesis focuses on non-technical design factors and still assumes that the function is neutral. So the ambiguity thesis is a stronger culture-ladenness claim.

We could further extend the ambiguity thesis of technology. The thesis is concerned with the cultural context of a *particular* technology. We may go along this line and think about the cultural context of technology *in general*. In premodern societies technology never had a chance to dominate, even in a society where technology was well developed. In contrast, modern societies have lifted technology to the paramount status, so now we have technocracy, even technopoly. In order to discover the cultural context of this technological dominance we also need to put different cultures side by side, just like what we do in studying cross-culture technology transfer. When we are confined in a particular culture, we tend to take many things for granted. A different culture could bring our own well accepted norms or common senses into question and reveal some hidden mechanism behind them. This is a big inspiration we can get from the ambiguity thesis.

However it seems to me that Ihde's philosophy of technology unbalancedly overfocuses on the functional element of technology and doesn't pay due attention to the design element. The two major parts of his philosophy of technology, the phenomenology of technics and the culture hermeneutics, are both about the function of a technology. The former is about how culture is embedded in the function of a technology and the latter is about how the function of a technology is embedded in a cultural context. The fact that a technology is created with a certain intentional design doesn't play any role in his philosophy. This unbalanced attention in the first embeddedness relation leads to instrumental realism, where technology is held to have priority over science. And the unbalanced attention in the second embeddedness relation causes Ihde to deny the possibility of controlling technology.

Ihde bases his denial directly on the ambiguity thesis. "The double ambiguity of *(a)* any technological artifact being placeable in multiple use-contexts, balanced by *(b)* any technological intention being fulfillable by a range of possible technologies, introduces a certain indeterminacy

to all human-technological directions." (Ihde 1990: p. 139) This indeterminacy first makes control appear very difficult. But the force of argument mainly comes from the culture-ladenness of technology. "To reframe the question, now in the context of the embeddedness of technologies within cultures, is to see that the question of the control of technology is analogous to the question: Can *cultures* be 'controlled'? This reformulation reveals the degree of complexity needed for its answer." (*ibid.*: p. 140) Putting the big culture context aside, even on the technical level human has little control of technology. "To enter any human-technology relation is already both to 'control' and to 'be controlled.'" (*ibid.*) He discusses how the evolution of writing technology from the fountain pen to the word processor has differently shaped people's writing habits.

To counter this argument we need first to clarify what control is. Generally speaking, control is the act of intentionally and effectively changing the state of an object. It certainly assumes the existence of a free will. This is something Ihde doesn't deny. So first, on the technical level a technology is intentionally created by humans. Hence humans have control over the creation process. They have control over the design and they could even decide not to create or apply a certain technology. Only when a technology is created can it start to function and shape people's lives. On this level the design has priority over the function and human control has priority over technological control. Second, on the cultural level, control doesn't contradict a culture context. Certainly every human action happens in a cultural context except very extreme cases, but this is not incompatible with the fact that control is still possible. Ihde's view on technology assessment is also interesting. "The type and degree of technology assessment currently practiced is clearly too minimal and primitive—as well as too controlled by precisely those who need to be 'controlled.'" (Ihde 1990: p. 143) This probably only applies to the situation two decades ago. Anyways, the question of whether control is possible is quite different than those of how to control and who should control. Technocracy is one kind of control, and democratizing technology design is another. In the next part I will suggest a third kind of control. Third, the indeterminacy of technology doesn't exclude the possibility of control either. Multistability is not equivalent to instability. Multistability appears in dramatic situations. In normal cases technology is stable and predictable. This is not only because the cultural context is normally stable, but also because technology has significant scientific element in it.

5.4 Politics of Artifacts (Winner)

The focus of Ihde's philosophy of technology is the phenomenology of function and that of Feenberg's is the political aspect of design. Both design and function are important in Winner's philosophy, but it's predominantly focused on politics. Here is the politics of artifacts thesis stated in his own words (Winner 1986: p. 19):

> The machines, structures and systems of modern material culture can be accurately judged not only for their contributions to efficiency and productivity and their positive and negative environmental side effects, but also for the ways in which they can embody specific forms of power and authority.

To illustrate the claim Winner talks about two types of technologies. In the first type different designs of a technology have different political consequences. His famous example is the low-hanging overpasses on Long Island deliberately designed by Robert Moses to discourage the presence of buses on his parkways. They didn't cause any hindrance to the wealthy people who drove cars. Only poor people and blacks who took buses were restricted. Another example is the molding machines in Cyrus McCormick's reaper manufacturing plant in Chicago. For a short period of time he chose molding machines with such a design that the machines could be operated

by unskilled workers. Although they produced inferior castings at a higher cost than the earlier process, the new machines let McCormick successfully destroy the union led by skilled workers. In these two cases the design of a technology is intentionally chosen by an individual to cause some political effects. However the choice doesn't have to be intentional on the individual level. It could be based on a social trend. The example for this case is about the mechanical tomato harvester in California. A harvester was invented at University of California to do all the picking and sorting work automatically. But a direct consequence was that thousands of workers lost their jobs. The researchers at the university apparently didn't have this in their mind when they invented the machine. "What we see here instead is an ongoing social process in which scientific knowledge, technological invention, and corporate profit reinforce each other in deeply entrenched patterns, patterns that bear the unmistakable stamp of political and economic power." (Winner 1986: p. 27)

In the second type of technologies, no matter what the design choice is, they have inevitable political consequences. Winner calls them "inherently political technologies." He first discusses Engels' essay "On Authority", where authoritarian social structure is seen as a necessary requirement of modern production with big automatic machines. While Plato uses the classical ship analogy to defend an authoritarian society, Engels finds the justification in modern technology. This apparently bears much deterministic flavor. Winner divides the political theories of technology into two kinds, a strong version and a weak one. The strong version claims that modern technology *requires* a certain type of political structure (mostly authoritarian), whereas the weak version only holds that the technology is *strongly compatible with* it. Winner also lists abundant examples for this case, from an ordinary factory to the railway system. Activities in these systems have to be coordinated by an authority in order for the whole system to function smoothly. Democratic societies have tried hard to contain the authoritarian structure within the various systems and prevent the corresponding ideology from spilling off into the whole society. According to Winner this is impossible when we run into a technology that has an extraordinary grand scope. Nuclear power is his arch-devil example. For Winner the greatest danger of nuclear power doesn't lie in the particular risks, but in the political consequences it may bring about. For the sake of safety the whole society could plunge into an authoritarian state, and in extreme cases martial laws could even be applied.

Winner's philosophy is so focused on politics that the disregard of political consequences constitutes the core of his bitter criticism of social constructivism. He lists four major problems of social constructivism, but they boil down to one, that is, social constructivism only studies how different designs are shaped by various social contexts and have no interest in their normative effects. According to Winner, while most existing approaches, those of Marx, Heidegger, Mumford and Ellul, each has a concern for the general human condition, social constructivism has a limited breadth of vision. So he calls social constructivism "a remarkably hollow box."

It's a little difficult to classify Winner's theory because it contains elements from different typical theories. His analysis of inherently political technologies apparently contains elements of technological determinism. In this case the political consequences are determined by the technologies themselves. But at the same time he also admits that the cultural context could determine the design of technologies, through individual choices with the final consequences explicitly in mind or not. He associates the normative effects so closely with certain technologies that his theory shares some significant characteristics with substantivism, including obvious nostalgic sentiments. But different from substantivism his theory is not as dystopian and pessimistic, because he can see hope and reform in "new technological forms." Anyways, on the basis of its predominant political focus Winner's theory captures an important aspect of the culture-ladenness of technology. In this case both the design and the function of technology are

politically colored. The design is influenced by a certain cultural context with political implications and the function also carries political significance.

Put in the general context of this part Winner's politics of artifacts thesis appears to overemphasize the political aspect of technology. Politics is just one area of culture. Although politics plays an important role in social life, not every entity or process has political meaning. Some part of the culture-ladenness of technology may have nothing to do with politics. On the other hand excessively associating the political consequences with particular technologies may hide the larger cultural context. So reforming technology is regarded as the final solution for political issues, while deeper cultural causes may be left untouched. Technology reform under the influence of overemphasized political issues may lead to inappropriate consequences for technology. This is reflected in the solutions Winner suggests for the political issues of technology.

Here is what he suggests. "First, I could say that there is a need to begin the search for new technological forms." (Winner 1977: p. 326) So the general solution is to reform technology. "Second, I could suggest that the development of these forms proceed through the direct participation of those concerned with their everyday employment and effects." (*ibid.*: p. 326) This is similar to Feenberg's democratizing technology design. "Third, I might point to the arguments presented here and offer some specific principles to guide further technological construction. One such rule would certainly be the following: *that as a general maxim, technologies be given a scale and structure of the sort that would be immediately intelligible to non-experts.* … Another worthy principle would be: *that technologies be built with a high degree of flexibility and mutability.* … Yet another conceivable rule is this: *that technologies be judged according to the degree of dependency they tend to foster, those creating a greater dependency being held inferior.*" (*ibid.*: pp. 326-327) These are stringent political rules that would create big hurdles for technological development. I think only the first rule would exclude most of the technologies we are using today. "Finally, I could suggest a supremely important step – that we return to the original understanding of technology as a means that, like all other means available to us, must only be employed with a fully informed sense of *what is appropriate*." (*ibid.*: p. 327) This suggestion is about controlling technology. But what is appropriate still seems to be based on the principles listed above. This solution appears to be reforming technology, but if all the principles are followed it's almost equivalent to abandoning modern technology.

The topic of this part is the relationship between technology and culture. My approach is to first analyze technology into its three major elements: science, design and function, and then discuss the several major theories of technology on the ground of the analysis. I think the analysis of technology is very important. It helps us not only reveal the complicated relations between technology and culture, but also understand the major theories. When we consider technology just as a whole the relations between technology and culture would remain general and vague. In fact some relation is through one element, others are through others. However technology is so complicated that some kind of division cannot be arrived on the basis of the analysis. The three elements are just different aspects of technology, but not components. They are intertwined in an integrated whole. This also provides the framework in which we could better understand the major theories. Each of the major theories captures an important aspect of the relationship between technology and culture, but they cannot be generalized. Basically we need to have the whole picture and a balanced view. I hope after the analysis of technology and the discussion of the major theories this whole picture has become clearer.

III Technology in an Alternative Modernity

The discussion of alternative modernity and the relationship between technology and culture in the first two parts provides the background on which I shall build my own theory of technology. My concept of alternative modernity is inspired by Feenberg's theory. I share with him the basic view about modernity that rationality is an essential part of it, but rationality has been overemphasized in Western modernity. So a main goal of alternative modernity is to regain some traditional values, the meaning of life, without loss of the progress that rationality has brought about. Some form of reconciliation between rationality and meaning is desirable. However, my theory of alternative modernity has a bigger scope. Specifically I put rationality in a bigger cultural context. While admitting that individualism and industrialization are two essential features of modernity in general, I propose that the Western modernity interprets individualism in a peculiar way, i.e. with egalitarian universalism. According to this view the value of an individual can be measured with egalitarian universal principles. And individualism in this sense promotes the respect for individual value thus defined and therefore the universal principles themselves. Egalitarian universalism finds its embodiment in scientism, capitalism, commercialism and democracy, which correspond to the cultural, economic and political realms of a society. With scientism in culture science is regarded as the only path to truth, so science has been dominating the cultural realm of modern society. What's under science is reason, which is both egalitarian and universal. With capitalism and commercialism in economy money becomes a universal token, and it's also egalitarian. With democracy in politics individual will becomes a universal token which can be evenly counted. Thus power is made equivalent to popularity. We can see rationality just happens to fit into a larger value system of Western modernity. This value system also greatly colored and shaped industrialization. From the very beginning industrialization in the West has been guided by this system of new values. Therefore for me the goal of alternative modernity is not just to go beyond rationality, but egalitarian universalism.

Existing studies have pointed out some connections between the new value system and the new Protestant religion. The association between egalitarian universalism and the Protestant religion accords with basic intuition. My conjecture is that solid historical evidences could be found to support this view. If this is true, the formation of Western modernity has deeper cultural roots. Hence the claim that Western modernity is the only path to modernity becomes untenable. This claim seems to be compatible with its own universal principles. There is a paradox in the universal interpretation of individualism. On the one hand universalism liberates individuals from the traditional hierarchical social restrictions, but on the other hand it doesn't seem to be in logical conformity with individualism. Individualism implies personality and difference from others, and suggests diversity rather than uniformity. Hence universalism appears to contradict individualism. When individuals are made universally free, they might be free in an abstract, but not real sense.

The alternative modernity theory is the general framework of the discussion in this essay. The theory about the relationship between technology and culture puts technology in a concrete context. Based on the analysis of technology and the discussion of several major existing theories I revealed in the previous part the complicated relations between technology and the other parts of culture, including science as a special area. There culture is understood as the artificial world in contrast to nature. So technology is also a part of it and the relationship between technology and culture actually becomes that between technology and other parts of culture. The relation between technology and science is bi-directional. Science is a dominating element in technology, in both its design and function. On the other hand scientific activities are more and more mediated through technology. The relation between technology and the rest of culture is also bi-directional. Many cultural factors play a role in technology design and thus directly shape the final look of a technology. Further a technology even has to actually function in a cultural context.

It may acquire an unexpected function in a different cultural context. In the other direction each technology helps create a lifeworld in which the whole culture should play.

Having discussed alternative modernity and the relationship between technology and culture, now we are ready to combine them and talk about how technology should fare in an alternative modernity. This has to start with the dominant role of technology in Western modernity. It has long been an undeniable fact that technology dominates modern life. This has led to both the utopian and dystopian views of technology. The utopian view regards technology as a panacea that can cure all the diseases in modern society. According to this view, granted that modern technology has brought about many problems, but these problems can be solved through developing more advanced technologies. As a general result modern technology can not only remove all the traditional malaises and restrictions, such as food shortage, pandemics and the toil of housework, but also create a whole new world with abundant new possibilities. On the contrary, the dystopian view finds in modern technology the source of all the problems of modern society. The problems include pollution, resource shortage, climate change, mechanicalized thinking and the loss of meaning of life. They suggest the degradation of both nature and human beings. Although some proponents try to point to some way out, the general mood about modern technology is gloomy. And the way out is colored with nostalgia and doesn't look very assertive.

A main thesis of this essay is that the dominance of technology in Western modernity has its cultural roots in egalitarian universalism. Technology was once well developed without dominating in the traditional society, with an elitist value system. Only under egalitarian universalism does technology turn into a paramount tool fully aligned with the new value system. Technology is best at realizing the universal values. It's best at generating material goods that satisfy everyone's needs. It's also best at influencing ordinary people's wills. And due to this technology becomes most powerful. On the contrary, in an alternative modernity which goes beyond egalitarian universalism, technology will lose its dominance. In such form of modernity core values of life that were once cherished in the traditional society will regain their central status. And those values are beyond the reach of technology. So when those values are put back again in the center, when the meaning of life is recovered, technology will move back to its right place. Once the value system is corrected, there is actually no dilemma between rationality and meaning. The dilemma only appears when rationality is put at the wrong place, the place which belongs to meaning, and thus meaning has no place to reside. But when meaning is put back again at the place it deserves, rationality doesn't have to go away.

The above view is supported by my own theory of the relationship between technology and culture, which I call cultural instrumentalism. This theory absorbs elements from various existing theories and combines them into a quite unique whole. It admits the determination of technology in culture, but meanwhile limits the determination within a certain scope. It also emphasizes the cultural context for the creation and the application of a technology, and especially its human controllability. And most importantly it regards technology as an instrument which may facilitate the creation of core values of culture, but cannot play any decisive role. It's just like the case where a hammer is merely a tool to hit the nails, but plays no decisive role in building a nice piece of furniture. The key here is to divide culture in the broad sense into material, lower and higher cultures. Roughly speaking, from the perspective of cultural instrumentalism technological determinism to a large extent applies to material and lower cultures, whereas common sense instrumentalism applies to higher culture. On the other hand the cultural context could be related to all cultures. In this way cultural instrumentalism is a synthesis of all the major existing theories, but it's different from any of them. Since higher culture carries the meaning of life, cultural instrumentalism puts technology in a subordinate relation to meaning. To get back meaning is equivalent to promoting higher culture. Now that technology could be a helpful

instrument for higher culture we need also to keep technology. Once we get the order right everything would be OK.

This part is organized in the following way. Cultural instrumentalism is not directly introduced at the beginning. Photography, as a unique discipline which nicely integrates technology and art, first provides thought provoking inspiration. Through the analysis of two recent technological advancements in photography I try to demonstrate the limited scope of technology. Digital SLR (single-lens reflex) cameras carry the cutting edge technologies today. However for photography they are mere instruments, although they greatly facilitate the creation of photography works. The essential part of photography, the art, is well beyond technology. Since art is a part of higher culture, this example directly supports cultural instrumentalism.

Based on cultural instrumentalism our attitude toward modern technology should be to both embrace and control. Because technology is just a cultural instrument, we can embrace modern technology without losing the meaning of our life. Hence dystopian substantivism needs to be refuted. At the same time we should put technology in its right place by controlling modern technology. Thus technology utopian fetishism also needs to be rejected. This is the major content of this part.

Several influential substantivist theories of technology will be discussed. They share the same substantivist view of modern technology, that is, some aspect of modern technology has become the core of modern culture and dominated the whole modern society, although they each pick a different aspect. For each of the theories I try to show that the aspect of modern technology it picks has deeper cultural context outside of technology itself. No matter whether it's treating nature as a resource well, efficiency, one-dimensional thinking, or device paradigm, they all result from the value system based on egalitarian universalism. So if modern society looks gloomy modern technology is not the culprit. Modern technology appears to be the blame because it's shaped by the underlying value system. In this way we don't need to abandon modern technology to solve the problems in modern society.

Cultural instrumentalism is introduced at this point. After the analysis of technologies in photography and the criticism of various substantivist theories, time is mature to point out the real status of modern technology. Although modern technologies have greatly influenced the photographic practice, in fact photography was originally only deemed as a technical invention, the art of photography is well beyond technology. Although modern technology appears to be the cause of all sorts of problems in modern society, and most seriously the forfeit of the meaning of life, it's actually directed by a value system that disregards the meaning of life. Both suggest that for some part of culture technology is just an instrument. And that's the gist of cultural instrumentalism. Cultural instrumentalism then is combined with the modernity theory to explain the phenomenon of modern technology. And finally an alternative modernity is proposed as the solution of the problems discussed. The status of technology in an alternative modernity also becomes clear.

From the perspective of cultural instrumentalism utopian fetishism of modern technology is based on the same concept as dystopian substantivism. That concept is the full scale determination of technology. Having revealed the status of technology theoretically we still need practical principles to implement the theory. In particular, modern technology needs to be controlled according to principles that revolve around the meaning of life. To do this utopian fetishism should be criticized in a similar way. Utopian fetishism puts modern technology on the altar to worship and believes in its almighty power. The Artificial Intelligence (AI) fundamentalists are the archbishops because AI seems to represent the highest achievement of modern technology.

While other technologies only deal with lower level of entities, AI is the challenge of technology to human intelligence, which belongs to the realm of meaning. AI fundamentalists along with their allies will be criticized in the spirit of Dreyfus. In this way the status of modern technology is further clarified. Then a deeper reflection on the relationship between rationality and meaning is in place. The basic claim is that meaning is the core of life whereas rationality is just an instrument. This has direct implications for alternative modernity.

So to regain the meaning of life technology needs to be controlled in conformity with meaning. Revealing the limit of technology can be regarded as conceptual control. Specific control can be found in the recent development of environmental ethics and technology assessment and regulation. Ethical issues concerning the environment are discussed to show how high values can be used to direct technology development. Technology assessment and regulation are also discussed. They are concrete steps of a direct technology control. Here high values may be directly honored.

Back to the basic question of this part, how should technology fare in an alternative modernity? The answer is, technology should be pulled down from its dominant status and made subordinate to the meaning of life. As an instrument of higher culture, modern technology should be both embraced and controlled. But this can only be fully achieved when the value system in Western modernity is reformed.

6. The Inspiration from Photography

Photography is a field where technology and art are interwoven, a discipline with many revolutions in a short history, and more importantly, an area where a single person can practice on his own. By practicing photography one may get a vivid feeling of how technology interacts with art.

Photography was invented in the first half of the 19th century based on light sensitive chemicals. At the beginning it was regarded as a technical invention which provided a way to record reality. In nearly two centuries of development it has become a well-recognized art form and involved a variety of advanced technologies. Compared with painting photography has much more direct relation to reality. While a painting comes out of the painter's imagination, a photo appears to be just a copy of reality. Even in a realistic painting the subjective processing of the painter still plays an essential role. This element seems to be lacking in photography. Certainly some photography objects can be manipulated, such as the pose of a person, the arrangement of still life and the furniture in a room interior. But even in these cases the photos created still appear to be a direct copy of reality. This is the major reason why for a long time photography was not accepted as a legitimate art form. The legitimization took place only in the 20th century. The first endeavor was to imitate painting with soft focus, because the painting style then in fashion was impressionism. This photographic movement was pictorialism. But it soon was rejected by a group of American photographers who called themselves Group f/64. As the name suggests their principle is to make the photos as sharp as possible. Besides sharp focus, precise exposure is another major goal. Ansel Adams, a key member of the group developed a comprehensive zone system, which is used to guide the exposure. In contrast to pictorialism, the group called their practice "straight photography." Their works of the American West demonstrated the power of artistic expression even in straight photography. Since then people no longer doubted photography as a unique art form.

The assumption that photography is a direct copy of reality turns out to be just an illusion. As Feininger writes in *Die Hohe Schule der Photographie* (Feininger 2005: p. 15, author's translation):

> Except the photographic copy of a page of print few photos can be really called "replicas," because most photographic objects have three dimensions – height, width and depth, while the photo only has two: the depth is lost. Besides our environment looks colorful to us, but a black-and-white photo only consists of gray tones: the color is lost. Finally most photographic objects changes their appearance with time, while a photo is static: movement and life get lost. And in reality direct light shines, while it looks white in the photo: the shining is lost.

In fact even the most straight landscape photo may give the viewer very different feeling than when he looks at the scene directly. These discrepancies between a photo and reality just provide the space for art creation in photography. Compared with other art forms photography certainly has the most direct relation to reality, actually it can also be used as a record of reality, but it's a selection, an analysis and an interpretation of reality. This brings it closer to other art forms.

The direct relation between a photo and reality is to a large extent based on the various technologies applied to photography. A full set of photography equipments makes a long list, but the camera is apparently the core equipment. Only focusing on the camera is sufficient for us to get a picture of the variety of technologies involved. They can be roughly divided into four major types in terms of physics and chemistry. Light is the medium of photography. The word "photography" literally means "drawing with light." The technologies to manipulate light, or

optical technologies, lie at the center of camera manufacture. A camera normally contains two optical paths, one for finding the view and the other for exposure. View finding is an essential part of the selection process, whereas the ensuing exposure freezes the result. The goal of the optical technologies is to make the image as close to the object as possible. Realism is undoubtedly the principle here. So the development in optics is mainly to remove various aberrations, including chromatic and spherical aberrations. This is achieved through using better material for the glass and improved lens design, normally including multiple lens components. Mechanical movement is also a necessary part of the function of a camera, from zooming and focusing the lens through closing down the aperture to opening and closing the shutter. Those kinds of movement should be very delicate, fast and precise. For instance, the exposure time could be required to be a hundredth or even thousandth of a second. A shutter has to achieve precision on that level. This definitely raises high requirements for the mechanical technologies. For a long time the photo recording media are based on chemicals, so chemical technologies are indispensable in photography too. Each type of film is supported by a particular compound of chemicals, and it's complicated and subtle. A slight deviation could cause a big failure in the final images. Chemistry is also applied in finding better material for building the camera. A strong and light material is always desired for photography equipments. Originally electronics was rarely used in photography, but electronic technologies played the major role in both the SLR and the digital revolutions. The first focused on camera control, whereas the second on the recording media. In the latest models of the digital SLR cameras, exposure and focus can be taken care of automatically by the built-in circuits in most shooting situations and the image is now formed on an electronic sensor, which converts it into a digital file. Generally we've identified at least four areas of photography technologies: the optical, the mechanical, the chemical and the electronic.

Looking at a person holding such a technology-laden modern camera many people would wonder what is still left for the photographer to do other than press down the shutter release button. This is not a difficult question for an experienced photographer to answer. There is a saying among experienced photographers, "it's the thing behind the camera that takes the picture." But here I would adopt a little different approach. Through a brief historical survey of how some important technologies were adopted in photography I show what technologies could do instead. The heavy technology-ladenness of a modern camera makes photography an ideal area for us to investigate the interplay between technology and art. And for the purpose of this essay this points to its main thesis of the relationship between technology and culture.

In particular we discuss two recent revolutions in photography: the SLR revolution and the digital revolution. Both are essentially technological revolutions. Let's try to extract from them the messages about the relationship between technology and art. The analysis of photography works provides the background for the discussion.

6.1 The Elements of Photography Works

In terms of presentation format photography and painting both belong to static, two-dimensional, visual art. But they have quite different creation processes and artistic expression methods. A photo is taken of an object through a camera, whereas a painting is painted with brushes by a painter. In comparison a painter has much more freedom than a photographer. A painter could make a painting solely based on his imagination. Even when painting a real object - a person, a landscape, or a still life - he could still combine image components from different time intervals together in one work. However a photographer doesn't have such freedom. In a sense every photo is a copy or record of some aspect of a certain part of the real world at a particular instant. This direct relation to reality makes photography follow different aesthetic principles. Similitude to

reality is a principle followed by some painting schools, but it cannot be used to guide photography activities. Similitude requires high level of skills in painting, but it is mundane in photography, especially with today's advanced cameras. Generally speaking photography is an art of selection. The aesthetic power of photography lies in its ability to present a particular aspect of the world at a particular time in a special way. The selection happens in several respects: the object, the aspect, the instant and the way of presentation. The comparison with painting helps to illustrate the characteristics of photography.

Now we move on to the elements of photography works. Based on the way of how a photography work is created, when we look at it we particularly examine its exposure. This is one major element of photography works. A photo is created through exposing light sensitive media in the light which carries the information of an image. The amount of exposure is determined by various factors: the brightness of the light reflected from the object, the diameter of the hole through which the light gets into the camera, the time interval of exposure and the exposing speed of the media. The brightness of light could change dramatically in the environment. When a patch of cloud moves away from the Sun the brightness of light increases dozens of times in several seconds. Human eyes have a very delicate mechanism to protect themselves and adapt to the environment. As the light gets brighter the pupils in the eyes shrink, so the amount of light that reaches the retina doesn't increase with the brightness. This mechanism meanwhile makes it very difficult to measure the brightness with naked eyes. The hole through which the light gets into the camera is called aperture. It functions like the pupil in the eye. The time interval of exposure is controlled by the shutter, another essential device in the camera. When a photo is taken the shutter opens up for a short period of time (could be a hundredth or a thousandth of a second) and lets the light in, so that the media are only exposed for that long. The exposing speed (or the ISO value) of the media could be thought as their sensitiveness. Higher speed means more sensitiveness. The speed here is not based on time, but the amount of light. Given the same amount of light exposed, the higher the exposing speed the more is the exposure effect. Different media have different exposure effects. For film it's the amount of chemical reaction and for electronic chip it's the electric current.

Exposure value (EV) is measured with logarithmic levels. Two consecutive levels of exposure have two time difference ($EV(n+1)=2 \times EV(n)$). The reason why exposure is important in photography is that the light sensitive media have a limited tolerance, that is, they can only record a limited range of EV levels. When the EV range of the object exceeds the tolerance of the media, they cannot record all the areas. Either some areas of the object are too bright, so that they are recorded as white, or some are too dark and recorded as black. In either case details are lost. If the exposure is not set right there are two possibilities: most part of the photo is white or most part is black. The former is called overexposure and the latter underexposure. A general principle is to make the exposure of the main object appropriate, i.e. set in the middle of the media tolerance range. In the early phase of photography history it's a painful task to get the exposure right. Photographers could only rely on experience and trial and error. A light meter, which measures the brightness of light, invented later proved to be a great help. Before a photo is taken the speed of the media is already determined. The control of exposure is done through setting the appropriate aperture-shutter pair based on the light measure.

Another element of photography works is clearness or sharpness. Clearness is a relative concept based on the discriminating power of human eyes. When we look at a big advertising bulletin from far away it appears very clear, but when we get closer it becomes fuzzy. When looked from far away a small area on the bulletin registers at the same nerve cell on the retina. So the fuzzy details in the area are not discernable. But when we move closer the area spreads out to different cells and becomes distinct. The clearness of a photo follows the same rules. According to optical

theory only light from points on the focused plane is converged through the lens to a single point on the image plane, where the media are put. A point in the scene that lies nearer or farther than the focused plane corresponds to a round disc on the image plane. The bigger the distance from the focused plane is, the bigger the size of the disc. However a point in the scene doesn't have to correspond to a single point in the image in order to be clearly seen. Since the discriminating power of human eyes is limited, clearness in the image has a range of tolerance. When the size of the disc is within a certain range, it's looked as a single point anyway. In this way there exists a depth of field in the scene, within which objects can be clearly seen in the image. Fuzziness could result from various reasons, such as motion or fog, but the optical fuzziness is a major one.

Just like exposure adjustment is required by the limited tolerance of the media, focusing is required by the limited range of depth of field. Since any optical lens cannot make everything in the scene clear on the image we have to choose the place to focus. Focusing aims at letting the depth of field contain the main object. Again focusing was not an easy task in the early phase of photography history. It had to be done manually. And different mechanisms had been invented to confirm the state of in-focus, such as the split image. In tracing moving object it really requires high skills.

Exposure and clearness are the two elements that are peculiar to photography. They are non-issue in painting. Exposure is equivalent to the brightness of the paint, which can be conveniently controlled in mixing. And a painter can make any part of the painting clear if he wants. Now we arrive at something which is similar to painting. As a two-dimensional visual art photography also requires composition, just like painting. Generally composition is the way to arrange components in an image in order to achieve certain aesthetic effect. This is the third element of photography works. Even in this respect photography differs from painting. In painting a painter could add an extra component and in many cases also remove an existing component at will. But in many situations a photographer doesn't have this luxury. Very often what he can do is to zoom in or out, or try different angles.

But photography composition shares common aesthetic principles with painting. A beautiful photo requires good composition. First, the photo must have a distinct subject. This is directly related to the basic feature of photographic art. We've said that photography is an art of selection. However due to its special relation to reality, a common trap is trying to include as many things as possible in a single work. When a photography work becomes a record of the whole world, it degrades into a straightforward copy, and then the art is lost. A good work has to focus on a particular aspect of reality. In this sense photographers often say "less is more." When disturbing unrelated components are removed and supporting ones reasonably controlled, the main object can then become prominent. Second, a beautiful photo is normally balanced. Each image component carries certain psychological weight for the viewer. The total weight needs to be balanced along various directions. People are most sensitive to the horizontal direction. When the weight is heavier on either the left or the right side, the viewer feels instability. And third, an interesting photo normally has a dynamic composition. Various factors can make the composition dynamic. The position of the main object in the image is one. Instead of putting the main object in the middle we put it close to the thirds. Lines are another factor. Curves are more dynamic than straight lines and diagonal lines are more dynamic than horizontal or vertical lines. The connection between image components is yet another factor which makes the composition dynamic. It could be the line of sight, the pointing line, close color or similar shape.

Composition only has to do with the organization of components in a visual image. It cannot cover all the aesthetic aspects of a photo. Beyond composition there are also other factors which play a role in the aesthetic value of a photo. Generally speaking a valuable photo should be able

to attract the viewer's attention. We may call all the aesthetic factors of a photography work that are beyond the organization of its components attractiveness. Certainly exposure, clearness and composition all to some extent contribute to attractiveness, but distinguishing a separate element helps analyze a photography work clearly. We may also list several factors here. The first factor of attractiveness is uniqueness. The fact that a unique photo attracts the viewer's attention is based on a general psychological law. When things are familiar they are moved out of the center of consciousness. The attention is focused on new and abnormal objects. This has apparent survival benefits. In a natural environment abnormal objects tend to be more dangerous, so they deserve more attention. A unique photo is new and abnormal. It can be made with unique subject, unique shooting angle or unique components. Another factor is impact. This is also based on a general psychological law. Impact means big stimulus. And stimulus and psychological reaction are positively correlated based on Fechner's law: bigger stimulus causes bigger reaction.[21] When a photo contains elements with big impact it definitely attracts the viewer's attention. Extraordinary height and gigantic volume can have an impact. So do vivid colors. Besides, heavy contrast may also generate big impact.

The above two factors are both based on human sensation. Sensation belongs to lower level psychological activities. We may further climb up the ladder. Emotion is a more complex part of human psychology. A photography work as a piece of art could also influence the viewer's emotion. When this happens we say the work carries a certain mood in it. The most obvious mood can be found in a photo of humor. This kind of photos can make the viewer laugh. Human emotion is very complicated and has many other forms. Besides happiness, there are also sadness, anger, love, hatred, etc. An attractive photo could generate different types of emotions in the viewer. It may either contain emotion in itself such as a portrait with a smiling face, or just let the viewer feel a certain mood in it. Next we move to another part of human mind, the thought. Thought is about concepts and ideas. Yes, a photography work can express thought too. This is specifically called concept photography. No matter whether it's a call to protect the environment, stop the war or fight poverty, the message is often very obvious in many journalist photos. The purpose of commercial photos is apparently also to convey an idea to the customers. Certainly not all ideas are born equal. Some are mundane, whereas others profound. The attractiveness of a photography work is dependent upon the thought it expresses in this case.

We've briefly discussed the four elements of photography works: exposure, clearness, composition and attractiveness. In comparison with painting the former two elements are peculiar to photography and they represent the technological side of photography. The latter two are common with painting and represent the artistic side. In the following discussion about the two recent revolutions in photography the meaning of this analysis will become evident.

6.2 The SLR Revolution: Convenience and Limitation

The beginning of the history of single-lens reflex (SLR) cameras can be traced back to the end of the 19th century, but important technologies were added in the second half of the 20th century. Most cameras contain two light paths: one for finding the view and the other for exposure. Before the SLR design cameras had separate lenses for the two light paths. Normally the lens for the view finder is located on top of that for exposure. By contrast in an SLR camera the two light paths share the same lens. The medium (film or chip) is put directly behind the lens. The view finder is still on top of the medium, but instead of having its own lens it receives light from the single lens of the camera reflected by a mirror located behind the lens. So the two light paths

[21] Precisely Fechner's law states that sensation is proportional to the logarithm of the stimulus.

diverge at the mirror. During view finding the mirror stays at 45º angle and reflects light from the lens to a piece of pentaprism on the top. The prism is responsible for reflecting the light further to the view finder eyepiece. During exposure the mirror is lifted up and lets the light reach the medium.

The next step is to introduce through-the-lens (TTL) light metering. In the TTL metering mechanism light sensors are put behind the lens on the light path. They are placed at different locations by different specific designs. Places actually used are in the pentaprism housing, under the mirror and in front of the medium. With the TTL metering exposure setting can be made automatic. When the speed of the medium is determined the exposure setting consists of two factors, the aperture and the shutter speed. At first automatic exposure was just semi-automatic. In this case the photographer sets one factor first and the camera does the other on the basis of the TTL metering. But later full-program auto-exposure was also possible, in which both factors are set by the camera. This requires a certain kind of intelligence, specifically scene recognition, because different scenes demand different apertures or shutter speeds.

Automatic focus is another step of development, which was introduced in the 1980s. Manual focus by human beings is a trial and check method. But the camera is not good at checking the view finder. Instead it calculates the position of the lens based on the distance of the object. Given the distance of the object from the image plane and the focal length of the lens, the distance between the lens and image plane can be calculated with optical laws. So the key to auto-focus is to measure the object distance. This is taken care of by the new lenses. Later development made auto-focus more sophisticated. The distance measure may be done on different parts of the scene simultaneously, and when an object moves from one part to another it may be kept in focus. This is called tracking focus and is very helpful in photographing moving objects.

Although SLR cameras had been there for a long time, they didn't become popular until about the last quarter of the 20th century. One major reason was that the new SLR cameras were equipped with built-in auto-exposure and auto-focus mechanisms. That made them really easy to use. We may list the major advantages of SLR cameras as follows:

- Sharing the single lens for both light paths is not mainly to save a lens, but to have the same image both in the view finder and on the medium. In this way what we finally get on the medium is the same as what we see in the view finder. So a type of WYGIWYS[22] is achieved. This brings much more certainty in photographing.
- With a comprehensive and cheap array of interchangeable lenses an SLR camera makes it much easier for a photographer to handle various objects and achieve desired effects. Different lenses may be used to expose frames in the same roll of film. Another kind of sharing is made possible.
- Auto-exposure based on TTL metering greatly facilitates the exposure setting. Modern cameras include accurate and sophisticated metering mechanism, so that right exposure for most situations can be automatically set. On the basis of an array of sensors modern cameras normally offers matrix, center-weighted and spot metering modes to handle different scenes.
- Auto-focus based on multi-area accurate distance measuring also makes focusing a trivial task. Some focusing tasks which either required high skills or were just impossible have now become a simple set-up on the camera. Sport photography provides a prominent example. The benefit of auto-focus is best displayed in handling fast moving objects.

[22] This stands for "what you get is what you see."

The generation of photographers contemporary with Ansel Adams took much effort to get the exposure right and tried hard to focus manually. Photography had been the privilege of professionals and wealthy people. With SLR cameras well developed in the last two decades of the 20th century suddenly serious photography was available for the general public.

We can see auto-exposure and auto-focus lie at the center of the SLR revolution. Although SLR cameras have a long history, the development of auto-exposure and auto-focus technologies took a much shorter period of time. And the revolutionary effect resulted from that fact. Auto-exposure and auto-focus have brought much convenience to taking photos. In these days, except for the really tricky lighting situations, the built-in auto-exposure and auto-focus mechanisms are totally reliable. Because of this and to some extent also due to its popularity, photography appears to turn into a trivial activity. Many people think photography is as easy as pointing the camera and clicking the shutter release button. When they find that their works need to be improved the first thing they think of is to upgrade their cameras. In general we can feel some kind of technological determinism here.

To examine this idea let's go back to the four elements of photography works. Although new technologies have made exposure setting and focusing much easier, technology even cannot take care of everything in the exposure and clearness elements. Different lighting situations require different metering modes. Matrix metering works for most situations, because it measures light in the whole scene and then averages all the values. In tricky situations we have to switch to center-weighted metering or even spot metering. The former gives values from the central area of the scene more weight, whereas the latter only focuses on a very small area. Both are ways to guarantee that the main object gets exposed properly when it's lit quite differently than other areas. The metering modes need to be set by the photographer. It's difficult to automate because it requires main object recognition. This is not an easy task for a machine although humans can do it effortlessly. Then there is the exposure mode. Choosing the exposure mode is essentially to set the appropriate aperture or shutter speed. But again this is based on the type of the scene. Scene recognition is a more difficult task for a machine. The auto-program exposure mode is based on that, but no serious photographer would use it.

Similarly auto-focus works for most situations, but we still cannot do away with manual focus. There are at lease three cases where manual focus is necessary. First, when we photography transient object such as fireworks we have to use manual focus. The distance measuring is difficult for the camera because the object exists for only a couple of seconds and keeps moving. Second, for a scene with few explicit lines auto-focus is also difficult, because distance measuring is based on lines in the object. And finally in cases where the focused point needs to be precisely controlled, such as in macro photography, auto-focus cannot be used either. Further, focusing is just one factor of clearness. In addition there is depth of field control. The camera cannot decide on what depth of field to choose. Not every photo requires the maximum depth of field.

This shows that even the technical elements of photography work cannot be fully handled by technology alone. As for composition and attractiveness, they are totally beyond technology. Something like an auto-composition is just impossible, let alone automatically creating a great work of art. That's where the photographer enters. Factors involved in composition and attractiveness, including balance, dynamics, uniqueness, impact, mood and thought, belong to the realm of meaning. Meaning is based on interpretation and related to a complicated system. It cannot be clearly defined by physical properties. Take the simplest factor in the above list for instance. The balance of a composition is based on the weight of image components. If we do a close study we may find that the balance along the horizontal direction in fact roughly follows the law of the lever, that is, a heavier component which is closer to the center can be balanced by a

lighter one farther away on the other side. But the problem is that the weight of an image component is a psychological rather than a physical property. Brightness, size and color matters here, but they are unfortunately not the only factors. Human face carries much more weight than ordinary objects. Even the empty space a person faces carries significant weight. Human beings can handle these very easily, maybe after some training. On the contrary machines are at a loss. What AI aspires to do is just to handle meaning with machines. We will discuss what it actually achieved in several decades of ambition later (8.1).

I hope the message we can draw from the SLR revolution is clear now. In a sentence, technology is convenient but limited. It helps a lot in the lower level of tasks, but can play no direct role on the higher level.

6.3 The Digital Revolution: Convenience and Irrelevance

Shortly after the appearance of the first digital camera on the common market at the turn of the century, a digital revolution was launched in photography. In around a decade, all the major camera manufacturers stopped developing new film camera models. Now over 80% of the camera market is occupied by digital cameras. The SLR revolution is about completely new technologies. Auto-exposure and auto-focus never existed in the past. By contrast, the digital revolution involves alternative technologies. What stands at the center of the digital revolution is a new light-sensitive medium. It uses the electronic chip to replace the chemical film. Compared with the SLR revolution in terms of dynamics the digital revolution is much more dramatic. The most part of it happened within a decade, whereas the development of auto-exposure and auto-focus technologies took several.

I personally experienced the digital revolution in my over a dozen years of amateur photography practice. The first commercial digital camera appeared at the beginning of 1990s, but with an astronomical price. When Nikon D1 came out in 1999, it was still only affordable for professional photographers who had a big budget. Another important factor was that it only had under 3 megapixel resolution, which is solely suitable for small size presentations, such as newspapers and magazines. It's actually targeted at journalists. When I upgraded my equipment in 2002 I chose Nikon F5, a film camera, which was poplar at that time. In the same year a much more affordable digital SLR camera with 6 megapixel resolution (D100) was released by Nikon. Many people including myself still didn't see the benefit to buy a digital camera. The conversion on the personal level happened step by step. I bought Nikon D100 in 2004, but for serious subjects I still used film, thinking film was superior to digital medium in various respects including resolution. But since 2006 I have been using D100, except a special case.

The reason why digital cameras replaced film ones in such a short period is that they do have a bunch of advantages over their predecessors. When photographers use digital cameras more they got a deeper understanding of those. Here I just list some major ones:

- Instant image viewing is probably the most important advantage of digital cameras. When film is exposed, before the image can be viewed it needs to be developed in the lab. The image needs to be fixed. Polaroid does offer film that is developed in the camera, but its quality cannot meet serious photographers' requirement. On the contrary, when an electronic chip is exposed the data is recorded on the fly. A process to fix the image is not necessary. The benefits of instant image viewing are obvious. When we can view the image on the fly we may do real time examination. Problems can be corrected right away by taking another photo. And the good photos can be transmitted on the spot. This is crucial for journalists.

- Cost effectiveness is another factor. It partly results from the above feature. With instant viewing problematic images can be deleted right away without taking any space. Digital cameras are still expensive for the moment, but in the long run the extra cost can be compensated by the savings on the media. Digital media can be reused. When a card is full the images can be downloaded to the computer hard disk, which is much cheaper. Then the card may be used again.
- Besides instant viewing there are other conveniences in digital photography. In shooting the exposing speed of the medium can be changed frame by frame, while with film we have to wait for the next roll. Also an ordinary storage card can hold hundreds or even thousands of images. Photographers can keep shooting for a long time without worrying about changing the card. In terms of post-exposure processing digital photography has moved the traditional darkroom onto the computer. A digital darkroom has much less requirements and is much less hazardous. Image processing software today can achieve most of the traditional effects and much more.
- With computer technologies, especially the internet, the presentation and exchange of digital photos are much easier and more efficient. A photo taken at one place can be instantly sent to somebody else at any place on the globe with internet access. Digital photos may also be conveniently shared in a large meeting with projectors.

Today we take these advantages for granted. And the trend is obvious: digital photography will replace most, if not all of film photography. However, at the beginning there was the film-digital debate, with entrenched film photographers defending film photography. They tried hard to prove that digital photography was not serious photography. The arguments they presented ranged from physical to personal. The major arguments were: First, digital photos have much less resolution, so they cannot be as clear as photos on film. Second, digital photography cannot achieve some special effects, including certain particular 'feel' in a chemical darkroom. Third, electronic sensors have a narrower dynamic range (tolerance) and their rendering of colors is not as vivid. Then come practical issues. Fourth, digital photography is so volatile that a single virus could destroy thousands of photos in a moment. And finally digital cameras are too expensive. But as time goes, all these arguments are gradually losing strength. The resolution of electronic sensors has increased significantly in several years, from 2 to over 20 megapixels. Photoshop with necessary plug-in applications can achieve almost all the effects in the traditional darkroom. The dynamic range and other image quality have also been improved. Practically careful backup could greatly reduce the danger of image loss caused by a virus or a computer system breakdown. And with the development of electronic technologies the price of digital cameras are falling all the time. For the moment only special purpose professional photography is still using film.

Looking back, the defense of film photography was rather unnecessary, if we really love photography. The acceptance of a new thing definitely takes time, especially when the new thing is posed to replace something we've been doing for a long time. Had I been photographing with film for many more years, the conversion would have taken longer for me. On the other hand, when we think it further we could probably behave more reasonably. If we pursue photography as a form of art, does the type of sensitive media really matter? Film or digital, we are doing the same photography, composing in the same way, creating art works in the same way. Actually the essential elements of art are well beyond technology. A particular type of technology is irrelevant to creating art works. In this sense, if digital photography is really convenient, if it's easy to check the result instantly, make all kinds of post-exposure manipulations and share the photos on the internet, why don't we welcome it wholeheartedly, instead of worrying about the death of photography?

If the SLR revolution lets us see the limitation of technology along with the convenience it brings, the digital revolution demonstrates that a particular type of technology is irrelevant to the essential part of art. Photography contains a significant part of technology and many technologies used are cutting edge. Given such technology-ladenness we could still identify a core of photography which is beyond the reach of technology. This provides an important inspiration for us to think about the relationship between technology and culture. Some general reflection on the relationship between technology and art may act as a helpful middle link.

6.4 Technology and Art

We've talked a little about the relation between technology and art in the second part. Technology and art share some common characteristics. They are both a type of human activity of creation. A piece of art work is something new and so is a technology. A piece of art work is created by artists with an intentional design and so is a technology by engineers. And in both art creation and technology invention existing technologies are used. Therefore it seems that technology and art have the same form of birth. Then what's the difference between technology and art? A direct reflection reveals that technology and art have quite different functions. All technologies have a certain utility, serve some purpose that resides outside of the technology itself. But what does a piece of art do? There are obviously many people who think that art is useless. This expresses an essential feature of art. Art by itself doesn't have a what-for element like the function of a technology. On the contrary, those who appreciate the value of art can see that art does have a use in it. A beautiful music can soothe our mood. A great painting can bring us back to the life of a historical period. A profound poem can let us feel the predicament of human life. But the use in this sense is a final use and so it's different from the normal utility. For any technology its use is not a final use. We may always further ask the use of its use. What's the use of a car? To transport people and their belongings. What's the use of that? So that they could go to work, do shopping and travel. What's the use of Google? To search information on the internet. What's the use of that? For one, I could find the resource I need to write my dissertation. But questions like what's the use of soothing our mood? or what's the use of feeling the predicament of human life? are fake ones.

From this functional difference we can further find an important difference in the creation of technology and art. Just because technology needs to serve a certain use in the normal sense its creation has much bigger restriction. Both its means and end reside in the scientific world, so the gap between them needs to be filled with scientific laws. On the contrary, art creation doesn't have this kind of restriction. The means of art creation still resides in the scientific world, but it's not the case with its end. In a sense it has a very open end. But this doesn't mean art creation is easier than technology creation. In some cases more freedom makes things more difficult. In light of this view our discussion about the SLR and digital revolutions in photography above can be easily understood. Camera technologies including auto-exposure, auto-focus and electronic light-sensitive medium all have there end in the scientific world. In contrast the end of photography art lies beyond science, although its means does. Therefore camera technologies can only bring more convenience to photography, but the essential part of photography is beyond the reach of technology.

7. Embracing Modern Technology

My stance on modern technology may be clearly seen in the discussion about photography in the previous chapter. On the one hand we should embrace modern technology with all the conveniences it provides us. But on the other hand we should at the same time be aware of the limitation of modern technology. At first glance this seems to be very straightforward. However, it's not commonly shared even in the field of photography. There are many people who would think that better cameras can always take better pictures. This is even widely held among professional photographers. Thus much of their resource, including money and energy, is spent on equipment. On the contrary, there are also people who get used to old technologies and would think anything new moves away from "the standard," although the technologies they are familiar with were once also something new.

This is also my general stance on how technology should fare in an alternative modernity. But to support this general stance more arguments are needed. Photography provides the inspiration, but it's too special in many respects. To name a few, first, technology has little negative effects in photography itself. Photography technologies are purposely designed to facilitate and improve photography practice. Even if they may cause negative effects, those don't have to have an impact on this particular field. Second, photography is a form of art. Although it also contains much technology, we could only see the interaction between technology and art in it. Third, none of the modernity issues shows up in the field of photography. Therefore we need to step back and take a general view of the modern society.

This chapter is dedicated to the first half of the stance. In order to defend the principle of embracing modern technology, our arguments apparently should be aimed at various kinds of criticism of modern technology. The criticism of modern technology only started at the beginning of the 20th century, after it became dominant and at the same time its negative effects grew severe. This essay is not interested in criticisms on the concrete level, those that deal with specific negative effects of modern technology. Instead it discusses several profound criticisms. They are profound in a couple of senses. First, they consider modern technology as a general phenomenon, so some underlying, deeper features can be revealed. Second, comprehensive impacts of modern technology on society are systematically considered. My strategy is to put these criticisms in a larger context and show that modern technology is directed by and functions in a particular cultural context. In this sense their criticisms target at the wrong object. And this is where the theories of alternative modernity and the relationship between technology and culture come into play. The culture-ladenness of technology is the focus here. Instead of basing modern culture on modern technology, we should do just the opposite, that is, put modern technology on the basis of a particular modern culture. Therefore the resolution of the issues that come with modern technology can only be found in an alternative modernity.

On this background my own theory about the relationship between technology and culture is proposed. Another necessary preparation is to distinguish among material, lower and higher cultures. Thus, the first culture concept (Culture-I) identified at the beginning of Part II plays a pivotal role here. Most critics of modern society lament that the meaning of life once cherished in the traditional society is lost in the modern world, although people's living standard has been greatly improved thanks to modern technology. Apparently the meaning of life is not in line with the living standard. But in order to regain the meaning of life do we have to lower our living standard, or abandon modern technology? The most important thing seems to be to correctly locate the meaning of life. My general answer is that, the meaning of life resides in Culture-I, and

Culture-I is beyond the scope of technology. So on the one hand the loss of the meaning of life is not caused by modern technology, and on the other hand recovering the meaning of life doesn't require the abandonment of modern technology either. And further Culture-I is not only beyond technology but also to a large extent controls how technology is developed. In this sense technology is a cultural instrument. This is the main thesis of my cultural instrumentalism. As the discussion in the second section will show, cultural instrumentalism combines all the major elements in the existing theories, but it's different from any of them. This technology theory can be combined with the modernity theory to interpret the dominance of modern technology and suggest a way out.

With the refutation of fundamental criticisms of modern technology and cultural instrumentalism the principle of embracing modern technology is well justified. If modern technology is not the root cause of the modern malaises we don't need to give it up in order to cure them.

7.1 Out of Dystopian Substantivism

Some philosophers in the 20th century cast gloomy light on modern technology. They can be roughly grouped under the title substantivism. Substantivism has the following common features: 1. It holds that technology is not neutral, but permeates in the value system, or even provides a way of life. 2. It maintains that modern technology has taken away most meaning from human life, so it's longing for values from premodern societies. 3. It generally doesn't regard solving the problems in modern society a very promising task. The word "substantivism" is borrowed from Feenberg, but I use it with a slightly different meaning. For him substantivism denies the human-controllability of technology, whereas my emphasis lies in the view that technology constitutes a substantive part of culture. Even Ellul talks about transcending the technological phenomenon. Heidegger also discusses the saving power. In this sense Marcuse and Borgmann are included here too.

So we discuss four philosophers' influential views of modern technology. They are Heidegger, Ellul, Marcuse and Borgmann, in order of the publication of their major related works. Heidegger's view of modern technology is ontological. For him modern technology is a new way to get along with being. The relation between human and nature is that of ordering and standing-reserve. This ontological relation determines the general existence of people in the Modern Age. Ellul's view by contrast is sociological. Based on social analysis he claims efficiency is the general principle of all the realms of modern society, including economy, politics and culture. So he calls it technological society. Marcuse starts with the Critical Theory and argues modern technology fosters a one-dimensional society in which people forfeits negative and critical thinking. This feature also permeates in various areas of society, from politics to philosophy. Borgmann's view is the most recent and reflects the latest development. He uses the device paradigm to characterize contemporary life enabled by modern technology. A device is a tool to achieve an end with a certain means. But the means is concealed to the user with only the end being salient. Compared with a thing with which people in pretechnological society engages, a device is contextless. Of the four views Ellul's and Marcuse's have many similarities, because they both were formed in the post-war period when the opposition between the Soviet Union and the United States built up. They see in technology the common culprit for problems in both communism and capitalism. There is apparent Heideggerian influence in Borgmann's view, including the sense of nostalgia, but the latter's major focus is quite different. Heidegger and Ellul don't suggest explicit way out. Marcuse and Borgmann try to offer either alternative or reform, but they haven't bear fruit.

In general dystopian substantivism misplaces the blame which scientism, capitalism, commercialism and to some extent, democracy deserve upon modern technology. Although modern technology constitutes the foundation of modern life, it's scientism that claims that science is the only way to truth and so it can interpret all the phenomena in the world, it's capitalism and commercialism that turn almost everything into a commodity and judge almost everything according to its market value, and it's democracy that turns every person into an abstract will bearer and counts everybody as the abstract number one. Modern technology is the direct cause of various problems, but the real culprit stands behind it.

7.1.1 Ge-stell as a new ontology (Heidegger)

In analyzing technology, mainly in "The Question Concerning Technology," Heidegger extends his philosophy of being. In contrast to the commonsensical view which regards technology as a tool, through the etymological investigation of the Greek word *technē* he argues that, "Technology is a mode of revealing. Technology comes to presence in the realm where revealing and unconcealment take place, where *alētheia*, truth, happens." (Heidegger 1977: p. 13) Further he characterizes modern technology as a special kind of revealing. Through the analysis of the hydroelectric plant on the Rhine he shows that the revealing mode of modern technology is a challenging-forth. In this challenging-forth the object, in this case the Rhine, is treated as a resource, specifically as an energy source. This is apparently not the normal way people engage the river. People who live by the Rhine may drink water from it, fish on its banks, swim in it, canoe in it, or just sit or walk by to appreciate its view. But seen from the perspective of modern technology the Rhine loses all its rich characters as an object. In this sense it becomes even objectless.

Heidegger then summarizes the characterization and gives it a particular name. "We now name that challenging claim which gathers man thither to order the self-revealing as standing-reserve: 'Ge-stell' [Enframing]." (*ibid.*: p. 19) As in many other places he plays the word "Gestell" here to have special complicated allusive effects. A Ge-stell is not just a frame, but through its word stem it also alludes to Stellen (setting-upon), Bestellen (ordering), and further Herstellen (producing) and Darstellen (prestenting). Apparently no English translation can capture all these effects. Anyways for Heidegger Ge-stell is the essence of modern technology. So ordering as a framework is the prominent feature.

Against this general feature of modern technology Heidegger continues to talk about the danger of modern technology and also of a certain saving power. "The threat to man does not come in the first instance from the potentially lethal machines and apparatus of technology. The actual threat has already affected man in his essence. The rule of Enframing threatens man with the possibility that it could be denied to him to enter into a more original revealing and hence to experience the call of a more primal truth." (*ibid.*: p. 28) Here we can clearly see, for Heidegger technology is not just an instrument, but it has become an ontology, a way of human's relating to being. And truth is the revealing of being. So the greatest danger of modern technology doesn't reside in its potential of damage on the concrete level, but in its potential of blocking truth to humans on the fundamental ontological level. Now that modern technology shapes modern ontology, the fundamental way of human existence, all human activities are performed on top of it. In this sense technology becomes substantial to society.

Citing Hölderlin's verse Heidegger claims, with the danger of modern technology also comes a certain saving power. This is based on an ambiguity in the essence of technology. And that points to the mystery of revealing. On the one hand, Enframing blocks the revealing of truth. "On the other hand, Enframing comes to pass for its part in the granting that lets man endure – as yet

unexperienced, but perhaps more experienced in the future – that he may be the one who is needed and used for the safekeeping of the coming to presence of truth. Thus does the arising of the saving power appear." (*ibid.*: p. 33) He talks about the association between technology and art. He also mentions poetical dwelling. However what exactly the saving power of modern technology is stays mostly a mystery. Dreyfus and Spinosa try to give it a positive interpretation. They attribute Heidegger the view that technology disaggregates our identities into a contingently built up collection of skills. So the greatest danger of technology lies in the loss of identity. But this at the same time gives us a chance to experience multiple identities. In their own words, "Freeing us from having a total fixed identity so that we may experience ourselves as multiple identities disclosing multiple worlds is what Heidegger calls technology's saving power." (Dreyfus & Spinosa 1997: p. 323) Whether this is what Heidegger really means is debatable. In what sense is this related to art and poetical dwelling? In what concrete way does modern technology help achieve this? In addition, they try to defend the view that Heidegger doesn't actually have much negative feelings toward modern technology. This seems to contradict many evidences from both Heidegger's personal life and writings.

He spent most of his later life in a log cabin in Black Forest, complaining about the ugliness of the TV antennas around. He always talks about things from the ancient or traditional world, temples, cathedrals, chalices, bridges connecting villages with reverence. But what he sees in the hydroelectric plant on the Rhine is monstrousness. He even finds an essential difference between the windmill and the plant. "Its sails do indeed turn in the wind; they are left entirely to the wind's blowing. But the windmill does not unlock energy from the air currents in order to store it." (Heidegger 1977: p. 14)

I don't think the storing of energy is the key difference here. Energy is stored in many forms, also in the traditional society. A piece of wood for burning definitely stores energy in it. Maybe the difference lies in the unlocking? If we insert an electric windmill between a traditional mechanical windmill and a hydroelectric plant, the boundary becomes even fussier. Looks like the essential difference in Heidegger's mind doesn't really lie in the technologies themselves, but the lives that revolve around the technologies. I'm wondering what Heidegger would say when he sees a vacation company lead a group of customers to visit a windmill from the 16th century, instead of the hydroelectric plant on the Rhine. If a traditional technology can be ordered as standing-reserve, then a more authentic life could also be unfolded around a modern technology. This is a major view I want to defend.

But first what about the great danger? Heidegger definitely points out an essential problem with modern society. In modern society life is materialized and objects are instrumentalized. The insatiable basic human desires are the driving force. Objects in the world are treated as different tools to satisfy those desires. So nature is turned into a resource well under arbitrary exploitation. In fact human beings are also turned into resource and are called "human resource". In this way they are split into two parts, desires and instrument. So we see a weird combination in the existence of a modern human being: he works to death and at the same time consumes to death. Rather than seeing the root cause in modern technology, I see scientism, capitalism, commercialism and democracy harmoniously work together to create this particular modern phenomenon. Democracy based on voluntary liberalism generates abundant free wills. And just because these free wills are so popular basic desires must dominate. Anyways higher desires need much effort to cultivate and hence are rare. Then commercialism comes in to satisfy these basic desires through the market, while capitalism motivates the production through the profit. And finally science and technology helps a lot in the production, to make it more efficient and even possible. We can see technology just plays a supporting role in this modern drama. Unfortunately it is caught as the culprit. It is so because modern technology is the direct cause of destruction and

other undesirable things. Technology destroys the forests, technology mines the Earth's womb, technology kills people in the wars, and even technology makes people lazy and fat.

If there are deeper forces under technology, then it's inappropriate to lift technology to the ontological level. As we discussed in Part II, technology is designed and functions in a certain cultural context. The character of modern technology is not accidental, but it's not necessary either. In other words, it happens to be that way for a reason, but doesn't have to be that way. Modern technology is apparently shaped by modern culture, its institutions and value system. Modern technology is used to exploit nature because that's driven by the consumption culture and the motivation of gaining profit. In a different cultural context, it could be used quite differently. This indicates a hope to reconcile modern technology and the meaning of life.

And that's the saving power I can see. However this saving power doesn't come from modern technology itself, but its cultural context. If we could go beyond scientism, capitalism, commercialism and democracy, modern technology could be aligned with an authentic life. This essentially requires an alternative modernity. In this alternative modernity freedom is no longer interpreted with voluntary liberalism, therefore higher interests are highly valued and encouraged. Happiness is interpreted more as the fulfillment of the spirit than the consumption of material goods. Profit is not the only driving force of production and science is not regarded as the only source of knowledge. In this way modern technology can be treated as a useful cultural instrument and put to good use. Besides doing damage and facilitating material life modern technology in fact has already been put to more meaningful use. It has turned a wasteland into a garden and buried fossils into a museum. La Tour Eiffel, as a technological marvel, has inspired many artists. So modern technology definitely has the potential. We just need to build the appropriate context.

7.1.2 Predominant efficiency (Ellul)

Ellul's approach to technology is sociological rather than ontological. His view about technology, mainly modern technology, is based on detailed socio-historical analysis. His concept of technique is not identical to technology, which he gives an explicit definition in the "Note to the Reader" in *The Technological Society* (Ellul 1964: p. xxv):

> The term *technique*, as I use it, does not mean machines, technology, or this or that procedure for attaining an end. In our technological society, *technique* is the *totality of methods rationally arrived at and having absolute efficiency* (for a given stage of development) in *every* field of human activity.

In this definition we can clearly see three key features: rationality, efficiency and universality. Technique is the totality, but not any particular technology. Its scope is even wider than technology as a general concept. Some techniques, such as economy planning and education technique, don't belong to technology. But technology is apparently a central part of technique. And based on the features technique is essentially the extension of technology. This definition already indicates substantivism of technology.

Compared with traditional technique, Ellul argues, modern technique has six distinct characteristics. The first is automatism of technical choice. "Technique itself, *ipso facto* and without indulgence or possible discussion, selects among the means to be employed. The human being is no longer in any sense the agent of choice." (*ibid.*: p. 80) The second is self-augmentation, which means technique tends to grow itself. Existing techniques provide a good platform for developing new techniques. They can even initiate new techniques to solve the problems they cause. The third characteristic is monism, which essentially means indivisibility. "The technical phenomenon, embracing all the separate techniques, forms a whole." (*ibid.*: p. 94)

So when we adopt one part of it we cannot avoid others. The fourth is closely related to the last two. It's called the necessary linking together of techniques. Here Ellul lists examples in which one technique necessitates another. Technical universalism is the next characteristic. Geographically technique has spread to various countries in all the continents. Qualitatively technique has penetrated into all the areas of civilization. And finally comes the autonomy of technique. "External necessities no longer determine technique. Technique's own internal necessities are determinative. Technique has become a reality in itself, self-sufficient, with its special laws and its own determinations." (*ibid.*: pp. 133-134) Obviously these characteristics are interconnected. We may take autonomy and universality as the two major ones.

In the major part of the book Ellul traces how technique expands from economy through the state to the human personal sphere by its internal logic. When technique is applied to economy there are two consequences. First economy becomes more and more concentrated. Ellul maintains that this is required by technique, because concentrated economy brings about more efficiency due to its scale and complexity. This concentration doesn't only mean monopoly, but finally leads to a planned economy. The planned economy must be authoritarian and antidemocratic. Second economy dominates culture. "More and more, the economic fact covers all human activity. Everything has become function and object of the economy, and this has been effected by the intermediacy of technique." (*ibid.*: p. 158) As a further result, human beings are turned into economic men. "Money is the principal thing; culture, art spirit, morality are jokes and are not be taken seriously." (*ibid.*: p. 221) A concentrated authoritarian economy apparently needs a strong authority to run. Ellul claims only the state can take this role. But in order to do that it needs to adopt a variety of techniques. In this way the state also functions according to the law of efficiency. Technocracy seems to be inevitable. When modern economy and politics have put humans in a stressful life, greatly changed their environment, including space and time, and reshaped their social relations, finally human techniques are necessary to soothe their mind. Hence arrive educational technique, propaganda, amusement, sport, etc.

In his "Foreword to the Revised American Edition" Ellul denies that he is pessimistic, but he definitely paints a gloomy picture of modern society. Everything seems to be determined by the sole principle of efficiency based on rationality. Human beings have no choice in the whole process. Technique is so autonomous that it can even transcend political ideologies. No matter whether it's capitalism or communism, once technique is adopted the results will be the same. He thinks a planned economy is the inevitable destination of technique, but in capitalism we only see monopoly and government intervention to some extent. And the planned economy in communism is more based on ideology than technical necessity. Whether a planned economy is more efficient than a market economy is debatable. It may appear so if we only focus on rational calculations on the macro level and ignore some basic factors in economy, such as people's motivation.

In the last part we've clearly seen that technical factors including efficiency are just part of the determinant of technology design. Besides technical factors there are various other cultural factors. So technology is far from developing in a vacuum. It cannot be as autonomous as Ellul claims. His strong autonomy claim to some extent results from the concept of technique. By mixing technology with all the other techniques in the different realms of society, he gives the reader the impression that technique spreads to all the civilization. There is nothing left beyond technique. So technique must be autonomous. It's evident that this strong autonomy is based on technological determinism. As he writes, "at the present, neither economic nor political evolution conditions technical progress. […] The converse is actually the case, […] Technique elicits and conditions social, political, and economic change." (*ibid.*: p. 133) In fact, this is not just technological determinism in the common sense. For Ellul technique not only determines economy, politics and culture from outside, but penetrates into those realms, so that those realms

are turned into parts of technique as a humongous whole. If substantivism can only be implied from Heidegger's ontological stance on technology, it's explicit in Ellul.

In his book Ellul demonstrates a strong sense of history. There are historical surveys in each of the chapters. He is distinctly aware that the so-called technological phenomenon is merely a modern phenomenon. Yet technology has been there since the earliest stage of human history. If technology is really as autonomous as he claims, then why didn't it become dominant earlier or later? In any way this sudden jump probably cannot be explained by the internal logic of technology alone. Certainly premodern technology also raised efficiency, but efficiency was not the major concern at that time. In fact efficiency is not the only goal that technology can achieve. And even rationality doesn't necessarily imply efficiency. Then why did efficiency suddenly become the predominant principle of modern technology? The reason probably has to be found outside technology itself. Ellul has a strange view about the relation between technique and economy. He says, "Technique is inevitably opposed to the liberal economy because the end of technique is efficiency and rationality, and the end of liberalism is money profit." (*ibid.*: p. 201) His example to support this view is that the industrialist replaces old machines which haven't been used up with more expensive new machines just due to the pressure of competition. It seems that economic competition is about the efficiency of machines, but not profit. To me this totally contradicts the facts. Buying more expensive new machines may mean a big investment for the moment, but it's definitely for the long term gaining of profit. Here Ellul puts the cart before the horse. In fact profit is just the direct driving force behind efficiency. Higher efficiency means less cost and more products in the same time period, which leads to more profit. And if we look for the deeper justification for efficiency, it lies in the materialized life. Efficiency is important for producing material goods. But for a more enjoyable life beyond the consumption of material goods, efficiency doesn't matter much, as the traditional life shows. When we are listening to a good piece of music, certainly we don't want to finish it as soon as possible.

Sometimes Ellul's sense of history turns into pure nostalgia, especially when he describes the modern personal life. We just need to look at a couple of places. Here is a sentence about daily life: "Man was made to do his daily work with his muscles; but see him now, like a fly on flypaper, seated for eight hours, motionless at desk." (*ibid.*: p. 321) There is a big difference between that man used to do something and that he is made to do something. There are still people who do their daily work with their muscles today, but given the chance they would prefer a work at desk. After complaining about the mechanization of the household he laments, "a house must be conceived less for the comfort of its occupants than for the accommodation of the numerous mechanical gadgets to be installed in it." (*ibid.*: p. 327) But aren't those gadgets intended to comfort the occupants? Certainly things may go astray, such as in TV or internet addiction, but probably we shouldn't blame the gadgets in that case.

With this sense of nostalgia and the view of strong technological autonomy Ellul slides into a predicament. "In the modern world, the most dangerous form of determinism is the technological phenomenon. It is not a question of getting rid of it, but, by an act of freedom, of transcending it. How is this to be done? I do not yet know." (*ibid.*: p. xxxiii) The transcendence cannot be going backward. Modern technology has fundamentally changed our lifeworld. It probably means transcending technological substantivism instead, in identifying the cultural context of modern technology and fixing the problems there. If as he says a technical humanism is impossible, that's not to say that we cannot have a humanist technology.

7.1.3 One-dimensional thinking (Marcuse)

There are a bunch of similarities between Marcuse's and Ellul's theories of technology. Their major works on technology appears in the same period. They both analyze how technological rationality penetrates into economy, politics and culture and how it dominates them. They both reveal how individuals are controlled by the authoritarian state. And they both think technology is powerful enough to transcend political ideology, so that capitalist and communist societies share the same problems. But Marcuse's theory is focused on a quite different aspect of modern society. He calls this one-dimensionality. Besides, while Ellul's theory has a socio-historical orientation, Marcuse's has a philosophical one.

Ellul demonstrates how technological rationality and efficiency dominates all realms of modern society. Marcuse emphasizes one specific consequence of the domination. But it's a fundamental one. Based on the Critical Theory Marcuse uses the word "one-dimensional" to describe the state where people lose the criticizing ability. This criticizing ability is displayed not only in the traditional Marxian class struggle, but also in various cultural areas. These areas include art, discourse and more importantly philosophy. Technology seldom appears as the direct topic in Marcuse's analysis, but that's just because his main focus is on its consequence. It's evident that technology is the main target under attack. In the Introduction to *One Dimensional Man* Marcuse explicit points out the relation between technology and the paralysis of criticism. "Our society distinguishes itself by conquering the centrifugal social forces with Technology rather than Terror, on the dual basis of an overwhelming efficiency and an increasing standard of living." (Marcuse 1991: p. xlii) And like other philosophers discussed in this section, Marcuse also holds that technology penetrates into all realms of society and becomes a culture itself. "In the medium of technology, culture, politics and the economy merge into an omnipresent system which swallows up or repulses all alternatives." (*ibid*.: p. xlviii)

Marcuse certainly is under the influence of Marx. The class struggle between the capitalists and the proletariats is a major theme in Marxism. Marx predicted that the proletariats would win the struggle in a revolution and establish the communist society. But the truth is, communism doesn't come into reality in any of the advanced capitalist societies. The social conditions in the middle of the 19th century has since greatly changed with the rise of the middle class, the promulgation of new labor laws and the establishment of the welfare society. Although there are still strikes and conflicts between the rich and the poor today, class struggle has been attenuated to a large extent and become a non-mainstream phenomenon, and few people would still think of a revolution. This is a main target of Marcuse's criticism. Being gradually integrated into the established society the working class loses its negative position. Marcuse is in fact not as orthodox a Marxist as he may sounds. He is more concerned with personal freedom than a revolution. He holds that the criticizing ability is essential to personal freedom. That's why he also directs his criticism to communism at the time. Communism is supposed to liberate the working class, but it actually uses the same techniques to control people, making them obedient with higher living standard and propaganda.

Marcuse's major criticism lies not in the economic and political realms, but in culture. Here we see influences from other sources. His criticism of art bears the apparent influence of Freud. One of Freud's major theses is culture as the sublimation of libido. According to Freud, libido is the drive of life which constantly seeks release. It basically gets released in aggressive and sexual behaviors, which are for the survival and reproduction of life. But there are other exits for human beings. When libido is sublimated it's directed to the creation of culture, with art as the highest form. Hence Marcuse talks about repressive desublimation. In such desublimation libido is released primarily through lower forms, predominantly violence and sex in popular culture, and thus it gives little chance to sublimation. Marcuse maintains that genuine art has the magic power of negation, by taking a critical attitude towards reality. This is something that popular culture

lacks. And it also has a material ground. “The conquest and unification of opposites, which finds its ideological glory in the transformation of higher into popular culture, takes place on a material ground of increased satisfaction. This is also the ground which allows a sweeping *desublimation*.” (*ibid.*: pp. 71-72)

Marcuse’s criticisms of discourse and philosophy are closely related, because the analytic philosophy he criticizes focuses on linguistic analysis. A general feature of contemporary language is “an overwhelming concreteness,” which suppresses deep reflection and history and eliminates transitive meaning. What are contained in statements are just detailed descriptions and concrete facts and they can no longer carry thought beyond the literal meaning. “This language controls by reducing the linguistic forms and symbols of reflection, abstraction, development, contradiction; by substituting images for concepts.” (*ibid.*: p. 103) Marcuse sees in dialectical logic the foundation of critical thinking. Dialectical logic is dynamic because in it a thing contains its negation in itself. So the thing has the tendency to move beyond itself, to transcend. As we get to formal logic things become closed and static. A is A and A is not ~A, so it can never transcend itself. With this abstraction history is impossible. Marcuse further claims that the negative thinking turns into a positive one in the logic of domination. But when humans use technology to dominate nature, they are actually dominated by themselves. With negative thinking forfeited they are closed from real freedom. And finally the positive thinking finds its embodiment in analytic philosophy. Based on formal logic and scientific language analytic philosophy congenitally distances itself from context and history. “The object of analysis, withdrawn from the larger and denser context in which the speaker speaks and lives, is removed from the universal medium in which concepts are formed and become words.” (*ibid.*: p. 180)

Compared with Ellul’s sociological analysis, Marcuse’s philosophical one seems to be more poignant. Unlike the other three philosophers discussed in this section, he doesn’t show a strong sense of nostalgia. He even constructively offers a way out for the modern technological society. When technology is so highly developed that all the human vital needs are fulfilled, there will be a break with the current one-dimensional world. “Under such conditions, the scientific project itself would be free for trans-utilitarian ends, and free for the ‘art of living’ beyond the necessities and luxuries of domination. In other words, the completion of the technological reality would be not only the prerequisite, but also the rationale for *transcending* the technological reality.” (*ibid.*: p. 231) A central part of this transcending process is the materialization of values, which is “the redefinition of values in technical terms.”

This looks to be an obvious residue of Marxism. Marx maintains, when the economy in a capitalist society is highly developed and concentrated, it actually paves the way to communism. And when the material goods are abundant enough the principle of distribution according to need can be adopted. This turns out to be a pure utopia. The problem is that people’s needs are very vague. And very often people’s desires are insatiable, especially of material goods. So the point where all the needs are met is impossible to reach. Marcuse here thinks along the same line. It sounds the current domination is caused by lack of material goods. And when people’s vital needs are fulfilled they will get out of the state of domination and realize the art of living. This contradicts a basic historical fact. The traditional society owned much less material goods than the modern society, but there higher culture had a higher social status. Further, how can we define values in technical terms? Is this consistent with his criticisms of thoughtless language, formal logic and analytic philosophy? In general Marcuse’s solution doesn’t seem to be in harmony with his analysis of the problems in popular culture and scientific-technical thinking.

In contrast I think the dominance of both popular culture and technical rationality is caused by democracy, capitalism and commercialism. Democracy distributes political power evenly among

the people, so everybody counts the same. Then it's very difficult for the government to adopt policies that favor higher culture. The reason is simple. In order to be able to enjoy higher culture one needs to go through a long process of cultivation. The extra effort makes higher culture unpopular. Bills promoting higher culture hardly get majority support in the parliament. If by chance one gets passed into law, it's criticized as perfectionism. Higher culture doesn't have a better fate in the economic realm with capitalism and commercialism either. Since it has a marginal market, it's put into a very disadvantageous position compared with popular culture. While popular music flourishes everywhere, classical music radio stations are begging for donations. The value of higher culture cannot be measured by the market, so it needs to be recognized in other ways. Donation only solves a tiny part of the problem, because in the same system there is little overlap between personal wealth and interest in higher culture. The only exception is when the majority of the population of a country is well-educated which makes higher culture also popular. But certainly this is very rare case.

Many people would claim an individual should have the right to choose what's good for him and it's only fair if higher culture is put in the same competition of a free market. The business of the government is solely to coordinate people's relations and guarantee a fair solution of conflicts. Therefore, if a person finds pleasure in the indulgence in pornography, then let him enjoy it. And if higher culture cannot survive in a free market, then let it die. This is definitely voluntary liberalism, a liberalism based on the will. It interprets freedom as doing things at will. But the will by itself is too abstract. It could be good or bad; it could be high or low. Voluntary liberalism reduces the good to the will, but in fact the will should be evaluated with the good. In my opinion this inverted value system is the root cause of the modern malaise. As a general symptom, lower values defeat higher values and material life devours spiritual life.

The dominance of technical rationality is a direct result of the inverted value system. First reason is an essential part of the will. In all forms of voluntary liberalism, from Hobbes through Locke and Mill to Rawls, rational calculation always plays a central role. Even behind Rawls' "veil of ignorance" an individual still has reason to calculate his best strategy, although that's the only thing he has. Without reason nothing would motivate an individual to get into a contract, hence a society is impossible. Second the dominance of material life makes technical rationality dominant. Technology is good at improving the production of material goods. When the consumption of material goods and sensual pleasure become the meaning of life, no wonder technology rules. After technology demonstrates the almighty power, it's just natural that every aspect of life should be aligned with technical rationality. Here we see another inversion. Reason and technology are means to achieve an enjoyable human life, but they turn into ends themselves. Human beings are the ends, but they are rationalized to fit into the technological world. On the one hand they are turned into human resource devoid of any subjectivity, and on the other hand their private life is more and more hooked to machines.

We can see the dominance of technical rationality is not an autonomous phenomenon of modern technology. It's based on a particular value system. When the inversion of the value system is corrected the second inversion should go away automatically. When the value of higher culture regains its deserved recognition and the spiritual pursuit is put in the center of life again, technology will also take its appropriate position, again. In that case what we abandon is merely the dominance of technology, but not technology itself.

7.1.4 The device paradigm (Borgmann)

While Heidegger, Ellul and Marcuse's critiques of modern technology are focused on ontology, sociology and philosophy respectively, Borgmann's is focused on everyday life. In *Technology*

and the Character of Contemporary Life he identifies a general pattern in modern everyday life, which he calls the device paradigm. To understand the device paradigm we need to make clear what a device is. Borgmann distinguishes a device from a thing. A thing is an object we encounter in its fullness, particularly in its context. On the contrary, a device is an artifact to meet a specific need with all the producing and functioning processes hidden from the user. A heater offers a comfortable room temperature in the winter; a frozen meal drives away the hunger. That's all the consumer cares. Here we see a separation of the machinery from the commodity. The commodity is the target function of the device, whereas the machinery is how the device is made and how it actually works beneath the surface. "Devices, that was the claim, dissolve the coherent and engaging character of the pretechnological world of things. In a device, the relatedness of the world is replaced by a machinery, but the machinery is concealed, and the commodities, which are made available by a device, are enjoyed without the encumbrance of or the engagement with a context." (Borgmann 1984: p. 47) Borgmann argues that this device phenomenon represents the general character of modern life, so that it becomes a paradigm. The device paradigm is apparently based on modern technology, so it's a technological character. And for Borgmann this also permeates into the whole modern society.

Although the device paradigm is most easily discernable in everyday life, it has deeper social and political consequences. A prominent social effect is the separation of labor from leisure. "The sharp division in our lives between labor and leisure is a unique feature of modern existence. It is my thesis that this division reflects the split between machinery and commodity in the pattern of technology. Leisure consists in the unencumbered enjoyment of commodities whereas labor is devoted to the construction and maintenance of the machinery that procures the commodities." (*ibid.*: p. 114) In this way both labor and leisure are degraded. The division of labor is a major cause of its degradation. When a complicated working process is divided into a sequence of simple steps and each is assigned to a different worker, a challenging yet enjoyable work is turned into a tedious and boring one. Simplification similarly is a major cause of the degradation in the realm of leisure. When life gets easier we are more and more depending upon the machines that make it possible and hence are cut away from our natural habitat. "But it is an entirely parasitic feeling that feeds off the disappearance of toil; it is not animated by the full-bodied exercise of skill, gained through discipline and renewed through intimate commerce with the world. On the contrary, our contact with reality has been attenuated to the pushing of buttons and the turning of handles." (*ibid.*: p. 140) The addiction to TV, and today the internet, is a good example.

Borgmann also talks much about the relation between technology and democracy. Liberty, equality and self-realization constitute the three fundamental notions of liberal democratic theory. The promise of technology seems to be well in line with these ideals. Modern technology has dramatically improved human living standard and thus liberated human beings from hard labor, hunger, disease, unpleasant weather and the locational limitation. Through a free market technology has make all kinds of goods available to each individual. And finally with liberty and equality every individual can pursue their dreams on their own. In Borgmann's words, "the liberal democratic vision of society is guided by a distinctive convergence of the notions of liberty, equality, and self-realization. This cluster of concepts seems to be in happy consonance with the instrumental conception of technology." (*ibid.*: p. 86) However as we get into reality things turn out to be different. Borgmann distinguishes three types of free society, which I think is very important. The first is the constitutional or formally just society. As the name suggests, in this society the constitution grants equal rights and liberties to all citizens. But these rights and liberties could become formal without equal opportunity to support them. If people just write "All men are created equal" in the constitution, but at the same time children from poor families cannot afford to go to school, this kind of equality can only be nominal. So the second type is a

fair or substantively just society. The above problem is fixed in this society, where equal rights and liberties are supported by equal opportunity. Further, a fair society may still be not enough. Life in a fair society could turn out to be very shallow and boring. So what we really want is the third type of society, which is a good one. Life in a good society should be meaningful and edifying. According to Borgmann liberal democracy aims at a good society, but it interprets a good life along technological lines. A good life in this sense would be the possession and consumption of high tech products. However technology is plagued with the device paradigm. So we finally get into a predicament. "It produces a wealth of different commodities. But underneath this superficial variety, there is a rigid and narrow pattern in which people take up with the world. This is the liberal predicament." (*ibid.*: p. 94)

Heidegger's influence is evident in Borgmann's thought, but he has an original philosophy of his own. While he also talks about the gathering power of a hearth for the family and a cathedral for the community, he finds Heidegger too nostalgic. Heidegger is anti-technology to some extent. On the contrary Borgmann actively seeks the reform of technology. He explicitly distinguishes between reforms *within* the paradigm of technology and reforms *of* the paradigm. He wants to follow the latter strategy. Borgmann's general stance is "not only to accept technology but also to limit it." This is almost the same as the general stance of this essay, but with different concrete meaning and context. His way to limit technology is to replace devices with things in our central concern. Borrowing from Heidegger's concept of gathering as the fourfold of Earth, sky, mortals and divinities Borgmann says a thing is a focus and also speaks of focal things and practices. When the whole family get together preparing and eating a dinner a full social context is involved. This event gathers various things, from the raw food material through the family members to an old cultural tradition, and thus provides a focus of life. By contrast when we grab and eat a Big Mac only hunger and food are left. So the reform of technology is to recover the central status of focal things and practices. "A reform so defined is neither the modification nor the rejection of the technological paradigm but the recognition and restraint of the pattern of technology so as to give focal concerns a central place in our lives." (*ibid.*: p. 211) After focal things and practices are put at the center technology turns into an instrument. "The present proposal is to restrict the entire paradigm, both the machinery and the commodities, to the status of a means and let focal things and practices be our ends." (*ibid.*: p. 220)

To examine Borgmann's philosophy let's first consider the device paradigm itself. He defines the device paradigm as the division between machinery and commodity. But this seems to be a natural result of the division of labor, which has existed since the traditional society. When a person bought shoes from a shoemaker and wore them in a traditional society he probably didn't know how the shoes were made. In this case the machinery and commodity are also separated. Shoes may be too simple and their machinery straightforward. But as a general rule, a person cannot make everything he consumes. As long as there is division of labor the machinery of something must be hidden from the consumer. Therefore this definition may not be very accurate in depicting the character of modern technology. Of course modern technologies tend to be more complicated than the traditional ones and their machineries are more difficult for an ordinary consumer to understand. But this is just a difference in quantity, not quality. Perhaps the emphasis should be put on the character of commodity. A traditional commodity always bore a cultural context. From a pair of shoes one could tell where it's made, even which shoemaker made it. There could be stories behind those shoes. This particular cultural context seems to be lost in modern commodities, especially in this globalized economy. This is the producing perspective. From the consuming perspective there is a bigger difference. A traditional commodity was normally used for a long period of time and could be cherished across generations. A pair of shoes could be worn for over a dozen years. In this way a traditional commodity could obtain a deeper connection with a person's life. By contrast in this consumption culture a commodity is

connected to a person's life only through a desire, very often a transient virtual desire which has no basis in the need. Thus a commodity is striped off of all its cultural context and becomes a device to satisfy a desire. And since the desires are mostly baseless and stand for their own sake, the commodities connected with them turn from means into ends. Therefore the device paradigm interpreted in this way captures the central character of the consumption culture.

Next let's consider Borgmann's solution to the problem. He thinks the device paradigm is a general character of modern technology and the reform of technology is to put focal things and practices at the center of life and use devices as means. Under closer scrutiny this doesn't seem to be a real solution. The problem is the prevalent device paradigm which has global consequences. Now the solution proposed is just to restrain the paradigm and recover the desired traditional values. It's like to say, the cure of a disease is to control the disease and recover health. A genuine cure should be how to cure, not the desired result of the cure. And how to cure needs to be based on the diagnosis of the cause of the disease, but not just the identification of the symptom. In my opinion multiple evidences show that Borgmann is very close to a genuine solution of the general modern problem. The main obstacle is still the substantivist view of modern technology. In this case it's the view that the device paradigm is a general problem of modern technology. And since we cannot do away with modern technology we can only control the device paradigm. It's just this substantivist view that blocks the root cause of the problem. The deviation in the definition of the device paradigm we analyzed above may also contribute to this view.

My general stance on the device paradigm is similar to those other problems discussed in this section. It's not a problem of modern technology, but caused by democracy, capitalism and commercialism. If device paradigm is regarded as the central character of the consumption culture, it can only be the result of democracy, capitalism and commercialism combined. I have analyzed this multiple times. In fact Borgmann is well aware that liberal democratic theory can at best guarantee a fair society, but not a good one.[23] The reason is that the theory is based on a doctrine of voluntary liberalism and lets everyone decide what's good for themselves. The resulting principle can only be of good in the dubious sense. If this kind of good ends up having an intimate relation with technology, it's because technology is developed following this principle. But it doesn't have to be developed this way.

Hence the solution for device paradigm should be transcending democracy, capitalism and commercialism. This is actually to go for an alternative modernity. Advocating focal things and practices in the untouched value system cannot solve the problem. Eight years later in *Crossing the Postmodern Divide* Borgmann lists ambiguous individualism as one of the major problems of modern society. He identifies commodious individualism in the consumption culture. And his fix for it is communal celebration. Here he seems to put individual and community against each other. But actually they are compatible. If the consumption culture can be diagnosed with individualism it's only a lower form of individualism.[24] To me individualism is an essential feature of modernity. If we get rid of individualism then we move back to premodern society. A fully developed individual is the ideal of a genuine individualism. And a genuine individualism doesn't go against community. On the other hand communal celebration is compatible with lower forms of individualism. A sport game is normally loaded with commercials. There are definitely communal celebrations in which people may go really crazy.

[23] In fact Borgmann's attitude toward liberalism is somewhat ambivalent. Authors have pointed out this ambivalence. Cf. Tuman 2002 & Ess 2002.
[24] This form of individualism is discussed later in 7.2.2.

7.2 Cultural Instrumentalism

With all the preparations made now I can propose my own theory of technology. This theory tries to absorb the valuable elements from the exiting theories and constructs a comprehensive picture of the relationship between technology and culture. With it I will offer a different diagnosis of the phenomenon of modern technology. On the basis of this diagnosis a different prescription for the modern malaise will also be suggested.

7.2.1 A synthesized theory

I call my theory "cultural instrumentalism". Like common sense instrumentalism, it essentially regards technology as an instrument, but it's not just an instrument with its function filling a straightforward slot in culture. The word "cultural" is used to emphasize the culture-ladenness of technology. Technology is culture-laden in very complicated ways. Here the concept of higher culture (Culture-I from Part II) plays an important role. We need to divide the general culture concept, the artificial world (Culture-III from Part II), into Culture-I and the rest, including material culture and lower culture. Material culture covers all the material objects that are employed in culture. The division between lower culture and higher culture in the spiritual world is based on the structure of human psychology. Human mind is roughly analyzed into three main fields: cognition, emotion and volition. Cognition is about understanding the outside world. Emotion is about feeling the internal state. Volition is about motivating an action. In all the three fields we can see components on different levels. In cognition sensation is transient, direct and very fallible, whereas thought is standing, reflective and examination based. In emotion a basic pleasure is shallow and unstable, whereas love is deep and enduring. In volition an instinctive desire is blind and short-lived, whereas the will to pursue a cause is goal-oriented and long-lasting. In an intrinsic value system which honors depth, durability and complexity the latter component in each field has higher value than the former. Generally lower culture corresponds to the lower components of human mind, whereas higher culture to the higher ones.

The boundary between material culture and spiritual culture is much clearer than that between lower culture and higher culture, although it's not crystal clear. A fuzzy example is computer software. Does it belong to material culture or spiritual culture? In a sense it's spiritual, because unlike computer hardware software is not physical. But in another sense it's material, because theoretically, if not practically, all software can be hardwired. That is, it can be built into the hardware without any loss of functionality, and that's what software is all about. Barring a small set of fuzzy examples as computer software, it's generally easy to tell whether an item belongs to material or spiritual culture. It's not the case with lower and higher cultures. The division itself is value-laden and specific categorization is more troublesome. In most cases lower culture and higher culture share the same form. Normally an entertaining fiction belongs to lower culture, whereas a Nobel Prize winning novel to higher culture. Similarly a *007* movie belongs to lower culture whereas classics like *Gone with the Wind* to higher culture. After watching a *007* movie once one gets all the visual impact, and at most one wants to watch it another time to figure out all the holes in the plot. Then that's it. But *Gone with the Wind* invites one to watch it many times. Each time one gets a vivid experience of the American history during the Civil War period, and by reviewing different personal fates and personalities on that big historical backdrop one is inspired to ponder on the meaning of life and the relation between personal fate and history. Certainly the number of times of interesting appreciation is not the criterion. Popular music such as Madonna's album is repeatedly listened to by people, but each time one gets some sensual pleasure and then it fades away. In contrast Beethoven's Fifth Symphony gives people energy to overcome the hurdles on the life journey and leads them to transcend everyday life. These seem to be clear cases, although I am pretty sure there are people who would debate on that. For many

other cases the classification is really difficult. And there are people who take advantage of the fuzziness. Some call their pornography nudity art. However, given the fuzzy boundary the division is still meaningful.

The division becomes apparent when we take a comparative and historical view of the various civilizations of mankind. Horizontally two civilizations may share the same material culture, but have different spiritual culture. For two material cultures to be the same it's not required that they contain the same set of material objects. All modernized societies can be said to share the same material culture, as they are all based on an industrial economy and prevalent use of machines. But not all modern societies share the same culture. They could diverge in spiritual culture. Further two societies may share the same popular culture, but have different higher cultures. American popular culture has spread to many other countries, but it hasn't changed all the higher cultures on its way. Vertically in the historical development of a civilization material objects and life styles could change dramatically, but fundamental ideas could be kept. Material culture is the easiest part to change, whereas higher culture is the most stable. In this way a civilization may undergo evolution without loss of identity. In this sense we may say higher culture is the core of a culture.

Under this division the main claim of cultural instrumentalism is that, technology is an instrument of higher culture although it to a large extent determines the rest, the material culture directly and to a less degree lower culture. Photography is a perfect example to illustrate this idea. All the photography equipment with cameras at the center belongs to the material culture. Technology directly determines the shape of photography equipment, from the original Daguerreotype through color film to today's most advanced digital SLR cameras. The equipment provides the basic platform on which all photography practice is performed. On this platform reality recording and visual impact constitute the lower culture of photography. Technology helps a lot in this field. Higher quality lenses have made reality recording much more vivid; auto-exposure and auto-focus have made reality recording much easier. And the ability of modern cameras to capture high resolution images from a great distance and freeze objects with a high speed always lets people be fascinated. This was once thought to be the only function that photography could serve. Yet it has struggled to win a prestigious place in the temple of art. It was soon demonstrated that photography could not only record reality but also interpret it. And the interpretation opened a whole new world of possibilities. A person's soul can be revealed, a social injustice can be exposed, the insanity of war can be displayed and a natural scene can be endowed with a mood. All these belong to the higher culture of photography. This part unfortunately can technology serve little. Certainly without the invention of photography technology this particular form of art is impossible. But it has to be the artist who does the art part, using technology as a means. And just in this sense technology is an instrument of art, an essential part of higher culture.

In this general frame we can incorporate the existing theories. Technological determinism is reflected in the relation between technology and material and lower cultures. But still the determination here needs to be qualified. Technology directly shapes our material life and through that has a print on lower culture, which relates to our lower mental faculties. In contrast higher culture is more autonomous. The technological lifeworld can at best provide a basic platform for higher culture to play on. However, the play is essentially the performance, not the stage. So for higher culture technology is something necessary and useful, but not essential. This is just what a tool is. In this way instrumentalism is incorporated in the relation between technology and higher culture.

The culture-ladenness of technology is about the influence in the opposite direction, that is, the influence of culture on technology. In Part II we saw that the influence is through the design and

functional elements of technology. Generally the design of a technology is guided by culture and when it's created it also functions in a cultural context. There culture is talked about in general. Now with the division of culture we may take a closer look at the culture-ladenness. Obviously technology is directly laden with material culture. A technology has to be designed to directly fit into the material world and functions harmoniously in it. It must be built on top of existing technologies and economically feasible. The influence of lower culture on technology is not as direct. The color of a car is not as important as its engine in the design. Even for an entertainment device like a TV the material factors are also the first to be considered in the design. The influence of higher culture is even more complicated and hidden. Very often it doesn't explicitly appear in the design of a particular technology. It works indirectly through other forces. And perhaps it may become evident only when we consider technology in general.

The analysis of technology and the division of culture enable us to construct a picture of the relationship between them with much finer granularity. Instead of talking about the relationship between technology and culture as two general entities, we can examine the relations between their elements and components. In Chapter 3 we analyzed technology into its three major elements, the scientific, functional and design elements. And now we divide culture into material, lower and higher cultures. So we have multiple items on both sides. In addition, the relationship between technology and culture is bidirectional. After all we are ready to draw a complicated picture. Compared with a general relation, this picture contains more subtleties. And I believe this finer picture is closer to reality. It's depicted in the following diagram.

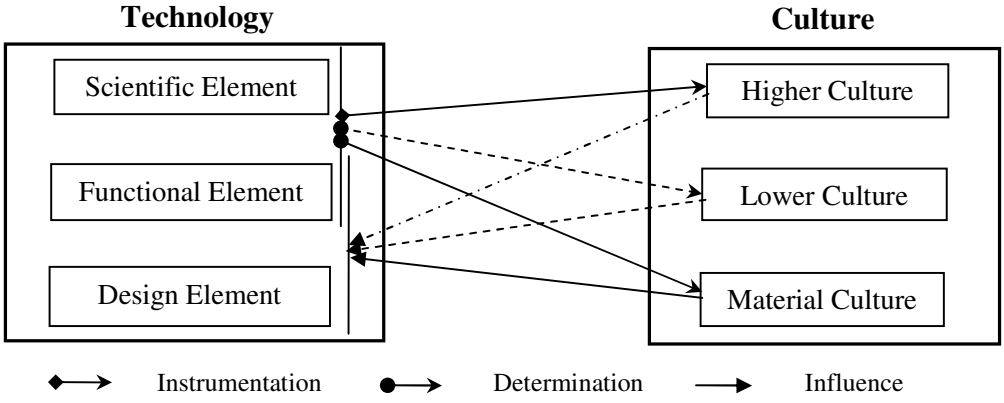


Fig. 7.1 An anatomical view of the relationship between technology and culture

In this diagram we have technology with its three elements on the left side and culture with its three components on the right. The action of technology upon culture is based on science and through its function. It generally builds a technological lifeworld where culture lives. While it more or less determines material and lower cultures, it only acts as an instrument of higher culture. The influence of culture upon technology is through guiding its design and providing context for its function. The influence of the three components has different forms (directness, strength). The density of the lines indicates the relative force of action. It's a synthesized theory because it contains almost all the major ideas in the existing theories. They are determination in technological determinism, instrumentation in common sense instrumentalism and culture-ladenness in contemporary theories. In fact each of the existing theories covers a part of the above picture.

The reason why I call this synthesized theory instrumentalism is that higher culture is the core of culture. In the strict sense only higher culture may be called culture, because it represents the

highest achievement of human beings. And technology is an instrument of higher culture. But this theory is apparently much more complicated than common sense instrumentalism. So I need the word "cultural" to indicate the complexity of it. This complexity is mainly the culture-ladenness of technology, which captures the mutual influencing relation between technology and culture. In a short sentence, the gist of cultural instrumentalism is that, *technology is a culture-laden instrument of the core of culture*.

7.2.2 Deciphering the phenomenon of modern technology

The central character of the phenomenon of modern technology is the dominance of technology. Since technology never dominated in the traditional societies, no matter in the West or the East, this is a peculiar feature of modernity we need to provide an explanation for. Critics of modern technology from Heidegger to Borgmann have focused on different aspects of it, but the dominance of technology is their common concern. Another common characteristic of their critiques is that they all pay much attention to the problem itself and some also try to offer a solution, but nobody tries to explain the problem. And due to this the solutions they offer don't seem to be able to really solve the problem. I think a major reason is their substantivism, that is, they all more or less treat technology as an autonomous entity that provides the value system for the whole culture. As technology is assumed to be so deterministic and authoritative, nothing else can explain it. On the contrary it explains other components of culture. And technology by itself doesn't seem to need much explanation. As the core of technology is rationality, everything within it appears reasonable.

In the whole book of *The Technological Society* Ellul tries to reveal the internal logic of technique's autonomy. But we still may ask the question why didn't this whole phenomenon happen earlier? So we still need to explain the phenomenon of modern technology. With my own theory of modernity and cultural instrumentalism I here try to offer a consistent and effective explanation. It needs to be pointed out again, the focus of this essay is on technology, so the latter has much more argumentative support than the former. My theory of modernity has to be kept sketchy here. In order to explain any general modern phenomenon we at least need to trace back to the infancy of modernity. That is the Religious Reformation. In the Reformation God and the Bible were kept, but the individual was liberated from the clergy. Thus the individual could reach God by faith alone. This is a moderate way to break away from the Middle Ages. One of my major theses is that, although the Reformation liberated the individual, as Western modernity grew it gradually resulted in a dubious individualism. "Dubious" is a word borrowed from Borgmann. He talks about dubious good, which means something good in a sense but not in the genuine sense (Borgmann 1984: p. 93). Dubious individualism consists of three aspects: scientism, capitalism-commercialism and voluntary liberalism, as shown in the following table.

	Religious Reformation	**Dubious Individualism**		
Realm	Religion	Culture	Economy	Politics
Thought	Protestantism	Scientism	Capitalism-Commercialism	Voluntary Liberalism
Means	Faith	Reason	Money	Will
End	God	Truth	Happiness	Freedom
Principle	Egalitarian Universalism			

Table 7.1 The parallelism between religious reformation and dubious individualism

While religion dominated all aspects of life in the Middle Ages, modern society branches into three distinct realms, although they are still intertwined. The three aspects of dubious individualism correspond to culture, economy and politics, respectively. There is perspicuous parallelism between scientism, capitalism-commercialism, voluntary liberalism and Protestantism. In Protestantism an individual reaches God through faith. In scientism an individual reaches truth through reason. In capitalism-commercialism an individual reaches happiness through money (wealth). And finally in voluntary liberalism an individual reaches freedom through the will.[25] The principle of egalitarian universalism connects them all. This principle treats each individual the same and the means involved are all universal means. Universal in the sense that it ignores all the particularities of the individual, no matter whether they are birth, talents, personality, education, interests and so on. So equality here is based on an abstract concept of the individual. Rawls' "veil of ignorance" is a perfect embodiment of this principle.

In *Dialectic of Enlightenment* Horkheimer and Adorno try to find the origin of Enlightenment in the ancient Greek myths. In contrast I try to locate the root of Western modernity in Christianity. Weber has revealed the connection between Protestantism and capitalism. But I propose a more general theory here. My general claim is that scientism, capitalism and liberalism are all shaped by Protestantism. For the moment this is just a conjecture. Argumentative support for this claim is well beyond the scope of this essay and has to be left for future studies.

While faith is a genuine way of reaching God, the other three means finally turn out to be dubious, although in the early phase they all looked very promising. The rise and success of science has convinced most people that the scientific method based on reason is the only path to truth. Anyways science has dispelled all kinds of superstition in the traditional society and established a glorious knowledge system expanding from the subatomic particles through life on Earth to the galaxies in the universe. This makes scientism very popular up to this day. The contemporary denial of the so-called "folk psychology" is just a reminiscence of the logical positivist endeavor to clear out all kinds of so-called "metaphysics" from our knowledge system. But unfortunately the fact is that, just in the "folk psychology" and "metaphysics" reside the things which evade science but on the other hand are most meaningful for human life. Similarly the Industrial Revolution has dramatically improved people's standard of living. And capitalism and commercialism seem to work harmoniously and smoothly to motivate the use of resources and bring all kinds of material goods to each individual. Comparing with all the hardship in the traditional life, most people in a modern society can proudly claim to be living a better life than a king in the past. So the heaven on Earth would be realized with first earning big money and then indulging in lavish consumption. But unluckily the indulgence in consumption quickly makes people feel boring and meaningless. Modern economy tries hard to make people's life effortless and easy, but on the other hand happiness is based on a significant amount of effort. Finally the French Revolution toppled the traditional authoritarian political system. Since then individuals have been step by step liberated from all sorts of social and political oppression and discrimination. At last human rights are defended across the borders. With all the personal freedom gained democracy is deemed as the perfect form of polity. However democracy is based on voluntary liberalism which interprets freedom as doing things at will. But it doesn't care what the will is. The only caveat is that mutual conflicts should be avoided. When human rights are effectively used by people to defend the addiction to pornography and drugs, one can tell something must be wrong there. In this case personal freedom arrives at its opposite and becomes dubious. On the contrary genuine freedom lies in controlling the lower wills and subjecting them to higher ones.

[25] This is understood in the sense that freedom is interpreted as doing things at will.

With dubious individualism the central concern of culture moved from higher culture to material and lower cultures. No matter whether what the Bible tells is true or not, the central concerns of people in the Middle Ages were with questions like What is the meaning of life? Should I orient my life to an external purpose? What should I do to fellow human beings and in my personal sphere for that purpose? What is it like after this life? These are questions which transcend everyday life. And transcendence is just the focus of higher culture. As history moved into the Modern Age people became less and less concerned with such questions, or just provided mundane answers. What is the meaning of life? The answer from science runs probably like this, "That's really simple now. In a few words, life is DNA controlled protein." This appears to be profound, but actually is irrelevant. Or we may get answers like, "The meaning of life is to consume as many goods as possible," or "The meaning of life is to have all the wishes come true." These don't seem to be exciting either.

This shift of central concern put technology, which had stood at the periphery of culture, into the center of stage. Although technology can only support higher culture without being able to contribute much, it plays an active role in material and lower cultures. When material and lower cultures were the central concerns, it's just natural that the importance of technology grew and grew. Specifically science offered a much better foundation from which technology soon benefited a lot and which finally became indispensable. On the other hand, capitalism, commercialism and liberalism worked together to provide the strong motivation and incentive. Therefore, it's not like what substantivism claims that modern technology grew by its internal logic and finally dominated the whole culture. But on the contrary, modern technology became dominant in a particular cultural context, under the influence of various other components. This is the main point of my deciphering the phenomenon of modern technology. And here my theories of modernity and technology are combined.

If modern technology was shaped by modern culture and became dominant, then there is no essential difference between modern technology and premodern technology. Certainly on the basis of science modern technology is much more powerful and efficient, but it's just a difference of degree. There is no paradigm change as Borgmann suggests, or even an ontological change as Heidegger insists. People can certainly gather around a heater just like a hearth, not just physically, but as a meaningful part of their life. One may also be very interested in the functioning of the heater when it gets repaired, but not just treat the heater as a device to meet the heating need. A church may have important meaning for a small community's life. An express way connecting a once mostly isolated mountain village to the outside world could have similar vital meaning.[26]

This already suggests the hope of a way out. But before I go to the prescription I want to say something about philosophy of technology itself. In particular, the history of philosophy of technology can have a better explanation now. In the premodern society common sense instrumentalism was the standard view. However, instrumentalism was not mainly based on the fact that technology was underdeveloped then and appeared to be merely a tool. Contrary to this popular view, it's actually more based on the fact that higher culture was in the center then, so technology could only be an instrument no matter how well it's developed. Compared with the technology of the medieval West, the technology in China during the same period was a lot better. But it was still regarded as a tool.[27] In the modern society technological determinism became the standard view. Again this was not mainly based on the fact that technology got well

[26] The notion of engaging devices proposed by Verbeek points to the same idea. Cf. Verbeek 2002.
[27] Further discussion can be found in Chapt. 9.

developed, but the fact that the cultural center shifted to material and lower cultures. And these are the fields where technology rules. Technological determinism went through the optimistic and pessimistic phases, corresponding to the rising and problematic stages of modernity. In postmodernism people started to deconstruct modernity. With science deconstructed technology was also put back into its cultural context. This is the discovery of the culture-ladenness of technology. In the deconstruction of modernity some peculiarities of the Western culture are also revealed. Feenberg goes as far as warning against an "ethnocentric" view (Feenberg 2000: p. 311). I think this benefits from his study of the Japanese culture. So he has a cross-cultural vision. But even he doesn't see any problem in democracy.[28] Anyways in this globalized world cross-cultural study could help disclose more peculiarities of the Western culture. We may finally reach the next phase where not only modernity, but also the Western civilization is deconstructed. Then we will find out not just why technology dominates in the modern society, but why modernity originated in the West.

7.2.3 A primary prescription for the modern malaise

In deciphering the phenomenon of modern technology I also provide a diagnosis of the modern malaise. The modern malaise is caused by the shift of the central concern from higher culture to material and lower cultures on the basis of dubious individualism. In my opinion individualism is the core of modernity. The greatest achievement of Western modernity is to liberate individuals materially, socially and spiritually. Science, capitalism and democracy have actually helped achieve much personal freedom. But the general paradox is that, while they all showed very promising through their great success in the early phase, they are finally revealed to be incapable of reaching their original goal. Many people could still claim that the goal is actually reached. But that's essentially just redefining the goal. Compared with the original goal the one that's reached is merely dubious. In principle egalitarian universalism is a way of liberating individuals from the hierarchical traditional society, but it goes against genuine individual freedom, which implies self-realization through cultivation, uniqueness and diversity. Yet these institutions are built into the Western modernity. I think this dubious individualism with its paradox constitutes the dialectic of Western modernity.

With this diagnosis a better cure seems to be in sight. First, there is no way we can go back. Nostalgia may still be kept as an inspiration for art creation, but it doesn't help to solve any real problem. People have a general psychological tendency to emphasize the beautiful things in an age far away, but ugly things in the current. If we were put back in the traditional society we would probably have more complaints. Anyways the reality is, the individuals have been liberated and progress has been made. We can't and shouldn't put individuals back into the authoritarian traditional society where superstition, poverty and obedience prevailed. Second, to cure the modern malaise we need to hit the root and the core of the problem. The predominant phenomenon of modern technology for some time hid its cultural context, so that it was caught instead as the culprit, blamed for all the problems. But it gradually turns out that it's just a scapegoat. Even after we've pinned down the root of the problem on dubious individualism, still the core of the problem is not individualism, but dubiousness. The general character of dubiousness is that all the major institutions of Western modernity work toward their glorious goal and can actually make big progress, but just cannot finally reach it.

[28] This is one thing I am curious about. Now science has been deconstructed, and capitalism was criticized by Marx long time ago, but democracy still looks so far so good. Maybe it's because democracy developed later than science and capitalism. Maybe the problems with democracy are still not salient.

This is the place where traditional culture can really come to the rescue, not through nostalgia of particular things in it, but through its general orientation. This general orientation is its central concern with higher culture, with transcendence as its core. So to get out of dubiousness we need to reorient all the institutions in the modern society to higher culture. Anyways all the glorious original goals of modernity lie in higher culture. All of the institutions are still useful and none should be abandoned, but they need to be reformed, through restriction or modification. We essentially need an alternative modernity. In particular, science as an effective view of the material world should be kept, but scientism should be denied. Humanities and fine arts need to be granted much more attention and support. The whole mechanism of market economy is still useful to motivate production and meet needs in the material and lower cultures, but higher culture needs to be promoted in other ways. The mechanism of power balance and the legal system are useful to guarantee smooth running of the modern society, but authority shouldn't be based on abstract popularity through counting people by head. Of course these are just preliminary theoretical guidelines. Theory is one thing, but practice quite another. And for different cultures of mankind this alternative modernity centered on higher culture theoretically should take different forms. Material and lower cultures tend to converge, because they are close to nature and the whole mankind is living on the same planet. It becomes even more so in this globalized economy. In contrast higher culture is where the human spirit soars. With this openness and freedom higher culture tends to diverge. So even in this apparently gradually universalized and normalized world an alternative modernity could still save diversity, which is essential to the survival of mankind.

Generally speaking the main idea of the alternative modernity proposed is to achieve genuine individualism with the institutions developed in Western modernity by shifting the central concern back to higher culture. Thus the alternative modernity is actually a synthesis of modernity and tradition. Individualism and the instruments are taken from modernity. The central concern with higher culture is taken from tradition. But there is something more. Once higher culture is put back at the center, some traditional values can be recovered too. In this way the tradition is also reformed and absorbed into the alternative modernity. When modern technology is regarded as the autonomous, humongous cause of modern malaise, there is always a dilemma. We either keep modern technology and lose precious traditional values, or abandon modern technology and lose modern progress and benefits. Thus there is no way to synthesize modernity and tradition. In the alternative modernity modern technology is put back to its instrumental role. Once acquitted modern technology can be kept without big concern. But on the other hand, its behavior needs to be carefully watched, guided, and if necessary constrained, lest it cause more damage again. Therefore our general stance on modern technology should be to both embrace and control. Up to this point the first part is well supported. In the next chapter more support will be provided for the second.

In the field of philosophy of technology, as far as I know, Borgmann and Feenberg reach the farthest concerning the problem of modernity. Borgmann clearly sees the limit of liberal democratic theory and is well aware that a fair or substantively just principle can at most guarantee a good society in the dubious sense. So he brings up the Aristotelian Principle to complement it. "The more complex the faculties to whose cultivation we are devoted, the more excellent our life." (Borgmann 1984: p. 211) Unlike Heidegger who just has a general nostalgia of the traditional values, Borgmann embodies them in concrete focal things and practices, so that they become much more meaningful for a modern life. And in general his reform strategy of modern technology is in the right direction. That is to let modern technology serve higher values. However due to his substantivist view of modern technology he cannot see the deeper problem behind it. So his reform boils down to purely advocating traditional values. With the real problem kept intact this can't be effective. Besides, he lists ambiguous individualism as a basic character

of modernity and pleads for communal celebration to fix the problem. This leaves people wondering if he still holds that individualism is an essential modern value we should keep.

Feenberg doesn't think that modern technology is autonomous. Under the influence of constructivism he sees the hope to control technology. He points out concrete examples where technological design is effectively influenced by ordinary users. This makes him distinctly aware of the cultural context of modern technology. In criticizing substantivism he writes, "the particular form in which these achievements are realized in the West incorporates values that are not at all universal but belong to a definite culture and economic system. Modern Western technology is uniquely rooted in capitalist enterprise. As such it privileges the narrow goals of production and profit." (Feenberg 2000: p. 310) It's one of his major concerns to reconcile rationality with meaning. And the way he finds to do this in the Western society is to democratize technological design. "Thus reform of this society would involve not merely limiting the reach of technical, but building on its intrinsic democratic potential." (*ibid.*: p. 212) This is the major limitation I find in Feenberg's philosophy. Given some positive examples, can democracy in general guarantee meaningful design? When the whole society is centered on material and lower cultures, technological design is probably oriented to consumers' mundane needs. If as Borgmann points out liberal democratic theory cannot guarantee a good society, then democracy cannot guarantee meaning either. Here we can see the influence of Marxism, which is based on the early phase of capitalism. Democracy was once a way to fight capitalists and technical experts for individual freedom. However, when Western modernity is fully developed democracy is aligned with capitalism. And I think it has gotten into this phase. Now the problem is not that the dominance of technology endangers democracy, but that democracy works together with scientism and capitalism to endanger genuine personal freedom.

Reforming Western modernity within it is certainly not an easy task. Facing the problems people need first to figure out the root cause of them. Because people take many things in their own culture for granted, even making the right diagnosis is a very difficult job. After a diagnosis is made people then need to find a proper cure. And an effective cure cannot be just a theory. In addition actions should be taken. In a retrospective paper Durbin laments the little influence philosophers of technology could actually make on the public and politics, and concludes that environmental ethics is the only effective way to go (Durbin 2000). Of course, to shift the central concern back to higher culture in a materialized world is to climb uphill. The major reason why environmental movement could be successful is that people's material interests are involved. It's no accident that Durbin's lament appears in the same book as Borgmann's relief (Borgmann 2000: p. 341):

> After a period of economic turmoil and political self-doubt in the late seventies and eighties, the economy has defied the supposedly iron law that unemployment and inflation cannot be low simultaneously and that federal deficit reduction must lead to a slowing economic growth. As we enter a new millennium, the United States finds itself the sole and unchallenged superpower and the model of the kind of open and enterprising democracy that is most hospitable to full employment and vigorous economic growth. The more regimented democracy of Japan is stumbling, those of Europe laboring; both were once thought to be more stable and productive than the United States. The United States, moreover, has recaptured and strengthened its leading position in the characteristic social and economic event of the moment—the information revolution.

Maybe an effective reform is only possible after the real problems expose themselves. Anyways the Religious Reformation was possible only in the decadence of medieval Christianity.

8. Controlling Modern Technology

In the last chapter, through the critique of several forms of substantivism we've revealed that the root cause of the modern malaise is not modern technology. The dominance of modern technology in the Modern Age is forged in a particular cultural context. With the central concern shifted from higher culture in the traditional society to material and lower cultures on the basis of egalitarian universalism, technology is put at the center of stage, while it only held a subordinate status traditionally. Therefore the cure of the modern malaise lies in the cultural context, but not modern technology. Modern technology should be whole-heartedly embraced in an alternative modernity, with a different central concern and a different cultural context. This is compatible with cultural instrumentalism, which holds that technology is essentially an instrument of higher culture. When higher culture regains its central status technology could be put to better use again.

Embracing modern technology is just one aspect of the implication of cultural instrumentalism. On the other hand, it also provides the foundation for controlling modern technology. If technology is just an instrument of higher culture, then we should first put it in that role. On the same ground of technological determinism grow out two opposite views. One holds that modern technology causes all the problems in modern society, whereas the other maintains that modern technology could achieve everything and solve all the problems. Although the former is pessimistic and the latter optimistic, they both agree on the dominance of technology. Cultural instrumentalism is a direct denial of this dominance. While it admits technological determination in a certain scope, it insists that some fields in culture are beyond the reach of technology. The first view, dystopian substantivism, is a major obstacle for embracing modern technology. The strategy of removing the obstacle is to reveal the hidden cultural context of the dominance of modern technology. Similarly the second view is a major hurdle for controlling modern technology. If technology could solve all the problems, then why should we control it at all? The attitude of many people toward technology today is still so devout that it may be called "fetishism." Fetishism is a form of natural religion where people worship an object and believe in its magic powers. Technological fetishism appears to be far from magic, but as we will see it has many similarities to magic. So I call the second view "utopian fetishism." The way to jump over this hurdle is show the limit of technology.

In particular we focus on Artificial Intelligence (AI), which represents technology's highest challenge to human dignity. A crane can lift up tons of material and a plane can move faster than sound, but they cannot make humans worry a little. In contrast when the chess master was defeated by a computer program he thought human dignity was hurt. My critique of AI will go along with Dreyfus, but I will try to make some extension and put his critique in a larger context. After the limit of technology is clarified, a further reflection on the relation between rationality and meaning can be done. And that's a major concern in the modernity theory. On the one hand debunking utopian fetishism further supports cultural instrumentalism, because it demonstrates the scope of technology a third time. On the other hand it in a certain sense justifies technology control. Controlling technology is possible only after it's pulled down from the altar.

In the second half of this chapter concrete technology control is discussed. Modern technology is so powerful that its impact on nature exceeds her digesting ability. But the belief that it can solve all its problems is more and more proved to be a myth. In traditional society nature could easily recover from human impact, but it's not the case any longer. In this new situation the relationship between human and nature needs to be reconsidered. With the new power come new responsibilities. This is the starting point of environmental ethics. In this context technology

needs to be controlled in accordance with a new view of human-nature, interpersonal, intergenerational and international relations. With the advent of technology assessment a single environmental concern has developed into a comprehensive evaluation. In technology assessment a particular technology is evaluated in terms of its different aspects of potential impacts, both natural and social. And because technology assessment is closely related to technology policies, it's a direct control of technology. In discussing concrete technology control special attention is still paid to modernity issues. How to embed high values in technology control is a major concern here.

8.1 Out of Utopian Fetishism

The utopian fetishism of technology is an extension of technological determinism. Technological determinism is a result of the success of the Industrial Revolution, which was thought to have brought great progress and changed the human life for the better. Even after problems appeared and people started to criticize technology, the worship of modern technology didn't stop. The reason for this is that, given the problems and criticisms technology keeps advancing and improving human life. In the two World Wars modern technology was used to cause much destruction, which once made many people pessimistic. But in the post-war era technology has made unprecedented progress, with genetic engineering and computer engineering as the two leading technologies. Only these two have brought enough benefit to fan utopian fetishism. For the worshippers technology is the key to solve all the problems, including those caused by itself. So facing the convincingly irreversible resource and environmental problems today they either try to prove that these (such as global warming) are normal natural processes, or just claim that new technologies can solve them all (such as resource depletion). Anyways it's just not easy for them to get out of the illusory utopia of technology.

Technology fetishism is seemingly the basis of Postman's so-called "technopoly." He classifies cultures into three types: tool-using cultures, technocracies and technopolies (Postman 1992: chapts. 2 & 3). In a tool-using culture technologies are used as tools to serve certain functions. This corresponds to a traditional culture. "In a technocracy, tools play a central role in the thought-world of the culture. Everything must give way, in some degree, to their development." (*ibid.*: p. 28) This corresponds to a modernized culture. And finally in a technopoly technology eliminates the thought-world by redefining the meaning of all its components, including religion, art, family, politics, etc. according to its own principles. So technopoly is "totalitarian technocracy." According to Postman American culture is the only technopoly. Correspondingly technology fetishism is most popular in America. Any major technological advancement would initiate some kind of all problems will be solved in the near future claim.

To debunk technology fetishism we need to demonstrate the limit of technology. And it cannot be better done than to target the AI fundamentalists, because they are the typical representatives of those who try to cross the boundary. By criticizing the AI fundamentalists the scope of technology can be clearly shown. Dreyfus pioneered this critique, but we could expand it and disclose its deeper implication for the modernity theory. In expanding his critique I try to sketch a general critique of the modern scientific worldview, which is the foundation of technology fetishism. This also puts his critique in a much bigger context. And this context has much significance for the modernity theory. So in this section I first clarify the foundation of technology fetishism with a focus on the AI fundamentalist view, then discuss the limit of technology in the spirit of Dreyfus, and finally make some reflections on the relation between rationality and meaning.

8.1.1 The AI fundamentalists and their allies

Technology fetishism is closely related to scientism, so first we take a general look at the foundation of scientism. The belief that scientific method is the only path to truth has much convincing support in the natural world. Since its birth modern science has been building a unified picture of an ever growing realm. Starting with physics, Kepler set up a theory of the motion of celestial bodies, while Galileo found the laws of motion of bodies on the Earth. Newton achieved the first unification. With his law of universal gravitation and three laws of motion he revealed that the motion of celestial bodies and bodies on the Earth follow the same laws. The second unification was achieved in Maxwell's equations, which disclosed that electricity, magnetism and light all are the same phenomenon. The theory of relativity was developed out of combining the Newtonian mechanics and the travel of light, but the unification of gravitation and electro-magnetism was Einstein's unrealized life dream. At the same time physics dived down deep into the subatomic world. First it reached electrons, protons and neutrons, and then the nucleus was further split into quarks. Later more elementary particles were found. According to the Standard Model there are three types of elementary particles: 6 quarks, 6 leptons (electron, muon, tau and the corresponding neutrinos) and 4 force carrier bosons. Quarks and leptons are matter and generally called fermions. In the subatomic world two more forces were found besides the gravitational and electromagnetic forces. They are weak and strong forces. These two forces were not known in Einstein's later years. Although the Standard Model contains the electromagnetic, weak and strong forces, it's still far from Einstein's dream because the somewhat recalcitrant gravitational force is not included. That dream keeps motivating physicists toward the next step: the Grand Unification Theory (GUT). In a GUT all the known particles and forces will be unified. There will be only one type of "particles", representing both matter and force. For the moment the string theory is the best candidate.

This is definitely a very exciting story. And there is no logical reason to doubt that a GUT will finally be achieved, although it still requires great amount of effort. However things go astray when excitement turns into arrogance. Before a GUT is established people already claim that a GUT is "a theory of everything," *without any qualification*. So even all of people's daydreams can be interpreted by the GUT. This "end of physics" tone is reminiscent of Thompson's claim at the end of the 19th century, in the eve of the last great scientific revolution in physics. But this time it might be really the end of physics, considering the cost of equipments which the advancement of physics depends on. It could turn out that it's not feasible or doesn't make much sense to go deeper into the micro world. Anyways the claim of a theory of everything has a very wild assumption, that is, everything can be reduced to strings. Without this reductive assumption, a GUT is not that thrilling.

To prove the truth of the reductive assumption we need to climb a ladder with four far separated rungs. The first rung is chemistry. On the basis of the theory of elements it has to do almost all with electrons of atoms. The chemical combinations and reactions seem to be easy to reduce. The structure and behavior of simple molecules can be directly interpreted with physics. But when it comes to large molecules things become complicated. The next is life. The discovery of DNA makes the reduction more promising. Since DNA determines all the biological traits, it appears that life can be reduced to DNA and DNA is a chemical molecule. But biochemistry deals with complex large molecules such as DNA, RNA and proteins. To what extent can we interpret their behavior with physical laws? Even when a clear correspondence between a particular sequence of DNA and a certain trait exists, it's still not sufficient for a reduction claim. In addition the correspondence has to be interpretable with physical laws. This is far from straightforward. And for complex trait such as a certain instinct, the correspondence is even not clear. The third rung is farther separated. Neurology has figured out much of the mechanisms of the senses, especially

vision, and pinned down the cerebral locations responsible for some psychological functions. On the basis of these achievements some people already try to reduce mind to neuron's firing. Like DNA neurons are the middle link in the reduction chain. By itself a neuron is not much more complex than a normal cell, but the complexity comes from the interactions among neurons. Even for vision much is still hidden in mystery. And finally we need to climb from individuals to society. Here the reduction seems to be more hopeless and has little to do with physics.

All in all modern science is astonishingly successful in the micro- and cosmo-world, but unfortunately the most interesting things lie in the macro-world. The claim that all the wonderful world of art and profound thoughts in philosophy are essentially just motion of strings is not very convincing. And the straightforward denial of "folk psychology" is basically playing ostrich. The geocentric "illusion" needs to be explained by the heliocentric theory. Similarly the "folk psychology" needs to be explained, in order to support the "theory of everything" claim. We've seen this kind of explanation has little hope. This hopelessness makes us reflect on the reductive assumption itself. The reductionism here involved is materialism, which holds that a thing is all about its matter. This apparently is just a modern belief. Traditional people, no matter in the East or the West, didn't think this way. If we trace it further we may find its origin in machine building during the early phase of Western modernity. Take the mechanical clock, which is the first prominent machine in Western modernity, for example. With all its gears, spring and swing a clock can tell the time. It might be a mystery for an ordinary user. But for the clockmaker a clock is no more than all its parts. When the functions of all the parts are clear, that of telling the time becomes obvious. This mechanical view had dominated modern science since then and in turn shaped modern thinking. Today when we talk about how things work we use the word "mechanism." The basic mechanical assumption is that a thing is the sum of its parts. On the ground of mechanicalism analytical method becomes a fundamental method of modern science. When something is studied the first thing to do is break it into parts. The mechanical view is so influential that even Newton himself didn't feel comfortable with gravitation, because it's a remote interaction. The mechanical view dominated for a couple of centuries, not without challengers. The debate between Newton and Huygens concerning the essence of light was famous. Later field theory was incorporated into the scientific view, but the reductive assumption and analytic method were kept.

The analytic method is pivotal to the success of modern science, because it helps to isolate the problem and make it easier to solve. With the concentrated pursuit of matter and force, a unified theory seems to be in sight, in which they are revealed to be the same dimension. However this leaves out another fundamental dimension of the world, that is, organization. Chimpanzees and humans have different intelligence levels not because their brains are made of different matter, but because the matter in their brains is organized differently. In other words the organization, not the matter makes the difference. In fact in a mechanical clock there is definitely the organizational dimension, but it's just ignored. Take apart the clock and lay down all its parts on the table we get something quite different. The organization of the clock cannot be reduced to its parts, even with their mechanics. An *ad hoc* mechanical description of this organization is possible, but this cannot be counted as a reduction. For another model we will have another *ad hoc* description. The two organizations belong to the same kind based on the function of time telling, but the two descriptions don't in terms of mechanics.

Matter is measured with mass and force with energy. Similarly organization may be measured with complexity. The ladder we just mentioned, including physics, chemistry, life, mind and society, is actually a ladder of complexity. Each rung has higher complexity than the one below it. It's no accident that the unity of matter and force should be found in the field with the lowest complexity. When we bring in the dimension of organization the GUT in physics is not a theory

of everything, but instead a theory far from almost everything. Materialism is like the claim that planetary geometry is a sufficient theory for all the solids. While it may be proved very successful in studying the simplest solids such as spheres and cubes through their intersections, when we move to more complex solids planetary geometry is at a loss. A whole dimension is left out. In fact we need not go to the fields of economics and history to find out the existence of organization. The chaos study in non-linear dynamics has discovered the so-called "deterministic but unpredictable" system. This seemingly paradoxical phenomenon is only paradoxical in the one-dimensional materialist worldview. In a worldview which takes organization as a fundamental dimension, determinism may turn out to be just a degenerated phenomenon at close to zero complexity. On the basis of the Newtonian mechanics Laplace once claimed that a demon could predict the world in the future in all the details. No doubt, even human beings could precisely predict an eclipse years ahead. But up to now it's impossible to predict the weather 5 days ahead. The difference here is still organization and complexity.

Although materialism is the dominant view of modern science, it cannot be carried out in all the fields due to complexity. It has little problem in physics. When the theory of elements is established in chemistry, the experience of material properties gained from previous experiments can be nicely grouped. But it's not the case in biology. Several decades since the discovery of DNA a grand theory of DNA has been dreamed, but the possibility to interpret the lives of all the species with DNA is basically close to zero. The situation is worse in psychology, economics and sociology, let alone politics and history. Where the materialist approach falls short the phenomenal approach is still adopted. Instead of going a level deeper and trying to find the foundation of the phenomena, the phenomenal approach focuses on the phenomena themselves and tries to figure out the regularities in them. In biology we have the evolution theory, in psychology we have the memory curve, and in economics we have the law of supply and demand. Compared with the model laws in physics these can at best be called quasi-scientific laws. The truth is that, this secondary science status doesn't reflect the underdevelopment of these disciplines, but the higher complexity of their objects. A theory of everything is just an illusion in a degenerated worldview. A complete view requires a fundamental paradigm shift. The paradigm shift will lay materialism to rest.

A thorough and well founded critique of modern science sketched above deserves separate books. The sketch provides a context here for us to talk about modern technology. In traditional societies technology had a direct dependence upon nature. Most of the materials were taken from nature directly. Metal was taken from nature with a more complicated process. Perhaps gunpowder represented the most sophisticated synthesis. Machines were built, but all driven by natural power sources: wind, water, animals and human beings. Plants and animals were cultivated. Children were educated. But there natural growth was slightly altered. In the Modern Age technology has become more and more bundled with science. Bacon says knowledge is power. With all the new knowledge obtained in modern science, humans are set to turn it into power through new technologies. First a power engine was built, which made a series of automatic machines possible. Then a new form of energy was tamed, which made power universally available. While humans kept building more and more sophisticated machines, they were not satisfied with only creating new things on the physical level. Thus all kinds of new chemicals were synthesized. Plants were still cultivated, but with the new fertilizer their growth could be greatly improved. Children were still educated, but the behaviorist Watson ambitiously claimed that given a bunch of infants he would educate them to become whatever an adult he wanted. Finally we reach the latest development. The success of genetic engineering has prompted ambitions as amazing as synthesizing a pet according to a customer's wish. But this is still not the most extravagant claim. That claim is to create the greatest marvel of the known universe—intelligence, surprisingly with a machine essentially belonging to the physical level.

We've finally arrived at our main target. But the path leading to it is not trodden in vain. What we've discussed so far clearly demonstrates the motivation behind the AI fundamentalists' endeavor and at the same time suggests the unfoundedness of their claim. We can see, as modern technology moves up the ladder of complexity solid technologies are mixed more and more with wild fantasies. Before we get into the details of AI we need to make a clear distinction. Searle distinguishes strong AI from weak AI. Weak AI only claims that machines can work intelligently, in some respect similar to, or even exceeding human beings, whereas strong AI claims that machines can also have mind and be as generally intelligent as people. In a metaphorical sense even a thermometer may be said to have certain intelligence, because it tells the temperature of the room. A computer can certainly do calculations much faster than a person. It may be undeniably regarded as an intelligent machine in this weak sense. In contrast, the AI fundamentalists defend strong AI. Extrapolating from some seemingly encouraging restricted successes the AI fundamentalists claim that creating a human or even superhuman robot is within their technological reach.

Now we move on to the story of AI. Shortly after computers were invented the multi-decade history of AI began. Computers originally were only used to do calculations, but they were soon found to be able to do more than that. Besides calculation they could also do information processing, such as manipulating symbols, sorting etc. Then they were assigned some stunning tasks. The whole history of AI can be divided into two stages: the representational stage and the naturalist stage. Dreyfus divides the first stage in turn into four phases. The first phase was cognitive simulation including language translation, problem solving and pattern recognition, led by Newell and Simon. Typical problem solvers were the logic theorem prover and the game player. And the so-called General Problem Solver could solve some more complicated problems. These successes let them claim that within a couple of decades computers would obtain human intelligence. But these projects soon ran into insurmountable obstacles. The second phase was semantic information processing championed by Minsky. Whereas semantics played no role in the first phase, the second phase is focused on understanding, especially natural language understanding. Again some preliminary successes were followed by unexpected hurdles. The third phase was manipulating micro-worlds. Basically this phase involves domain specific systems, including language understanding, scene analysis, concept learning and robot building. Since these systems were built within a narrowly defined domain, they couldn't be generalized. So they didn't provide much support for the strong AI claim. The fourth phase was facing the problem of knowledge representation. In this phase the focus again was put on generalization. Apparently in everyday life human beings can cope with all kinds of situations, instead of a narrowly defined one. In order to reach the level of human intelligence, a program needs to be generalizable. Then comes the problem of how to represent all the knowledge from everyday life. No matter how many facts are included in the system there are always some things missing, while many of them are just commonsense for human beings. This is the famous commonsense knowledge problem.

Although AI is generally based on the materialist worldview, the representational approach is not materialistic. Instead it's phenomenal. The programs involved in the first stage all simulated the problem solving strategies and understanding as they might appear to the AI researchers. They believed that all the problems could be represented as facts and rules. This didn't have to be true. In fact the difficulties they encountered just indicated that this belief was problematic. Due to the difficulties the representational approach became unattractive in the 80's. At the same time alternative approaches were adopted. Dreyfus discusses three. They are interactive AI, neural network and reinforcement learning. Evidences suggest that these new approaches to some extent were influenced by Dreyfus's critique of AI, especially the interactive AI. I group all these under

the title of naturalist approach. They are naturalistic because they are based on the human body, which is the bearer of human intelligence, but not on the phenomenon of intelligence. Dreyfus's critique just emphasizes the essential role the human body plays in human intelligence. The interactive AI researchers explicitly admitted the influence of Dreyfus. And the connection between Dreyfus's critique and the reinforcement learning is obvious. Besides, we need to distinguish the naturalist approach from the materialist approach. A naturalist approach doesn't have to be materialistic, although it's true the other way around. Of the three naturalist approaches mentioned above, the neural network is materialistic, but the other two are not. Neurons are undeniably the matter of intelligence. The belief that intelligence can be reduced to the physico-chemistry of neurons is definitely materialistic. But the interaction with the environment in interactive AI and the reward-drivenness in reinforcement learning are not directly based on the sheer matter of intelligence. Higher level functions are involved.

Let's look at each of the three approaches in more details. In the representational approaches researchers try hard to build an inner representation of the world. In contrast the interactive AI researchers hold that the environment itself is the best representation of the world. So their programs directly interact with the environment. Although this is a very attractive theory, practically no significant success has been made. Comparatively the neural network is a huge success. It's especially successful in pattern recognition, where the representational approach is at a loss, because a representation is very difficult to build in this case. For instance, a neural network may be able to recognize the sex based on the image of a human face. A normal neural network consists of several layers of nodes. The nodes are the simulation of neurons, which have inputs and outputs. The nodes on the ground layer take inputs from the environment. In this case it could be the RGB values of the selected pixels in the image. Nodes on one layer above take inputs from all nodes below. The relations among the inputs and outputs of a node are specified by certain functions with weights for different inputs. In this way a network is built, with the top nodes signaling the final outputs. In this case we have a single top node for the sex output (male or female). Before the network can be used it needs to be trained with a sample set. All the weights in the functions are set to initial values. The deviation of the actual output from the target output is used to adjust the weights according to a backpropagation algorithm. The samples may be reused. The goal of training is that the neural network generates the target output consistently for all the samples. As the weights are adjusted in the training process we may say that the neural network learns. But this learning is supervised because the target output of each sample is given by the researcher. The supervision is not needed in a reinforcement learning, in which the agent explores the environment by itself guided by certain reward. The reward is a function of the action taken in a particular state and may be updated on the way of learning. The problem space contains an initial state and a target state, whereas an action is a transition of state. The goal is to gain the maximum total reward on the way from the initial state to the target state. In each state the agent takes the step with the maximum reward. Since the initial reward functions are probably not optimal, the first successful path cannot be optimal either. But it provides important information for updating the reward functions. So generally reinforcement learning looks like a trial-and-error learning. In a simple problem with good learning strategy the agent may reach the optimal path after several rounds of trial. The problem with neural network and reinforcement learning is still low generalizability. Although there is no inner representation of the world involved in the program, the researcher still need to represent a real problem in the form of a neural network or a reinforcement learning problem. It has to be artificial anyways.

When I went to study AI at the end of last century neural network and reinforcement learning still represented the state of the art. After all the difficulties encountered in half a century AI researchers were not that arrogant and became more practical. They were more focused on solving well-defined particular problems than realizing ambitious dreams, although the

fundamentalist elements were still discernable every once in a while. Some still confidently believed that the world just consisted of physical objects with properties and so could be modeled in a program. Of course tic-tac-toe was still the most favorite toy.[29]

8.1.2 The limit of technology (Dreyfus)

Dreyfus is a staunch critic of the AI fundamentalists. This apparently has annoyed many people. He is called "the black knight of AI." However, as a reviewer writes, "*What Computers Can't Do* was widely attacked but quietly studied." Dreyfus's critique of the Strong AI is meticulous. It doesn't make much sense to get into many details again. What I want to do here is first recapitulate the basic spirit of his critique and then draw its implications for modern science and technology in general.

Dreyfus is under the heavy influence of Heidegger. In order to put his critique in context let's make a brief review of the history of modern Western philosophy. Descartes is dubbed "the father of modern philosophy." He made the so-called epistemological turn, after which the focus of philosophy was shifted to the question of how an individual could gain knowledge about the world. Two opposing camps were soon formed. The rationalists represented by Descartes, Leibniz and Spinoza held that knowledge could be generated from the subjective mind alone. On the contrary, the empiricists represented by Locke, Berkeley and Hume claimed that human knowledge had to come from the outside world through our sensation. The mind by itself is just a "*tabula rasa*," as Locke stated. But Hume quickly figured out that some fundamental knowledge couldn't be constructed from our original images. One of them is the concept of causality. Kant made a brilliant synthesis and implemented a "Copernican Revolution." Human knowledge was based on the outside world before, but after the revolution the world was based on the faculty of the mind. According to Kant space and time as transcendental forms make our sensations possible and basic categories and principles make a meaningful world out of the sensations. So Hume was right. There's no way for us to obtain the concept of causality from the sensations, but that doesn't mean we cannot have a causal world. In fact human mind organizes the sensations according to the basic category of causality, so we can only have a causal world. But this can only be a phenomenal world. Unfortunately there is no way for us to go beyond. When we wonder what lie outside (Dinge an sich) we are still in the phenomenal world, because the word "lie" presupposes space and space only makes sense in the phenomenal world. So for Kant reason is the faculty of the mind. It's *a priori*, but cannot generate knowledge by itself. Yet it makes both the world and knowledge possible. The conditions for both knowledge and its object are the same.

Although Kant elegantly synthesized rationalism and empiricism and laid the foundation for further developments, philosophers later were not completely satisfied with his transcendental idealism. One complaint was its subjectivism. Kant regarded space, time and logic as the faculty of the subjective mind. Hegel's philosophy was developed against subjectivism. His logic belonged to the Weltgeist. Another important complaint was the idea of transcendence. For Kant space, time and logical categories and principles were all *a priori*, that is, they were taken merely as given. Husserl's phenomenology tried hard to analyze consciousness and construct the world. Time consciousness was a critical part. This prepared for Heidegger's *Sein und Zeit*. While Husserl still started from the subjective mind and tried to reach the world through intentionality, Heidegger began with the human existence (Dasein) instead. Through the analysis of everyday

[29] I was involved in a project to figure out all the objects in the environment based on the real-time images collected by a moving robot. It was a failure. I came with enthusiasm and left with a better understanding of AI. This made me more susceptible to Dreyfus's teachings.

human existence Heidegger revealed that it's a Being-in-the-world (In-der-Welt-sein) based on a web of references and the basic mood of care (Sorge) embraced the totality of this existence. Further this care also had temporality (Zeitlichkeit). Compared with Husserl, Heidegger no longer needed to cross the gap between the subject and the world. The subject already carried a world with it. Compared with Kant, although the human existence was still a given, space and time had a further basis. For Kant, space and time as transcendental forms were just *a priori* supposition. In contrast Heidegger gave them an explanation in the human existence. And finally compared with Descartes, the original "*Cogito ergo sum*" had turned into "I so exist, therefore I so think."

Dreyfus's philosophy is easier to understand on this background. One of his major claims is that human intelligence is based on a cultural context, whereas artificial intelligence is context-free. Take one of the most mundane concepts "chair" for instance. What matters is neither its physico-chemistry, nor its geometry, but its relations in a cultural context. A chair doesn't make any sense in the Australian bush or even in traditional Japanese culture, where everybody sat directly on the floor. Dreyfus calls this context a situation. The situation is crucial because relevance and significance are based on it. As he writes, "Human experience is only intelligible when organized in terms of a situation in which relevance and significance are already given." (Dreyfus 1992: p. 288) We can see the clear influence of Heidegger. AI starts with context-free facts and tries to construct knowledge by applying logical rules. It quickly gets into a dilemma. To make the system more knowledgeable it has to include more facts, but the more facts it includes the more difficult it is to apply the rules. All the problem lies in relevance and significance. The core of human intelligence resides in the ability to ignore most of the facts, in other words, only pay attention to the manageable relevant facts in a particular situation.

In recognizing the situation of human intelligence Dreyfus still stays in Heidegger's philosophy. But he does more by emphasizing the role human body plays in intelligence. Human body here doesn't just include the brain, as the materialists hold, but also the sensory-motor skills and even needs and desires. Thus Dreyfus criticizes the dubious dichotomy between intelligence and rationality on the one side and skills, emotions and appetites on the other in Western thought. He generally argues, "*since intelligence must be situated it cannot be separated from the rest of human life.*" (Dreyfus 1992: p. 62) Know-what may take an important part of human knowledge, but it substantially consists of know-how. So the critical limitation of AI is the lack of something like a human body. In my opinion, by recognizing the importance of human body Dreyfus pushes the line of thought sketched above a step further from Heidegger. In Heidegger's philosophy the human existence is analyzed, but still treated as a given. However human body as it behaves in a cultural context provides an explanation of this particular human existence. With this we step on a kind of naturalist path. But this naturalism is something quite different from Quine's naturalized epistemology, which essentially bases human knowledge on the *scientific* knowledge concerning human *cognitive* behavior. (Quine 1969, 3)

Before I draw more implications from Dreyfus's philosophy, let's next look at his diagnosis of the AI fundamentalists' thought. He lists four key false assumptions of the strong AI programs: a biological assumption, a psychological assumption, an epistemological assumption and an ontological assumption. The biological assumption is that the brain also processes information in a digital way as a computer does. This only applies to the representational approaches where cognitive simulation is on the phenomenal (logical) level. It's not necessary in a neural network where the connections among nodes are not digital and the nodes directly simulate the neurons. The psychological assumption holds that the mind works like a device operating on bits of information according to formal rules. Cognitive psychology has shown that the information processing model works well in sensations, especially vision. But it cannot be successfully applied to higher level psychological faculties. Philosophically this is still based on Descartes's

mechanistic view of the human body. The epistemological assumption is that all knowledge can be formalized in terms of formal logic. This apparently derives from the basic scientific method. It generalizes successful method of physics to all human knowledge. Finally the ontological assumption states that the world, or what there is, in principle can be analyzed into situation-free, independent facts. This basically is the scientific worldview as represented in Russell and earlier Wittgenstein's logical atomism, where the world is viewed as basic empirical facts connected with logical rules. In *Der logische Aufbau der Welt* Carnap even aspires to build the whole world in this way, but evidently he cannot complete a tiny portion of his project.

We can see all of Dreyfus's diagnosis points to the scientific worldview. It's almost like, after centuries of great successes modern science and technology finally try to arrogantly challenge the greatest marvel of the known universe, only to explicitly expose their own limitations. As Dreyfus writes, "the recent difficulties in artificial intelligence, rather than reflecting technological limitations, may reveal the limitations of technology." (Dreyfus 1992: p. 227) Since modern technology is essentially based on modern science, the limitations of technology in fact discloses the limitations of modern scientific worldview. It's time to do deeper reflections on this worldview. It's mechanistic, analytic and materialistic. It works astonishingly well in physics, but frustratingly badly in human mind and society.

To pick up the line of modern thought again, when we reach the human body our knowledge of our knowledge has gone through several milestones: from Descartes's abstract *cogito*, through Kant's transcendental forms, categories and principles, through Heidegger's Dasein and finally to Dreyfus's human body. A natural reaction is to wonder what's next. Certainly human body is not an original existence in the known universe. As materialists often argue, once upon the time there were only elementary particles, how come we now get human mind? The conclusion they draw from this fact is that the mind has to be reducible to elementary particles. Hence there is the claim of a theory of everything. So to explain human mind including knowledge materialists don't need the whole human body, let alone the cultural context. All they need to do is take the human brain and try to break it into neurons, chemicals, electrons and hopefully up to elementary particles. They believe they could reach a clear understanding of human mind at the end of this path. Although there is no lack of successes at peripheries, as they go deeper into the labyrinth of the mind they quickly get confused. All they see is neurons firing here and there, but they cannot make sense of them. Many evidences show that this is a dead end. If materialists cannot provide us an explanation of the mind with physics of elementary particles, then there are still some missing links. We have to believe physics about the origin of the universe. If the universe started with elementary particles, we still wonder how human mind comes from there.

In fact we already have a story, a much more natural one. We just need to tell it from a different perspective. Here is how it goes. Once upon the time, right after the Big Bang, there were only elementary particles contained in nebula. The nebula contracted into stars, one of which is our lovely Sun. Now there were also simple atoms (hydrogen and helium) formed from the particles. Due to rotation the Sun threw out many portions of different sizes, of which several were significant. The one called "Earth" was definitely the most significant. As it cooled down heavier atoms were formed. The most important thing was that from a certain time on it's covered with water and wrapped with atmosphere. Up to this point we may already call it a miracle. But greater miracles were still to come. Next the main stage was between water and air, where complex organic molecules came into being. This prepared for the entrance of the primitive life. Life then went through evolution to generate high level species. Finally one branch of primates had the chance to obtain consciousness and cognitive faculties. Tool using and social interaction apparently played important roles in this last stage.

This may look like just a normal natural history. However we can look at it in a different angle. This is a history of how matter organizes itself one level after another. In the course of history the complexity gets higher and the possibility of forms gets greater. The elementary particles have the lowest complexity and the least possibility of forms. Atoms have a more complex structure. Stable atoms are about 100 and molecules are much more. Life is even more complex and species are much more diverse than molecules. Finally human mind and society are the most complex and have an open end of possibility. The most important thing is that we should take organization as an independent dimension of the world which cannot be reduced to matter. An atom may still be looked as a machine with elementary particles as its components. But life cannot be treated as a machine consisting of chemicals. When chemicals are organized into life, it gains higher level properties than chemistry. When chemicals are organized into a human body, it demonstrates even higher level properties. Generally this is an anti-reductionist, anti-materialist view. Materialism holds matter (measured with mass and energy) is the only dimension of the world and everything in the world can be reduced to its matter. On the contrary, this organizationalist view maintains that organization (measured with complexity) is another dimension besides matter and an organized whole is greater than the sum of its material parts. The view also allows materialism as a degenerated form at low complexity. This is definitely naturalism, but no materialism, although it incorporates materialism as a special form.

With these naturalist links closed we seem to have a whole picture of the world. In Descartes knowledge is a given, in Kant space, time, categories and principles are given, in Heidegger the human existence is a given, in Dreyfus the human body is a given, and now we have a theory about how the human body comes from elementary particles since the beginning of the universe. Having pushed the frontier one milestone after another, it appears we now have everything lying on a solid ground, directly or indirectly. But unfortunately there is no solid ground. By stepping on the naturalist path we actually go back to the starting point. Again we take knowledge as a given, our knowledge about natural history. Yes, we have a circle here. We end up explaining our knowledge with our knowledge. But this circle is probably our ultimate given, a given we can never go beyond. It's our human predicament. Over two hundred years ago Kant already revealed this predicament. Today we've just made the circle richer. Einstein criticizes Kant's concepts of space and time and insists that space and time are properties of the outside world. But don't forget the outside world as depicted in modern physics is constructed by human mind. The outside world is outside our skin, but cannot be outside our mind. It can only be *our* world. By treating our world as *the* world one misses the gist of Kant's fundamental Copernican revolution. In the real Copernican revolution we can go beyond the geocentric worldview. However in Kant's revolution we can only recognize the boundary, but never go beyond. Whereas a conceptual restriction is involved in the former, a logical restriction is involved in the latter. To go beyond our phenomenal world is a logical impossibility.

Hegel made the first systematic attempt. From the view of his philosophical system the natural history is a process in which the Weltgeist realizes itself and finally reaches self-consciousness. Although his dialectics contains many deeper insights, his Weltgeist is just a projection of the Menschengeist. Let's review the natural history from a different perspective. Another fact is that the higher the complexity the less the probability is. Of trillions of stars in the universe the Sun is chosen. Of the Sun's eight planets the Earth is chosen. There are about a hundred elements on the Earth, but carbon is chosen. Carbon is preferred to silicon although they are closely related in the periodic table. Of millions of orders the primate is chosen. Finally, of thousands of species in primate homo sapiens is chosen. Any of the above choices could turn out to be otherwise. What happened on the Planet of Apes cannot be excluded logically. Looking at this teeny-weeny chance of success we could celebrate our prestigious status. Yes, we're *THE* chosen! But chosen by whom? The Weltgeist? All the possible alternative branches in the natural history leading to

human mind on the other hand suggest that this destination may be just an accident. Until we someday really get into contact with an extraterrestrial intelligence from a planet far away, this is a valid assumption. If a bat can live well with a different kind of sense, then how can we claim that the world as we think it is is *the* world? This looks to be a very saddening picture, but not as chilling as the materialist worldview, which depicts human life as essentially just the motion of strings. With this modern science has shown double arrogance: it first claims that our world is *the* world and then claims that our world is just a materialistic world. In a richer worldview we don't have to feel sad. Given our predicament, Mother Nature has granted us a complexity with unbounded possibilities. Watching a child grow from conception to about 4 years old and finding out that she suddenly can have a smooth conversation with an adult, we can only wonder. What else can we still demand from Mother Nature! All we need to do is to cherish this precious gift and develop it to its fullest potential.

Now we are ready to make some deeper reflections on AI and modern technology. Dreyfus points out that the limitation of AI lies in the lack of a body and a situation. He even imagines that we could build a simple program with a body like in a robot and let many robots interact with each other like humans in a society. This is an interesting imagination. But based on our discussion above even this cannot achieve genuine intelligence. Human body is not just any body. When we hold a new-born child, it's not just a body that has developed in the mother's womb for ten months, but also one that has developed in Mother Nature's womb for millions of years. That body carries its whole natural history. If as Dreyfus shows that sensory-motor skills, emotions and desires are all necessary for intelligence, then how can we create a silicon based robot body that have all these properties? Even if we could create such a body, then we still need to educate it to reach adult intelligence. Practically we would ask why bother? The use of strong AI is first to obtain an intelligent agent from a production line maybe in hours and second to have the intelligence but without the moral burden. If both become senseless now, then why not just go ahead and bear another child? And finally let's spell out the word "Artificial Intelligence." What does "Artificial" mean? It means AI is created by human intelligence. In order to create intelligence we need to know how intelligence works. But intelligence is based on an organization with so high complexity that materialist approach doesn't work well. On the other hand on the phenomenal level in many cases, especially in the highest forms of intelligence such as creativity, we can only perform but cannot tell why. The mystery of intelligence might be a Ding an sich.

The failure of AI to achieve genuine human intelligence discloses the basic limitation of modern technology. It's based on the one-dimensional materialist worldview. So it cannot handle phenomenon with organization of high complexity, such as human mind. But the meaning of human life is built on human mind. Next I draw further implications for the modernity theory.

8.1.3 Rationality and meaning

The relation between rationality and meaning is a major concern in the theory of modernity. While rationality dominates in the Modern Age, many critics find that some meaning of life which was cherished in the traditional society has been lost. On the one hand we don't want to abandon rationality with all the progress it has made, but on the other hand we urgently need to regain the lost meaning of life. Thus looking for reconciliation between them becomes a central endeavor in the theory of modernity. The discussion of the limit of technology helps to shed some light on this issue.

First we need to clarify the concept of rationality because it's so ambiguous. When human mind engages with the world it makes sense of it based on the stimulus it receives. In the most general

sense this ability of making sense is rationality. Kant's notion of reason seems to be closest to this general sense. Generally speaking Kant's reason is just the faculty of human mind to make sense of the world. Before him the rationalists thought that rationality is the ability to generate knowledge by its own, whereas the empiricists held that rationality is direct manipulation of the sensations, analysis, combination, comparison, grouping, etc. The scientific rationality as represented in logical empiricism and related philosophy later is influenced by empiricism and Kant's philosophy, but it's neither. Different from empiricism the scientific reason doesn't just perform direct manipulation on the empirical facts, but uses mathematics and formal logic to create grand theories about the world. Although the theories have to match the empirical facts at their boundaries, they are much more than just buildings made out of empirical facts. The scientific rationality takes the analytic-synthetic distinction from Kant and simply turns it into the logical-empirical dichotomy, but logic and facts are inseparable in Kant. Without logic facts even are impossible. This logic-facts dichotomy seems to still come from the materialist worldview, as logical atomism suggests. Quine criticizes the two dogmas of empiricism, but even his holism doesn't get out of this dichotomy.[30] And finally we have technological rationality. Since technology is utility oriented, cost-effectiveness and efficiency become the core of technological rationality. But technological rationality is apparently based on scientific rationality. Habermas calls scientific-technological rationality instrumental rationality.[31] This is the rationality we are concerned with in the theory of modernity, because it dominates in the Modern Age.

Our discussion of the limit of technology has shown that instrumental rationality is based on the one-dimensional materialist worldview. Materialism doesn't just dominate the content of modern science, but even shapes its method. The distinction between mathematics-logic and empirical facts and that between theory and experiment are both derived from the materialist worldview. In this worldview everything is built with matter bundled with forces. So we also have facts as matter and logic as the bundling force. While the theory deals with mathematics and logic, the experiment handles the empirical facts. The matter needs to be traced to elementary particles and similarly the facts need to be the most basic universal facts. Materialism also redefines what truth is. In the materialist worldview truth can only be about matter and forces. Anything else is either false or just nonsense. In this way of course the scientific method is the only path to truth. Again materialism redefines what utility is. Utility has foremost to do with mass and energy, and also efficiency. So the utility defined in this way becomes the dominant goal of modern technology. The shadow of materialism doesn't stop here. Its influence apparently has penetrated into human society too. Under this influence human society is even regarded as a machine, with individuals as matter and laws as the binding force. So in economy with every individual pursuing their own interests the magic invisible hand would automatically creates a wealthy society. And in politics with every individual acting according to their own will the laws, which essentially just help to maintain order and resolve conflicts, would automatically guarantee a free society. Here we see the connections among scientism, capitalism and democracy from a different perspective. With the materialist worldview dominating the Modern Age, an inevitable result is that human beings are more and more turned into machines. Therefore the one-dimensionality of modern human beings doesn't just lie in Marcuse's notion of lack of critical power, but in something much more fundamental, i.e., a one-dimensional materialist worldview. As Dreyfus profoundly warns, "Our risk is not the advent of superintelligent computers, but of subintelligent human beings." (Dreyfus 1992: p. 280)

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[30] In Quine's holism theories match empirical evidences as a whole. But we still see logic on one side and facts on the other.

[31] In the strict sense instrumental rationality is one of "means-end-relations" (Habermas 1968: p. 69). This best characterizes technological rationality. As science and technology become closely intertwined, scientific rationality is also incorporated into the general means-end-calculation.

If meaning doesn't have its place in the materialist worldview, it has to be sought somewhere else. This is to say that we need to get out of materialism and adopt an organizationalist worldview. In this worldview things don't just have their material dimension, but also organizational dimension. So a human brain is not just a heap of neurons controlled by physico-chemical laws, but well organized matter with very high complexity. How it's organized is still a mystery to us. But we know that it's a product of millions of years of natural history. In the early phase of the history matter is organized with low complexity, but when life and then mind are reached the complexity is getting much higher. More complex things are built on top of less complex things, but with the organization on a new level, new properties and regularities emerge, although properties and regularities on the lower level are kept. To say that a human brain is a heap of neurons controlled by physico-chemical laws is not wrong, but it misses what makes a human brain a human brain, that is, its higher level organization. This is why human mind is beyond the reach of materialist worldview. If the materialist approach falls short and the brain's organization stays a mystery, it doesn't mean human mind is a black box. Besides the materialist approach we still have the phenomenal approach. For instance, from the phenomenal perspective we know that our thinking is governed by logic.

However, in the materialist worldview even a non-materialist phenomenal approach could become biased. Under the influence of materialism formal logic has dominated modern science. It strongly believes that human thinking is governed by formal logic and everything in the world can be modeled with mathematics. The falsity of such a belief has been demonstrated by many people including Dreyfus. Here I just want to emphasize metaphor and its close relation with meaning. Let's take a look at one of Shakespeare's many sonnets (No. 73. Cited from Brooks & Warren 1976: p. 5):

> That time of year thou may'st in me behold
> When yellow leaves, or none, or few, do hang
> Upon those boughs which shake against the cold,
> Bare ruin'd choirs where late the sweet birds sang.
> In me thou see'st the twilight of such day
> As after sunset fadeth in the west
> Which, by and by, black night doth take away,
> Death's second self, that seals up all in rest.
> In me thou see'st the glowing of such fire
> That on the ashes of his youth doth lie,
> As the death-bed whereon it must expire,
> Consum'd with that which it was nourish'd by.
> This thou perceiv'st, which makes thy love more strong,
> To love that well which thou must leave ere long.

In this sonnet Shakespeare first uses three metaphors in sequence. He compares the old age to autumn, twilight and a dying fire and finally states that the thing which will be soon lost is loved more by people. Metaphors are analogies. We may take one, the one between old age and autumn, and look at it closely. In what sense is old age analogous to autumn? Formal logic interprets analogy as common property or relation. It appears there is no common property between old age and autumn. The temperature gets cold in autumn, but even in old age people's body temperature doesn't drop. Trees turn bald in autumn, but not everybody becomes bald in old age. From a materialist point of view these two things are so different that they cannot share any physical properties. Then what about relations? There seems to be a correspondence between the position of old age in life and that of autumn in a year. So it's a common time relation. But in this sense old age can also be compared to a thunderstorm that's about to stop. Such a thunderstorm apparently doesn't fit into the sequence of autumn, twilight and a dying fire. What connects the things in the sonnet cannot be found in a materialist world, but is based on a deeper understanding

of the progression of human life. In the concluding couplet Shakespeare uses another metaphor on a different level. There he compares everything we love, but are about to lose to an old man. Just like we will love a grandpa who is dying more than usual, we love everything we cherish but are about to lose more than ever. Again this analogy only makes sense on the basis of human emotions. One doesn't need to be a great poet to use metaphors. Metaphors are used everywhere in our daily lives. Even one of the most mundane phrases "hot chili" is in fact a metaphor. The chili is hot not in the sense that a stove is hot, which means having a high temperature. It is hot because it makes people who eat it feel hot. If in this case the body temperature of the people who eat chili still matters a little, then think about the sentence "Sally is a block of ice," which Searle analyzes. Between an emotionless person and a block of ice we cannot find any connection in the materialist world.

As said above, metaphors are analogies, but this kind of analogies is mostly beyond formal logic and mathematics. If rationality is generally the ability to figure out connections and regularities in the world, then the ability to see metaphorical analogies can also be called rationality, but this is definitely not instrumental rationality. We've seen human emotion plays an important role in metaphorical analogies. The dichotomy between intelligence and emotion is totally wrong in this case. Since Dreyfus first explicitly argues against this dichotomy under the influence of Heidegger, we may call this emotion-based rationality Heideggerian-Dreyfusian rationality. Hence the popular view that science is about truth whereas art is about beauty is not tenable either. We've shown that a poem can reveal deeper facts. So do other forms of art. The scientistic belief that the scientific method is the only path to truth is just a biased view in the materialist world. On the other hand, the meaning of life is closely related to metaphors. So the conflicts between rationality and meaning only happen to instrumental rationality. When we move from instrumental rationality to Heideggerian-Dreyfusian rationality the conflicts would be automatically resolved.

Organizational naturalism provides the metaphysical foundation for this reconciliation. By recognizing the organizational dimension of the world it places things in the world on an organizational spectrum according to the measure of complexity. So physical objects, chemical objects, life, mind and society constitutes a sequence with ascending complexity, as shown in the following diagram. Organizational naturalism doesn't completely abandon materialism, but regards it as a degenerated case. Just like Newtonian mechanics is a degenerated case of the theory of relativity where velocity is much less than the speed of light, materialism is a degenerated case of organizationalism where complexity is very low.

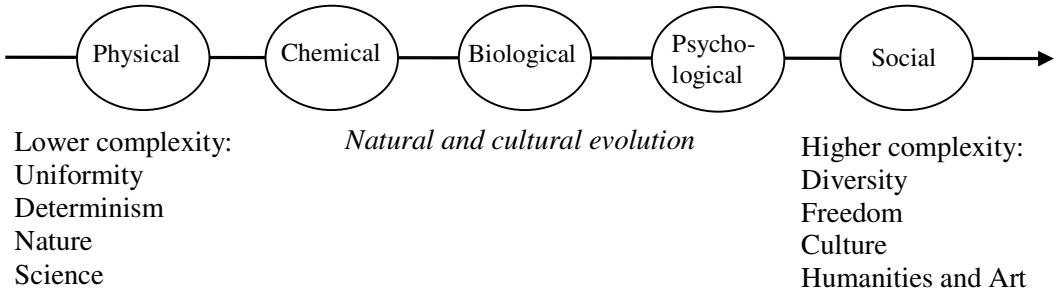

Fig. 8.1 Organizational Spectrum as Reconciliation of Various Dichotomies

In the organizationalist worldview many existing fundamental dichotomies can be explained and reconciled. Here I just mention a few to show its great potential. The first is the dichotomy between materialism and supernaturalism. On the one hand materialists claim that their method

has been successfully applied to more and more phenomena in the world, so a supernatural approach is just nonsense. On the other hand supernaturalists claim that the materialist approach is irrelevant to the spiritual world, and only a supernatural approach can provide a unified worldview. From the view of organizational naturalism, materialism grasps the lower end of the spectrum and projects it onto the whole spectrum, whereas supernaturalism does just the opposite, that is, it grasps the higher end of the spectrum and projects it onto the whole spectrum. Although they work in opposite directions, they certainly share a common feature. It's interesting to notice that both strive for a grand unification theory.[32] While organizational naturalism can explain both materialism and supernaturalism, it agrees with neither. It's organizational, but not materialistic; it's natural, but not supernatural. In an organizationalist world a theory of everything is impossible because organization is diverse and open-ended. Second, the dichotomy between nature and culture can also be reconciled. In the organizational worldview nature and culture belong to the same organizational spectrum. The difference just lies in the fact that nature has lower complexity, whereas culture has higher. While nature occupies physical, chemical and biological levels, culture occupies psychological and social levels. Third, the dichotomy between the so-called two cultures in the science wars can be reconciled too. On the one hand scientists accuse humanists that they know little about science and their theories are just groundless metaphysics. On the other hand humanists accuse scientists that their alleged realism and objectivity are just a sham, because the whole scientific endeavor unfolds in a cultural context. They even claim that the scientific worldview is just an arbitrary narrative of the world like a fiction. From the organizationalist perspective, again both camps hold one end of the organizational spectrum and insist that the whole spectrum is like that. They are almost like the blind men who are touching an elephant. If one happens to grab the trunk or the tail then just study it well. Don't claim that the elephant is like the part one has grabbed. When both camps recognize the whole picture of the world their quarrels become senseless.

We have to come back to the core question of this essay: what we should do with modern technology? Since modern technology is closely bundled with modern science, our attitude toward modern technology should be just the same as modern science. Modern science has constructed comprehensive theories about the lower end of the organizational spectrum and modern technology has greatly improved our material life. These facts are undeniable. So they should be embraced. But on the other hand modern science and technology have their limited scope due to the fact that they are based on the materialist worldview. While this works at the lower end of the spectrum, it falls short at the higher end. Unfortunately the meaning of life and higher culture lie at the higher end. If we want to regain meaning science and technology at first should be put back to its proper role, as an instrument of higher culture. This is also what cultural instrumentalism entails. Putting modern technology back to its instrumental role is the first step of technology control. In the next section we will see that even within its proper scope modern technology could go astray due to its unprecedented power. Therefore further control is needed.

8.2 Technology and Nature: Environmental Ethics

Recognizing the limited scope of modern technology constitutes a conceptual control of it. Under this control modern technology is deemed as being able to more or less determine only a part of

[32] Before the contemporary GUT two centuries ago Hegel already proposed a grand unification theory. In his system everything could be explained by the Weltgeist. It's definitely a theory of everything. I have a personal inkling that a similar fate to that of Hegel's philosophy is waiting for the contemporary GUT. What's still meaningful today in Hegel's system is philosophy of right. Similarly the contemporary GUT will probably end up to be a theory of elementary particles.

human life or culture. In other words there is some part that lies beyond the determination of it. However for modern technology only this conceptual control is not enough. Compared with traditional technology modern technology has grown so powerful that unbridled development and adoption has demonstrated its capacity to bring about extensive, severe, and in some cases even irreversible damages. Technologies are created to serve certain human purposes, to have some utilities, to benefit human life. Those unintended, undesirable side effects make concrete control necessary.

At first glance there seems to be a contradiction between the limited scope and the ever-increasing power of modern technology. But in fact there is no contradiction here, because the scope and the power are about different matters. A crane is powerful in the sense that it can lift tons of materials, but on the other hand it's just a simple machine. Similarly modern technology is powerful according to scientific standards, but it has a limit in terms of complexity. For instance, following Dreyfus we've shown that genuine human intelligence is beyond the reach of technical means (Cf. 8.1.2). However, there is an asymmetry between construction and destruction. A complex system needs to be constructed in a complicated way, but it could be destroyed very easily. While human intelligence is the result of millions of years of natural and cultural evolution, it could be disturbed or destroyed with basic physical methods.

Just because human life is so vulnerable we should be sensitive to every detrimental factor. Among all the undesirable side effects of modern technology we focus on the environment in this section. The environment is the natural habitat of human beings and it constitutes a foundation of human life. With its unprecedented power modern technology has fundamentally changed the relationship between human and nature. In the past nature mostly followed its own course and human impact upon nature was marginal. Now with modern technology humans can cause significant effect in natural processes. Thus man-made environmental problems become extensively noticeable. In this section I first briefly examine the new scope of human actions in modern society. In order to handle this new situation some authors have strived to set up new ethics. As we will see there exist different approaches. After discussing some important approaches I associate them with the modernity theory. Of course environmental problems are not the only side effects of modern technology. But environmental ethics offers a good example of how concrete technology control may be put on a theoretical ground.

8.2.1 The new scope of human actions

Many people had probably noticed the expanded scope of human actions in modern society before Jonas made this phenomenon salient when he tried to advocate a new ethics on the basis of it. Undeniably this new scope of human actions is a result of the development and adoption of modern technology. In a broad sense humans had been using all sorts of technologies since the earliest civilizations, from tools made of stones and bones through iron ploughs to seafaring ships. The introduction of every major technology definitely had some impact on the environment. But there was a common feature of premodern technologies. Their interference with nature, in Jonas's words, "were essentially superficial and powerless to interrupt its fixed equilibrium." (Jonas 1979: p. 19, author's translation) But this is no longer the case with modern technology.

We may trace the historical path a little closer. In a hunter-gatherer civilization the population was sparse and had high mobility. The life sustaining material was taken directly from nature. Certainly the natural processes could be disturbed by collecting fruits and hunting animals. Over-collecting or over-hunting could make plants or animals in a certain area extinct. But in the best case the hunter-gatherers could move to a different place. And in the worst case the community

underwent sacrifice. Anyways the environment would finally recover. In this stage we see humans were basically part of nature and the brutal natural laws dominated. In an agricultural civilization humans started to domesticate plants and animals. That's the beginning of large-scale human interference with nature. Deforestation was a major form of interference because large area of forest was turned into arable land. Compared with the hunter-gatherer civilization the agricultural one caused much more disturbance in natural processes. However nature has certain amount of resilience, so that disturbances within a certain scope can be absorbed. Domesticating plants and animals only slightly modified their life cycles. They mostly still followed their own natural course. The life sustaining material was still taken from nature and the transformation procedure was not complicated. For the three major traditional materials, the use of wood was straightforward, the processing of clay was a little complex, and the handling of metal was the most complicated. On the one hand these materials were taken from the surface of the Earth, including the ore. Deep mining was beyond premodern technology. On the other hand, when these materials were out of use they decay in a relatively short period of time.

The above situation doesn't hold in a modern industrial civilization any longer. The industry heavily depends on fossil fuels and other minerals for energy and material, so mining is an essential part of it. In this case surface mining is no longer enough. The demand for large amount of resources drives the mining deeper and deeper underground. Further, deep mining is just one part of the interference with nature. It only has to do with what humans take from nature. The other side is what humans throw to nature. The use of fossil fuels as energy source generates all kinds of chemicals and these constitute a major part of air pollution. Some of the chemicals are poisonous, such as those contained in the acid rain. CO_2 is not poisonous, but there are evidences showing that it causes climate change. Modern chemical industry also creates all sorts of new substances. When these new substances are dumped into nature as waste, not all of them can be easily handled by nature. Two prevalent modern materials glass and plastic need much longer time to decay than traditional wood and clay. If we take the industrial civilization as a whole and pay attention to its interface with nature, we can see that its interference with nature is deepened in both its input and output. On the one hand it ventures deeper into nature to obtain necessary resource. On the other hand it throws waste into nature beyond the latter's absorbing power. To make things worse, depth is just one factor and intensity is another. The seizing of resource and the generation of waste both proceed at unprecedented speed. As a result, the loss of balance in natural processes emerges.

Since long ago humans have been carrying out large scale projects. Some ancient projects even come down to our own time as technological marvels. However, due to the restrictions in energy source the influence of human actions in premodern society was mostly limited to local areas. The major premodern energy sources were humans, animals, water and wind. The former two were weak, whereas the latter two were restricted with respect to location and season. Although there was no lack of contacts between cultures lying far away from each other mobility was rather low. It took months to travel thousands of miles. Under these circumstances communities to a large extent were isolated from each other. Transportation was one of the first things that were greatly improved in the Industrial Revolution with modern technology. The crucial step was to find an effective way to harness a new stable and more powerful energy source. The improved transportation expanded the traditional community. It at the same time broadened the scope of human influence. Today facilitated with a globalized economy human influence has extended to the global level. What people do at a certain place could cause effects far, far away. This is all made possible by modern technology.

From mostly isolated communities scattered in a vast natural habitat humanity has gradually grown into an interconnected unity. This unity is not only interconnected within, but also without.

The latter connection is through nature as the environment. When human influence was weak and nature strong enough to absorb all the human impact, the environment kept stable. In that case one community would not feel the influence of another through the environment. But now modern technology has granted humans the power to shake nature out of its own balance. When the whole environment becomes unstable and starts to reverberate everybody can feel the repercussions. This instability is obviously evidenced in the climate change. Now people are experiencing more and more extreme weather conditions, such as abnormal temperatures, severe storms and droughts. Besides, the pollution is also raised to the global level. Due to the persistence of modern pollutants, they have the chance to be spread far away mainly carried by air and ocean flows. Generally nature can no longer be treated as an inexhaustible resource well and an endlessly resilient waste dumping ground. The environment becomes a factor people need to take into account.

On this background we see the scope of human actions expand in **two dimensions**. **First**, the influence of human actions has extended from the local area to the global sphere. This is a horizontal expansion. Advanced transportation and communication technologies greatly shrink the distance and make the whole plant into a virtual village. Despite cultural and political differences and even conflicts, a global economy gradually takes shape. In a global economy products are produced internationally and targeted at a global market. Since people from different places in the world are interrelated human actions may have global influence. The influence could also be exerted indirectly through the environment. In the past the impact of human actions was confined within the local environment. Now it has exceeded the local environment thanks to its dramatically raised strength. They may disturb nature as the global environment. As the whole mankind share this global environment, people faraway could experience the disturbance. **Second**, the influence of human actions has extended from the living generation to future generations. This is a vertical expansion and mainly through the environmental impact. When the impact was on a small scale it couldn't last for very long. Normally it died away in a generation or two and was finally absorbed by nature. But now the impact can reach many generations later. Stored nuclear waste may cause radiation problems many years later. The effect of climate change is also on a scale of generations.

8.2.2 What kind of new ethics?

According to Jonas the expanded scope of human actions creates an ethical vacuum. Traditional ethics was mostly concerned with relations among people in a local community. He calls this "neighbor" ethics. Now with the new scope of human actions people are related on a global level and cross-generations. Therefore traditional ethics is not able to handle this new situation. Jonas's core task in this area is to set up a new ethics to cope with this changed scene of human relations. Although some of his ideas, such as the intrinsic value of nature, may be equally applied to the first dimension of scope expansion above, his theory is focused on the second dimension. In fact he calls his new ethics the "future ethics."

Some central ideas of Jonas's new ethics are a new imperative, the priority of bad prediction, the intrinsic value of nature and the non-reciprocity of responsibility. Building on Kant's ethical theory of categorical imperative Jonas brings up a new imperative. He argues that Kant's categorical imperative of universal law is based on a logical principle of self-compatibility. This doesn't preclude the supposition that mankind stops to exist. Therefore a new imperative needs to be added. Specifically it prescribes: "Act so that the effects of your action are compatible with the permanence of genuine human life on the Earth." (Jonas 1979: p. 36, author's translation) The priority of bad prediction seems to be a necessary principle for the new imperative. For the survival of mankind we need to prevent the worst case from happening. In other words, if a

technology threatens the survival of mankind in the worst case, it should be prohibited. The last two ideas are directly related to the current environmental issues. The intrinsic value of nature is a fundamental idea of environmental ethics. Facing the environmental issues people naturally feel the obligation to protect the environment. But theoretically this obligation needs to be well-founded and that constitutes a major task of environmental ethics. To argue for the intrinsic value of nature seems to provide theoretical support for the obligation. Jonas's approach is a teleological one. His axiology is based on a teleological view of nature. Organisms demonstrate some goal-orientedness and nature as a whole may be regarded as moving toward organisms in the evolution history. For Jonas purposes bear their own value, because purposes are better than purposelessness. Further, responsibility is based on value. We are responsible to protect valuable things. But in this case we see the non-reciprocity of responsibility. We are responsible for something that cannot carry responsibility.

Jonas's theory was ground breaking for the field of environmental ethics, but it has received various criticisms. First, the teleological view of nature is problematic. If goal-orientedness can be clearly seen in organisms, especially high level organisms, in what sense may we say that the whole nature strives for some purpose or goal? Less organized natural entities, such as physical objects and chemical compounds can have no purpose. And the natural evolution may be interpreted as driven by blind natural forces. Although the increase of complexity can be seen as a general pattern of natural evolution, it's hard to say that it's a process heading toward a predetermined goal, such as the creation of human beings. When we push the teleological view harder we get closer to the theological view. Second, related to the first criticism, Jonas conflates the meanings of different concepts of purposes. We may speak of three different kinds of purposes (Hillerbrand 2006: p. 53): a. conscious goal-orientedness (going to the bakery to buy some bread); b. unconscious goal-orientedness (life-keeping of organisms); c. the function of an object (blood-pumping of a heart).[33] Jonas seems to distinguish these different concepts of purposes, but he treats them the same in the value theory. Third, to deduce moral obligation from intrinsic values is not valid. It conforms to our basic intuition that we have the obligation to protect valuable things. But the value involved in this latter case is a relative concept. "Valuable" means valuable to the moral subjects. In contrast the intrinsic values based on the teleological view of nature are absolute values. No matter how valuable in whatever sense an object is by itself, if it has no value for human beings as the moral subjects, an obligation to protect it can still not be justified.

Traditional ethics was centered on human beings. The starting point of Jonas's new ethics is still human affairs. This is distinctly reflected in his new imperative. The human survival on this planet is his basic concern. However, his theory seems to be based on a foundation that lies beyond human sphere. When the protection of environment is justified by the intrinsic value of nature, how does the human survival fit into this picture? Jonas's new ethics probably inspired some physiocentric theories in environmental ethics and the basic tension in his theory is inherited in all of them.

Physiocentric theories are said in contrast to traditional anthropocentric theories. Anthropocentric theories share the common idea that only humans have moral value and the environment is protected on their behalf. On the contrary, physiocentric theories claim that a part of or the whole nature also has moral value and the environment is protected on its own behalf. Krebs divides the physiocentric theories into two major groups according to their different approaches. The first group adopts absolute arguments, whereas the second extensional arguments. The former goes

[33] Krebs also distinguishes two kinds of purposes: purposes in the practical sense and purposes in the functional sense (Krebs 2000: p. 72). These correspond to the first and third kinds here.

directly to nature and demonstrates its own value. Apparently Jonas's theory belongs to this group. Besides goal-orientedness other features, such as biodiversity, are also used as the foundation of value. In contrast the latter starts with human beings as the model moral entity and tries to extend the moral community to a part of or the whole nature based on different properties. Ott lists four approaches with growing scope of moral community: the sentientistic (pathocentric) arguments, the biocentric arguments, the ecocentric arguments and the holistic arguments (Ott 2010: p. 18). They extend the moral community to sentient beings, organisms, ecosystems and the whole nature, respectively.

The absolute arguments in the physiocentric theories can be generally countered like Jonas's teleological argument. No matter what natural property is value based on, it's absolute value. But moral value is relative to moral subjects. Absolute value that is independent of moral subjects can hardly be used to justify moral obligations. The extensional arguments may be primarily rebutted with moral conflicts. When the moral community is extended to the non-human nature, interest conflicts immediately show up between humans and non-human nature. For the extensional approach with the least scope of moral community, the sentientistic arguments, there are already interest conflicts that seem unresolvable. It would require humans to all become vegetarians to avoid doing harm to sentient animals that can feel pain. But the claim that it's immoral to eat meat can be accepted by few people. Compared with confining the moral community to moral subjects, all the extensional approaches seem to be arbitrary. Among the criteria of the extensions one is not better than another. Why is the ability to feel pain a better criterion than being alive, or *vice versa*? However, being a moral subject has special meaning for morality. The foundation of morality is free choice based on free will. Only moral subjects have free choice.

Therefore we need to stay with the anthropocentric approach. But on the other hand we also need to expand traditional theories to cope with the new scope of human actions. Since the responsibility to protect the environment becomes evident in this new situation, the new ethics has to justify this responsibility. The strategy of physiocentric theories is to include a part of or the whole nature as the object of responsibility through extending the moral community. As Hillerbrand points out, it results from a confusion between the object and the instance of responsibility (Hillerbrand 2006: p. 58). When someone *p* promises her neighbor *n* to take care of *n*'s cat *c* while *n* is on vacation, a responsibility comes into existence. In this case *p* is the subject of responsibility, *n* is the object and *c* is the instance. Although we may say *p* is responsible for *c*, *n* instead of *c* is the object of responsibility, because the responsibility is on behalf of *n*. Similarly in environmental ethics when we say we have the responsibility to protect the environment, the environment is the instance of responsibility. The objects of responsibility are humans, because it's on behalf of them. In this way we incorporate the responsibility to protect the environment without extending the moral community. But we do need to make some extension in the field of responsibility. On the one hand, the objects of responsibility in the traditional neighbors' ethics need to be extended in two dimensions. In one dimension people from a different country may be included. In the other dimension people of future generations may be included. On the other hand, the subjects of responsibility also need to be extended. Besides individuals collectives, such as a company, may now be regarded as subjects. In all these extensions the moral community is kept to the human sphere.

So far I've been generally following Hillerbrand's positions in reviewing the physiocentric theories. Her basic approach to the traditional anthropocentric theories also looks attractive to me. Specifically she advocates a synthesis of utilitarianism, duty ethics and virtue ethics. Birnbacher tries to extend the classical utilitarianism to handle the new scope of human actions. He includes future generations in the happiness calculation and proposes the discount principle. According to this principle future utility should be discounted according to the time distance from the present.

As for the utility of the environment, it doesn't only have instrumental value, but also intrinsic value for health, security, etc. Utilitarianism has some problems. Happiness itself is a very vague concept. What constitutes happiness has no unanimously agreed criteria. Measuring happiness is a more complicated matter. Even though happiness could be feasibly measured, the basic principle of utilitarianism, i.e., the greatest happiness of the greatest number, runs counter to intuition concerning justice and fairness. Suppose we distribute a rich man's property to a group of poor men. This would increase the total amount of happiness among all the people involved. But it doesn't seem to be fair.

Kant's duty ethics is fairness and justice oriented. His categorical imperative demands that individuals should be treated as ends but not means. Utilitarianism is based on internal feelings of individuals, whereas duty ethics is based on human reason. The categorical imperative requires the generalizability of norms. This is no other than a rational requirement. From the individual's perspective these general, rational norms are duties from above. They guarantee justice and fairness. But just this generality contains a problem in it. That we should not lie is required by the categorical imperative. However, we know it doesn't apply to all the circumstances. For a sensitive cancer patient we should keep the diagnosis as a secret the longest we can. In this case the patient's feeling and welfare override a general duty. We even could have two duties conflict with each other. In that case duty ethics cannot point a way out of the dilemma. Again we need resort to utilitarian principles. At this point a synthesis between utilitarianism and duty ethics becomes necessary. Patzig's formal-material ethics just aims to do that. On the formal side he inherits Kant's notion of categorical imperative. But in addition to the principle of fairness he proposes a second categorical imperative, the principle of solidarity. The principle of fairness treats individuals as abstract rational beings, whereas the principle of solidarity takes particular conditions of individuals into account. On the material side he proposes the utilitarian principle of preference, according to which different interests involved in a particular situation could be ranked. This helps to resolve duty conflicts. This new form of utilitarianism also goes beyond the traditional hedonistic utilitarianism.

Hillerbrand argues even a combination of utilitarianism and duty ethics still cannot deal with another important fact in moral affairs. The fact is that moral subjects have motivational and cognitive limitations. Both utilitarianism and duty ethics are based on reliable knowledge of motivations and consequences. When there are uncertainties in motivations and consequences the application of their principles becomes problematic. She maintains that virtue ethics could handle this problem well. Particularly she discusses Höffe's eudemonistic virtue ethics. What's prominent, Höffe brings up two virtuous duties concerning ecology on the basis of a eudemonistic concept of striving happiness. This concept of happiness has its origin in Aristotle, who sees happiness in the pursuit of excellence. The two virtuous duties are called ecological calmness (Gelassenheit) and ecological prudence (Besonnenheit). Ecological calmness requires us to recognize the limit of human power, whereas ecological prudence instructs us to espouse the boundary of desire. For Höffe technological utopianism and unbridled desire are two main causes of today's environmental crisis. To Hillerbrand, these virtuous duties offer us helpful guidance under uncertainty. And this uncertainty has become an unavoidable feature of adopting complicated modern technology.

In summary, with the unprecedented power of modern technology the scope of human actions has greatly expanded. The expansion takes place in both the spatial and temporal dimensions. Now the whole planet is interconnected and the lives of generations in the future are under impact. The disturbance of nature constitutes a major way of this expansion. When nature was stable communities were mostly isolated. Once the power of modern technology was strong enough to interfere with natural processes, actions in one community could have influence far away and

long time later. Thus, the responsibility to protect the environment showed up. It's a central task of environmental ethics to justify this new responsibility. I agree, using some intrinsic value of nature to justify human responsibility presupposes certain absolute principles, which is a heavy theoretical burden. On the other hand, the extensional approach theoretically appears rather arbitrary and practically causes many unresolvable moral conflicts. In fact, the task can be carried out with an anthropocentric approach. Specifically traditional ethical theories with extension and combination can provide a good justification for the responsibility to protect the environment.

In connection with the modernity theory, utilitarianism and duty ethics originated in the Modern Age and their central ideas conform to the general principle of Western modernity. Utilitarianism is primarily based on pleasure and duty ethics on reason. Both pleasure and reason are universal. Everybody can feel pleasure and is a rational being. And due to this universality, the basic principles of both ethical theories are egalitarian. Everybody is treated the same in the principle of the greatest happiness of the greatest number and the categorical imperative. I argued in the previous chapter that this general principle of egalitarian universalism in a way fosters the dominance of modern technology. If the responsibility to protect the environment is solely justified with these two theories the protection cannot be carried out thoroughly. For instance, nature may still be treated as a resource well and a waste dumping ground. In other words, nature is still regarded as an instrument to satisfy human material needs. Incorporating virtue ethics is a way to move beyond egalitarian universalism. It doesn't resort to any universal property of an individual, but instead values the pursuit of excellence. So for me the significance of virtue ethics doesn't lie in handling motivational or cognitive limitations of the moral subject, but transcending modern ethics. This opens up new views. Virtue ethics calls for a change of human attitude toward nature, specifically from dominance to appreciation and care. It advocates a meaningful, fulfilling life, which puts more emphasis on spiritual richness rather than material wealth. As a result, we should no longer treat nature as a resource well standing there for human exploration and exploitation. On the contrary we should regard nature as the being which creates and sustains our lives and enriches our spirit, and so take good care of its well being.[34]

8.3 Technology Assessment and Regulation

Environmental ethics constitutes a theoretical foundation for concrete control of modern technology. Although environmental issues are not the only motivator of technology control, they are among the most important. In this section we look at a form of concrete control. Institutional technology assessment originated with the Office of Technology Assessment in the US Congress in 1970s. Since then similar institutions have been established in many other countries. The need of technology assessment arose when people realized that the application of modern technology could bring about negative effects. It grew in the cultural context where people started to question technological optimism and utopianism. Following the tradition, no matter whether an institution of technology assessment is subordinate to the government or relatively independent, it always has great influence on the technology policy of the government. The policy is normally represented in specific laws regulating the development and application of technologies. Therefore, technology assessment is closely related to technology regulation.

[34] Naess's notion of deep ecology leads to similar teaching, although it's based on anti-anthropocentric thought. It promotes a complex, but not complicated life. Yet it advocates biospherical egalitarianism. Cf. Naess 1973 & Seiler 2000. This also has some connection with feminism. A constructive aspect of feminism is to look at nature from the female perspective and treat it with affection and care. The Mother Nature metaphor is extended in this case. Cf. Merchant 1983.

In accordance with the general concern of this essay technology assessment and regulation are examined in light of the modernity theory. On the background of some general description, the issue of embedding high values is discussed.

8.3.1 A direct control

Technology assessment is built on a fundamental notion. Grunwald calls it the ambivalence of modern technology. This ambivalence is displayed in various aspects. He does a comprehensive analysis of it in the second edition of his *Technikfolgenabschätzung: Eine Einführung*. The first aspect of the ambivalence is between progress goals and unintended effects. It's an undeniable fact that modern technology has brought about much progress. This had fostered technological utopianism, but it became shaky when negative effects of modern technology were more and more remarkable. The negative effects include, according to Grunwald's list, accidents, environmental issues, health problems, social and cultural disturbances and even dependence on technology. The second and third aspects directly have to do with freedom. Technology on the one hand creates new opportunities and grants humans more autonomy, but it on the other hand closes other options and forces humans to adapt. The fourth aspect is related to the use of technology. It's a double-edged sword. It can be used for good causes and also for bad. The fifth and the sixth aspects involve politics. The positive and negative effects of technology may be distributed unevenly in society. Thus political issues arise. Here we see the tension between different perspectives of the deciders of a technology on one side and people affected by it on the other. Another tension is that between technocracy and democracy in general. These two tensions are closely related.

The major tasks of technology assessment are based on the various aspects of the ambivalence of modern technology. Certainly the general goal is to maximize the positive effects while minimizing the negative ones. In achieving this goal technology assessment has two distinct features. First, it's future oriented. Instead of focusing on the problems in existing technologies, it's mainly concerned with effects of potential technologies of the future. Certainly experience from the past can provide guidance in predicting the future, but it's more important to make the right decision now. Second, it's specific technologies oriented. Technology assessment is generally a practical discipline. Of course, even a practical discipline cannot do totally without theory. But it aims to provide practical advice. Therefore it has to handle specific technologies. In this case the particularities of a certain technology matter much. A rough discussion about technology in general doesn't help a lot.

One of the central tasks of technology assessment is to analyze the potential negative effects of a particular technology. Once the negative effects are identified, measures would be figured out to avoid them first. If that cannot be achieved attempts are made to reduce the negative effects. As the last resort ways would be found out to handle the effects. Depending on specific circumstances, the solutions recommended are different in terms of degree of change required. The easiest could be just a different parameter value (e.g. speed or height limit). Harder than that would be a design modification (e.g. more safety measures). Sometimes a particular technology could be prohibited and alternative technologies encouraged (e.g. solar, wind energy instead of nuclear energy). In the extreme case a whole type of approach would be prohibited (e.g. climate engineering). No matter what solution is finally required, it's always better to make the correct evaluation earlier than later. On the one hand, if the negative effects of a particular technology could be identified in the early phase of its life cycle, preferably before its real world application, obviously the damage would be effectively contained. On the other hand, finding the problems earlier also help save effort in the technology development itself. Whether modification or cancellation is the final requirement, doing it earlier means less waste of effort. But things are not

always as people like it. There is a dilemma with respect to the identification of side effects of technology. Collingridge first brought up this dilemma in his book *The Social Control of Technology*. As he points out, it's difficult to evaluate the impact of a technology in the early phase of its life cycle, although negative effects are hard to fix when they are found late. In real life the timing has to be handled according to specific situation.

As we have mentioned the ambivalence of modern technology is not only reflected in the coexistence of positive and negative effects, but also in their uneven distribution among different groups in the society. The latter constitutes another dimension of the issue. Corresponding to the first dimension the task of technology assessment is to generally minimize the negative effects without much loss in positive ones. As we move to the second dimension we need to take another factor into account. In this case the positive and negative effects must be evaluated with reference to particular groups. And to address the problem here a general minimization of negative effects is not enough. What's at issue are fairness and justice. A relatively moderate task of technology assessment is to identify potential conflicts and try to resolve them. When benefits and detriments are unevenly distributed without a commonly agreed clear justification conflicts are inevitable. Early identification of the conflicts definitely helps resolve them, but a nonviolent resolution depends on making all the parties aware of the justification, or if necessary creating a justification, such as through compensation. However a systematic way to avoid or reduce conflicts is democratize technology. This is appropriately embodied in the concept of participative technology assessment. In participative technology assessment along with technical experts ordinary citizens are involved in evaluating a particular technology. It's hoped that the participation of diverse laypersons, especially those affected, could make the technology more legitimate.

Various methods of technology assessment are developed to achieve the tasks. Environmental impact is an important effect of technology. The life cycle analysis and ecological balances method is designed to evaluate this property. As the name suggests the evaluation is done for the whole life cycle of a technology. And there is an ISO standard for carrying out the ecological balances evaluation. Safety is another important feature of technology. The risk assessment method is used to evaluate the risk of a technology. Traditional risk assessment adopts probability theory, but both quantification and objectivity have been challenged by new cases. The cost-benefit analysis measures all the positive and negative effects in terms of economic value. The scope of its application is questionable. Since technology assessment is future oriented, predictive methods are indispensable. Trend extrapolation predicts the future directly on the basis of the past and the present. Data from the past and present are used without interpretation to forecast the future with mathematical functions. Model based simulation goes a step further. A model is more than a function that optimally approximates the existing data, but an interpretation of the data. When precise prediction cannot be achieved, such as due to lack of data, scenarios may be used. Based on the current driving forces, scenarios are different possible future states.

There are also methods for resolving conflicts and achieving legitimacy. Discourse analysis includes a set of methods to collect data through interviews and media analyses, analyze a discourse into explicit arguments, opinions and positions, and construct a value tree. It helps to resolve technology conflicts. When the positions, arguments and normative stances of the conflicting parties are made clear reconciliation is easier to reach. Mediation and arbitration are direct ways to resolve the conflicts. In this method a neutral party acts as the mediator or arbitrator. Technology legitimacy is normally achieved by involving all concerned in the decision-making process. The consensus conference method does just that. A consensus conference includes both experts and laypersons. The laypersons are selected according to even distribution in several aspects, such as age, gender, education and profession. The cooperative

discourse method assigns three parts of technology assessment to different groups: evaluation to people concerned, knowledge of effects to experts and action consideration to normal citizens. Similar methods also include planning cells and focus groups.

Technology assessment strives to be objective and independent. As Grunwald puts it, "TA provides knowledge, orientation, or procedures on how to cope with certain problems at the interface between technology and society but it is neither able nor legitimized to solve these problems. Only society can do this, through its institutions and its decision-making processes." (Grunwald 2009: p. 1113) However, this doesn't contradict its role in political consultation. Since the very beginning results from technology assessment have been used in forming technology policies. Of course the government stands at the center in this matter. Even in a decentralized democratic society, the government still has various ways to influence technological development. With its democratic institutions and processes the state is the only actor in the society who is able to make binding and legitimate decisions (Grunwald 2010a: p. 48). Through political consultation technology assessment directly contributes to technology regulation. In the context of this essay, while ethics provides a theoretical foundation of concrete technology control, technology regulation is a direct control of technology.

8.3.2 Embedding high values

In the previous subsection we've seen that normativity stands at the core of technology assessment and regulation. Normativity is specifically represented in the benefits (positive effects) and detriments (negative effects) of modern technology. Since all technologies started with certain benefits, functions to serve some human purposes, technology assessment and regulation are more focused on the detriments, negative effects that have long been overlooked and become more and more evident and significant. It's their central goal to minimize negative effects without putting too much hindrance on the positive effects. Generally through the choice of better technology or better design negative effects could be avoided, greatly reduced, or their impacts could be mitigated. The distribution of positive and negative effects among different groups in the society constitutes the second dimension of the matter. Fairness and justice are the issues here. So the legitimacy of technology is another major goal.

In this subsection I put technology assessment and regulation in the context of modernity theory. I first relate them to the three essential features of Western modernity and then reflect on how they can be best aligned with the spirit of alternative modernity.

Technology assessment and regulation are somewhat initiated by the recognition that technological optimism and utopianism are unfounded. When technology was undoubtedly associated with progress there's no need to evaluate its effects and regulate its development. On the other hand, technological optimism and utopianism in modern society are based on the scientific worldview. The belief that modern technology can solve all the problems results from the view that modern science can provide a theory for all the phenomena and the fact that modern technology are intertwined with modern science. Therefore, technological utopianism is closely associated with scientism. From these two premises we can draw the conclusion that technology assessment and regulation also go beyond scientism. Although they are focused on concrete technologies, scientism is incompatible with their general assumptions.

In a sense technology assessment and regulation also go against capitalism and commercialism. According to the principles of capitalism and commercialism the development of technology should be guided by the free market. But the scope of technology assessment and regulation is well beyond the market. To some extent they are a fix of effects caused by the free market. The

environmental issues offer a very illustrative example. Guided by the free market a company would never consider the problem of pollution. In fact solving the problem is a burden for achieving maximum profit. However environmental issues are an important factor in technology assessment and regulation. Capitalism and commercialism are blind to many issues due to its restricted sight on profit and market. Technology assessment and regulation with its wider vision is a way to correct this blindness.

We've seen legitimacy is a major concern of technology assessment. Democracy is a necessary way to guarantee the legitimacy of technology. Under the view of technological utopianism, technology dominated human life. This fostered technocracy where technical experts were granted paramount authority in technology development. Later studies revealed that under the technical rationality were hidden political interests. Under the monopoly of technical experts the interests of certain groups of people were often ignored, or even intentionally sacrificed. Democratizing technology is a direct fix of technocracy. The basic goal is to let all the people affected have a say in determining the design and application of technologies. The modern representative democracy is already an institution leading toward that goal. In addition participative technology assessment is a step further. Compared with representative democracy people affected have a direct influence upon technological decisions in participative technology assessment. Also more emphasis is put on deliberation than voting in the latter case. The important thing is to have a face-to-face discussion, rather than simply cast a ballot. In this way participative technology assessment contains some improvement of representative democracy.

Generally technology assessment and regulation are associated with alternative modernity in several key aspects. Scientism, capitalism-commercialism and democracy are the three essential features of Western modernity. We've shown above that technology assessment and regulation move beyond all the three features in various degrees. Theoretically they don't necessarily require the refutation of scientism. In the scientific worldview technology may still need to be evaluated and regulated. But historically the growth of technology assessment and regulation benefited from the waning of scientism. In contrast, they definitely put some control on capitalism and commercialism from a much wider perspective. Factors other than profit and market are cited to justify the restraints on economic behaviors. As for democracy they still operate in accord with its basic principle. Its method is for the people to participate in determining common affairs and its goal is to achieve fairness and justice. Both are embodied in participative technology assessment.

Further, the general stance on modern technology adopted by technology assessment and regulation matches that advocated in this essay. Although a specific technology may be prohibited or restricted by certain regulation on the basis of certain assessment, technology assessment and regulation embrace modern technology in general. On the other hand, technology assessment is focused on the negative effects of modern technology and regulation means some kind of control. So the embracing-controlling-stance on modern technology is also adopted by technology assessment and regulation.

However, in a strong alternative modernity technology assessment and regulation need to be extended. A major symptom of the modern malaise is the dominance of modern technology. When high values in human life are subordinate to technical rationality (e.g. eating is degraded to an efficient way to obtain nutrients) some meaning of life is forfeited. This symptom has to be removed in an alternative modernity. To meet the task technology assessment and regulation must be sensitive to this basis issue. If they only focus on material negative effects (accidents, environment, health, etc.) and the legitimacy of modern technology, the dominance of modern technology could well be kept. Suppose a person lives on canned food. Although the food is safe and satisfies her taste, we still feel an important aspect of her life is too pale. In cultural

instrumentalism I divide culture into three different parts and demonstrate the relations between technology and them separately. The dominance of modern technology results from the fact that the central concern is put on material and lower cultures. When we evaluate a technology we may also consider its effects on different levels, material life and spiritual life, lower spiritual life and higher spiritual life. To overcome the dominance of technology we have to take its effects in higher culture into account. In other words, technology has to be evaluated and regulated according to high values too.

Technology assessment is an interdisciplinary endeavor and it tries to evaluate technology comprehensively. But the emphasis seems to be put on the material level. One major reason is that consensus is much easier to reach on the material level based on scientific studies. Once high values come in consensus is almost impossible. These have to be left to philosophical debates mostly in the form of ethical issues. However philosophical debates can help clarify the issues concerning high values and increase the common ground. Of course ethical issues concerning high values are already an integral part of technology assessment. For instance in the issues revolving around clone technology some high values are certainly involved. Should we forbid cloning human beings? The justification is not mostly based on its possible material damage or its potential to cause injustice, but the disturbance it will bring about in family relations and further the meaning of human life. When more of similar issues are integrated in technology assessment and regulation, modern technology can finally be put back at a subordinate role again. Instead of dominating culture, it will serve it. A strong alternative modernity demands embedding more high values in technology assessment and regulation.

Finally I relate the three sections again to conclude the chapter. This chapter is about controlling modern technology. Refuting the utopian fetishism of modern technology removes a fundamental obstacle of technology control. This may also be regarded as a conceptual control. Environmental ethics offers an example of the theoretical support for concrete technology control. Of course other theoretical support may also be provided, but environmental protection is one of the most important requirements of technology control. Technology assessment and regulation is a form of direct technology control. Historically technology assessment grew with the decline of technological utopianism and theoretically environmental ethics is an important foundation of technology assessment and regulation.

IV Case Studies

With the preparations in the first two parts respectively, the theories of modernity and technology are further elaborated and combined in the third part. The goal is to answer the core question of this essay, that is, what should we do with modern technology? The theory of modernity has a much bigger scope than this essay can cover, so it has to be kept sketchy. But it provides a necessary historical and cultural context for developing the theory of technology. Anyways, modern technology cannot be fully understood without modernity. On the other hand, the theory of technology is also indispensable for the theory of modernity. A biased theory of technology could hide the real issues of modernity and make their resolution unreachable. On the basis of the analysis of Western modernity and the survey of existing theories of technology a synthesized theory, cultural instrumentalism, is proposed. This theory implies an embracing-controlling-stance on modern technology and calls for an alternative modernity. On the one hand, modern technology is a foundation of modern life and a powerful and useful instrument for the core of culture, so it should be embraced. On the other hand its limitation and power necessitate that it should be controlled at the same time. Modern technology is limited because it's closely associated with the materialist worldview and so cannot directly contribute to meaning. To regain meaning it has to be put back in a subordinate role. Further control is necessary because modern technology is powerful enough to do damage in unprecedented scale. The malaise of modernity seems to directly point to the dominance of technology. But the dominance of modern technology has deeper cultural root. Only when the real problems of Western modernity are solved in an alternative modernity, can modern technology be both wholeheartedly embraced and appropriately controlled.

So far the central ideas of this essay have been developed. They will be applied to concrete cases in this part. Of the four cases that will be discussed the first two are relatively general whereas the last two specific. Particularly they are Chinese traditional society, Chinese modernization, medical technology and information technology. In all the four cases the embracing-controlling-stance on technology will be the focus.

With one of the oldest cultures that has undergone thousands of years of essentially continuous development and a culture that is deeply different from the Western culture, China provides a good case study for an alternative modernity. Its rapid development in the past several decades makes the study very urgent. To study China we have to take its history and tradition into account, because its history is so long and its tradition has dominated for centuries. So first we shall discuss the place of technology in traditional Chinese society. We will see, with its humanist core and advanced technology traditional Chinese society achieved a distinct historical implementation of the embracing-controlling-stance. On the one hand, innovations were encouraged and supported so that technologies were well developed. On the other hand, technology was just treated as an instrument while humanities stood at the center of culture. But with the new situation this historical implementation was outdated. Then we shall move on to Chinese modernization and discuss how it can contribute to an alternative modernity. The new situation was that China was forced unto a modernization path by the impact of Western modernity. The old social structure was destroyed and modern science and technology were quickly adopted. But directly copying from the West was soon proved impossible for such a unique culture as Chinese. What's needed is a synthesis between Chinese tradition and Western modernity. Only with the synthesis will the traditional embracing-controlling-stance on technology be recovered in the Modern Age. A viable synthesis should absorb the essential features of modernity while at the same time keep the identity of Chinese culture. This constitutes an alternative modernity.

While Chinese modernization offers a general potential case of alternative modernity, the study of two specific technology fields, medical and information technologies, demonstrates the handling

of technology in an alternative modernity on a concrete level. The specific cases will still be put in the general context. For both technologies, first we will discuss a little about their historical development. Modern medicine and computers both have a short history. The beginning of modern medicine can be traced back to Vesalius and Harvey in the 17th century, whereas computers only came into shape in the Second World War. But in a short history they have revolutionized people's lives, both material and spiritual. The huge benefits justify that we have to embrace them. On the other hand, with the benefits also come the problems. The problems necessitate some kind of control. We shall touch post-modern medicine and information censorship in particular.

9. Technology in Traditional China

Needham has revolutionized people's view of science and technology in traditional China. Before his study the standard Western view of traditional China is that it's a stagnant culture with little creativity. There were sinologists who tried hard to derive all the known technologies in China from other ancient civilizations, mainly Babylonian. The standard view was essentially refuted by his study. Ironically, while Needham was writing his great books about traditional China, Chinese were engaged in a fanatic movement to destroy everything old. The story all began with several Chinese scholars coming to Cambridge to pursue their doctoral studies in biochemistry under Needham and another professor in 1937. Then an enthusiasm for traditional China was kindled. And then there was the precious chance for him to stay in China for several years during the Second World War, so that he was able to collect a variety of Chinese literature and exchange with prominent Chinese scholars. Finally comprehensive knowledge, wide vision and first-hand access generated an admirable series that has fundamentally changed people's view.

Needham's sometimes sinophile tone has apparently annoyed some Western readers, but his solid scholarship is undeniable. He has successfully revealed, contrary to the standard view, that traditional Chinese culture was a very creative one. He lists hundreds of inventions originated in China, which then spread to the West. And some of them played pivotal role in Western modernization. Printing, gunpowder and the compass, the three inventions which Bacon said "have changed the whole face and state of things throughout the world" turned out to all come from China. Thus the standard picture of progressive West vs. retarded East has changed into advanced modern West vs. advanced traditional East. Needham's study has been greatly motivated by the urge to explain this phenomenon. The so-called "Needham Problem" with the core question of why modern science only originated in the West will be discussed later (9.1.1.4).

While Needham's focus is on science and technology, my interest here in traditional China has a larger scope. I tend to put science and technology in a wider cultural context. So I will discuss something which appears to have nothing to do with science and technology, but I believe actually shape them in a fundamental way. This chapter certainly still revolves around the core question of this essay. On the ground of Needham's study I can clearly see that traditional China achieved a perfect implementation of the embracing-controlling-stance on technology. So we discuss first the technological achievements in traditional China and then the place of technology in traditional Chinese culture.

9.1 Technological Achievements in Traditional China

Needham's study with the collaboration of a team of Chinese scholars and international sinologists has produced dozens of books in the series *Science and Civilisation in China*. Except some general discussions each of the books handles one or several particular scientific or technological areas. What makes sense here is just to highlight some major areas. In particular I choose mechanical engineering, navigation, gunpowder and ceramics, and medicine. The choice is roughly based on significance and influence. It serves our purpose here without distinct criteria. But before we dive into the specific areas we also make some general reflections on the philosophical foundation of Chinese science and technology. This facilitates the understanding of the technological achievements and also is closely related to the discussion of the place of technology in the next section.

9.1.1 Philosophical foundations

Although traditional China produced many advanced technologies during its own time, Chinese science is quite different from modern science. When we call both science, the word "science" is understood in the general sense. In this sense science is the human endeavor to study the regularities in the phenomena. When we get into the philosophical foundations of Chinese science we will find that it does share some essential characteristics with modern science. But on the other hand there are also fundamental differences.

Li Zehou 李泽厚 adopts an interesting view in interpreting the *Analects of Confucius* (*Lun Yü* 《论语》). He thinks that the Confucian thoughts are generally derived from the primitive shamanism (*wu shu* 巫术). In fact this can be applied to the whole Chinese culture, including scientific thought. Anthropological studies have discovered that all the primitive cultures practice shamanism. In shamanism a shaman is the mediator between the human world and the spiritual world. When the shaman gets into a state of ecstasy, it's believed that he can talk to various spirits. The basic character of shamanism is the interaction between humans and the spirits. This has a sharp contrast with Christianity, where God has the almighty power and controls everything. While God plays magic in Christianity, magic is played by a shaman in shamanism. Further when a spirit doesn't do as humans want, it may be punished. As shamanism develops the magic doesn't have to be played by a professional shaman, but by everybody. So when one puts needles in an effigy of an enemy he believes that he can hurt the enemy. Also the target of the magic doesn't have to be a spirit. So when a couple have sex by the field they believe that it can make the crops yield more grains.

In terms of religion shamanism is the most primitive form, whereas Christianity is the most developed form. There are other forms in between. In ancient Greek myths Gods are still not separated from human beings. They participate in human activities, such as wars and even can have sex with human beings to procreate demigods. In Buddhism God doesn't interfere much with human lives. Even karma doesn't need to be enforced by God. But all the forms of religion presuppose dual worlds: a world of the human beings and another world of spirits or God(s). What's unique about the Chinese culture is that it branched out from shamanism and never developed a higher form of religion on its own. Of course it didn't stay with shamanism. As the spiritual flavor of shamanism gradually dissolved, the Chinese culture became essentially irreligious. Certainly superstition in common people is inevitable, but the core of culture is against supernaturalism. And the human world is the only world. On the other hand residues of shamanism could still be seen in Chinese culture later on. After Buddhism and then Christianity penetrated into Chinese culture we often see cases where people treated Buddha and God just like a shamanic spirit. When they got a problem in life they started to visit a temple or church. If the problem couldn't be solved they probably would quit soon. If the problem was really solved, it would encourage them to do the same again in the future. In this case visiting a temple or church is essentially a shamanic magic.

When the development of Chinese culture reached the classical period it took distinct shape. The dissolution of the old aristocratic feudal society stimulated a flourish of philosophical thoughts. Confucianism and Taoism finally gained dominating status. Shamanism underwent a *sublimational metamorphosis* in Chinese classical philosophy. The spirits were despiritualized, while the shaman was sublimated. The spirits were transformed into the spontaneous heaven or Tao. The shaman was transformed into the sage. The shamanic singing and dancing were transformed into personal cultivation. The shamanic ecstasy was transformed into the supermoral aesthetic state. And finally the talk with the spirits was transformed into the unity of human and

nature. When a new social order was set up in the Han dynasty Chinese culture obtained a very unique identity, an identity that has been kept for over two thousand years.

9.1.1.1 Organic naturalism

Needham characterizes Chinese science with organic naturalism. It's very accurate. Organic naturalism apparently contains two parts, naturalism and organicism. Naturalism is against supernaturalism, which holds that not only human beings have spirit, but the whole world has spirit, or is controlled by spirit. Organicism is against materialism (mechanism, reductionism), which holds that everything in the world can be reduced to its parts, even to its composing material.

Naturalism is an essential part of Chinese classical philosophy. It's a major achievement of the metamorphosis from shamanism. Naturalism is best represented in Taoism. The concept of Tao may bear some mysticism with it, but it's nothing spiritual. The Chinese word for nature *zi ran* 自然 literally means "being this way by itself." So nature is essentially spontaneous, not controlled by anything else. In *Dao De Jing*《道德经》, a major book of Taoism there is the statement, *dao fa zi ran* 道法自然, the principle of Tao is nature or spontaneity. Following nature is a basic teaching of Taoism. In this respect Feng Yu-Lan 冯友兰 makes the clear distinction between Taoism as a philosophy and Taoism as a religion. He writes, "Taoism as a philosophy teaches the doctrine of following nature, while Taoism as a religion teaches the doctrine of working *against* nature." (Feng 1966: p. 3) I accepted this idea when I first read his book years ago, but now I think it's debatable. The major argument he provides is that both Lao Zi 老子 and Zhuang Zi 庄子 treat death as a natural process and calmly accept it, but in contrast the Taoist alchemists try hard to avoid death in searching for elixir. If he also clearly sees that the alchemists carry the spirit of science, then are they essentially against nature? What is elixir? It's not a supernatural existence, but a natural substance supposed to be obtained by natural means. In this sense we even should not call them religious. Following nature is not just staying there doing nothing and handing our fate to natural processes. In fact this is against shamanism, which is mostly a very active human endeavor. This is probably closely related to a misreading of a basic Taoist concept *wu wei* 无为. It's not doing nothing as its literal meaning suggests. If Lao Zi still seemingly preaches to keep the pristine state, in Zhuang Zi *wu wei* is a state one needs to pay much effort to reach. Only when one grasps the constant in the incessant flow of change, is *wu wei* possible. In this way we have *wu wei er wu bu wei* 无为而无不为, we can achieve a lot by doing little. But the path leading to this state demands much personal cultivation. This cultivation, the meditation of the hermits and the effort of the alchemists have the same significance. Thus this particular dichotomy between Taoist philosophy and religion becomes superficial.[35]

The central focus of Confucianism is on human relations and society. Confucius tried hard to retain *Zhou Li* 周礼, Zhou customs and ceremonies. But this is in fact not directly a conservative approach, but a very creative one. What's creative is still the metamorphosis. According to Li, the Zhou customs and ceremonies are a developed form of the shamanic ceremonies. The heaven (*tian* 天) in this developed form still bears significant spiritual aura. Although in *Analects* heaven sometimes is talked about as if it had personality and controlling power, that should be interpreted as metaphorical speech. What's most important for Confucius is human lives based mainly on

[35] There does exist a genuine Taoist religion in China. That's about the Jade Emperor, the master of the heaven, but not alchemists and the elixir. The fact that many Taoist philosophy and practices are included in the religion makes the situation really complicated. However we cannot view things superficially.

ethics. A spiritual heaven is not necessary any more. Similarly destiny (*ming* 命) is interpreted as more based on contingency than pre-determination. Later Confucianists have many explicit attacks on superstition and supernaturalism.

According to Needham Chinese organicism is mostly represented in Han-Confucianism and Song-Confucianism, particularly the philosophies of Dong Zhongshu 董仲舒 and Zhu Xi 朱熹. Dong synthesized various schools before him and created the systematic theory of *Yin-Yang* 阴阳 and Five-Elements (*Wu Xing* 五行). The five elements are metal, wood, water, fire and earth. They have little similarity to modern chemical elements. They are more property than matter. For one, all kinds of liquid have water as an element. For another, fire is obviously not matter. More important is the dynamic relations among them. The five elements have mutual production and conquest relations. Also *Yin* and *Yang* are not two independent forces. On the one hand they are more like states or components than forces, although they are also regarded as two fundamental forces. On the other hand they cannot be separated. Everything contains *Yin* and *Yang* in it. They even mutually contain each other. They are also in continuous conversion into each other. The perfect state for a thing to be is in a balance, where *Yin* and *Yang* harmoniously coexist with each other. Generally the relation between *Yin-Yang* and Five-Elements is totally different from that between force and matter in modern science. Another essential part of Dong's philosophy is the theory of correlations. With *Yin-Yang* and Five-Elements as the foundation of the world correlations can be set up among various things and phenomena. The most important are the correlations among the human body, the society and the cosmos. So the emperor is the head of the society and the heaven the head of the universe.

Organicism in Zhu's philosophy is embodied in its two basic concepts of *Li* 理 and *Qi* 气. They are apparently developed out of *Yin-Yang* and Five-Elements, respectively. And they are more abstract, with the undeniable influence from Buddhism. While *Yin-Yang* and their movements are shared by all things and processes, *Li* is what makes a thing that particular thing. Everything has its own *Li*, but there is also a common *Li*. There are contending interpretations of this concept. Feng explicitly interprets it as the Platonic idea. Platonic ideas have independent existence, but sometimes Zhu denies that. Needham contends with such an interpretation. His major argument is that *Li* has little idealist flavor. As he writes, "The work of Chu Hsi [Zhu Xi], therefore, was to remove *Li* from most of its Buddhist contexts, and to restore its ancient naturalist significance, immanent rather than transcendent." (Needham 1954, 2: p. 478) So he interprets *Li* as organization. But the common *Li* causes problem here. We may say everything has its particular organization. However, a common organization doesn't make any sense. In my opinion the reification of basic concepts in Zhu's philosophy under the influence of Buddhism causes the basic tension in it, so that it seems to be ambivalent on some major issues. This also makes the interpretation difficult. Comparatively Dong's philosophy better represents pure Chinese thought. *Yin*, *Yang* and the five elements all exist in particular things and don't exist on their own. Needham interprets *Qi* as matter-energy. This may also be misleading. First this suggests modern scientific meaning which the concept doesn't have. Second *Qi* is more active than raw material. For one thing, it can condense by itself.

The general categorization of organic naturalism has no problem. Chinese philosophy views the world as a human body. On the one hand it's not spiritual, on the other hand it's holistic. Its naturalism agrees with modern science, but not its organicism. Contrary to the Christian worldview, the modern scientific worldview also contains a spontaneous nature. But this nature is mechanic instead of organic. Its model is a machine rather than an organism. Materialism dominates modern science although there is no lack of dissidents. Needham himself is a prominent proponent of organicism.

9.1.1.2 Empiricism

Organic naturalism as the fundamental character determines other aspects of Chinese science and technology. Empiricism is one of them and is mostly based on naturalism. If people believe in spontaneous nature then the best way to learn something from nature is to engage with it directly. That's exactly what the astrologists and the Taoist alchemists did. The observation of the celestial bodies dated back to long time ago. On the basis of observation regularities were figured out. Records show that eclipses were successfully predicted thousand-years ago. It's hard to say that people then already held the concept of a spontaneous nature. But later on it became obvious. The agricultural society depended heavily on the movement of celestial bodies, especially the Sun and the Moon. Chinese used a very complicated calendar, which is based on both the Sun and the Moon. To call it a "lunar" calendar is misleading. Although the months are based on the Moon, the years are still based on the Sun. The 11 day difference between the solar year and the "lunar year" is adjusted periodically with leap months. So unlike the Muslin calendar the Chinese years are aligned with the Christian calendar and the Chinese New Year can only be around the end of January. "Agricultural calendar" (*nong li* 农历) is the name that Chinese call it. And in fact agricultural activities are directly in accord with the calendar. The whole solar year is divided into 24 periods (*jie ling* 节令). There are rules of thumb which recommend in what periods to do what. All these are based on years of experience.

If the goal of agriculture is mostly normal survival, the Taoist alchemists aimed much higher. An essential driving force was the search for elixir, the pill of immortality. So the goal in this case was the ultimate survival. This may appear to be against nature, but it's actually naturalism *par excellence*. The reason why elixir was important was that the alchemists believed that when the human body died life was over. Had they believed that there was a heaven after death elixir wouldn't have made that much sense. Besides, the idea of immortality is in fact not that far away from nature. There are many diseases of the human body that can be cured and aging could be just one of them. When aging is cured the direct result is immortality. It's interesting to realize that modern scientists are reviving this line of thought. Just because the basic thought was naturalism the means they adopted were also natural. They tried to find all the esoteric and scarce materials and then mix them in all kinds of combinations and permutations. Evidences show that quicksilver was one of the most favored materials, perhaps because of its similar appearance to a precious metal and also somewhat mysterious property of evaporability. In so doing the alchemists pushed the empirical method of astrologists a step further, from observation to experiment. No doubt trial-and-error constituted a substantial part of the experiment. But it's not all randomly based. There was no lack of testing of speculations. Needham points out that alchemy is an important part of Chinese science and technology and the ancestor of modern chemistry.

Empiricism is not restricted in the natural area in Chinese civilization. It's also demonstrated in the social-historical area. No other civilization can compare with China in taking meticulous historical records. In traditional China not only the emperor's daily activities were recorded, but most counties also wrote detailed logs. These logs were not just a record of history, but provided historical experience. They showed successors what's good and what's bad. Social policies later would be based on historical experience.

In general we can say that Chinese empiricism is on a par with Baconian empiricism. It starts with experience and tries to draw regularities and lessons from it. Chinese didn't use inductive logic explicitly. But the sophistication they reached is comparable to what inductive logic can.

9.1.1.3 Phenomenalism

The feature I want to talk about here is to some extent related to organicism. Needham also uses the word "phenomenalism," but in a different sense. His phenomenalism refers to the thought that human activities correlatively influence natural processes. For instance, if the emperor behaves immorally the crops will not grow well. This is apparently some residue of shamanism. I use the word here to denote the fact that Chinese science and technology revolve around phenomena. According to this phenomenalism things are what they show up in the phenomena. There don't exist things beyond the phenomena which even control the phenomena behind them. This is also a result of the metamorphosis of shamanism. In shamanism the spirits are still entities that control things from behind the phenomena. When these spirits are despiritualized, when nature becomes spontaneous, what's important is its being this way, but not why it is this way. Hence the focus is on phenomena, but not what lies behind them. This is a unique character of Chinese thought which many people overlook.

Although traditional China developed advanced technologies, its science appeared very shallow compared with modern science. Its scientific theories were mostly direct summaries of experience. The medical theory probably represented the highest form of theoretical construction, but it's still closely associated with experience. The reason for this state of underdevelopment was not that Chinese were not good at abstract thinking, but that they had a quite unique worldview. Generally they only believed in this world. Another world beyond this one was inconceivable. Certainly there were different kinds of superstition and religion in Chinese culture, but the core of culture was against other-worldliness. Evidences show that besides superstitions that were based on primitive shamanism, all higher forms of religion had foreign influence. Buddhism and Christianity were obvious examples. Even the genuine Taoist religion (not about the elixir, but the Jade Emperor) had no local origin. This cultural monism, which will be elaborated later, has crucial implication for the worldview. Thus the world is all about what we can experience. Certainly what we experience is not a world of hodgepodge. There do exist regularities in the phenomena. Chinese science is aimed at these regularities. But a reified natural law that exists behind the phenomena and controls them is beyond the scope of Chinese science.

As mentioned above, this phenomenalism is related to organicism. When the world is regarded as an organism, many phenomena are just normal and don't need further explanation. A prominent example is about the cause of tides. Chinese had known that tides are caused by the Moon long time before Europeans. When Kepler brought up this idea Gelileo dismissed it as a fiction. For Europeans this kind of remote action was inconceivable. Newton's Law of Universal Gravitation finally filled the gap. In contrast for Chinese the interaction between the Moon and the water in the ocean is just normal, because the whole universe is treated like a human body. All parts of the body are interconnected. Therefore some hidden cause behind this interaction is not necessary, even unimaginable.

Phenomenalism was not a problem for traditional China. On the one hand, on the basis of phenomenalism technology was still allowed a large space of development. Technology is more practical than theoretical. Shallow science is compatible with advanced technology. On the other hand human affairs were the core of traditional Chinese culture. And the knowledge of human affairs can mainly stay on the phenomenal level. It's true even up to this date. After its success in the natural world, modern science has tried hard to expand to the human world, but without paralleled progress. Probably there will never be universal laws discovered which govern poem writing, or the course of history. However phenomenalism is obvious the major hurdle for the birth of modern science. This brings us to the Needham Problem.

9.1.1.4 The Needham Problem

Needham's revelation of an advanced Chinese technological past has raised some very interesting questions. A major one is, if China had much better technological preparation then why did modern science originate in Western Europe? Other related questions can also be asked, such as why did China have advanced technology in the past? Why did Western Europe lagged behind in the Middle Ages? The latter two questions seem to be easy to answer. If the whole world was believed to be controlled by the almighty God and everything was believed to be described in the Bible, then all people needed to do was study the Bible. The best minds in the medieval Europe were involved in the proof of God. When people even had no intention to engage with nature it's very unlikely that technology would get well developed. On the contrary Chinese took a very active stance on nature. The naturalist worldview and the empirical method are the two cornerstones of China's technological advancement. However the major question is very difficult to answer. There is still no generally convincing answer up to now. One thing is popularly accepted, that is, China has become a bench-test for any theory about the birth of modern science. Suppose a theory claims that feature *F* is an essential factor in the birth of modern science. Then we would go to traditional China and see if we could find *F*. If it's successful then the theory has a problem, because China provides a direct counter example.

Needham's own answer to the major question adopts a social-economic approach. He maintains that the rise of the bourgeoisie is the essential factor in the birth of modern science. As he writes (Needham 1954, 7.2: p. 211),

> A good deal of work remains to be done on the exact nature of the tie-up between modern science and nascent capitalism. I have always pictured it as beginning with the exact specification of materials. If a merchant purchased a large quantity of oil from a Greek island he would need to know not only what its normal use was, but what it could also conceivably be used for; he would want to know its surface tension, its specific gravity, its refractive index, indeed all its properties, before he could decide who to sell it to.

This doesn't seem to be able to pass the China test. Although there never existed independent city-states in China, capitalist production on a small scale was not rare in China, especially in the Ming dynasty. When the workshops produced goods for the market, they had the same general needs as described above. On the other hand, these particular needs seem to presuppose modern science. When modern science was still not born surface tension etc. didn't make much sense. The merchant had no idea of these things. They would want to learn more about their goods and this would encourage direct engagement and empirical method. But why did they need modern science? Why was something like Chinese science not sufficient?

The Marxist flavor in Needham's answer is evident. He tries to explain a thought movement with economic conditions. Instead I would prefer a Weberian approach. The influence of material conditions on a civilization is undeniable, especially when the civilization is in its primitive stage. But once it gets stronger, mature and even obtains its personality, its internal factors, especially fundamental thoughts that have deposited from history, start to play dominating role in shaping its further development. Weber discloses the influence of Christianity on the rise of capitalism. Similarly I propose that Christianity is the major factor in the birth of modern science. Its influence is not through capitalism, but direct conceptual connections. To explain that, we need to take a closer look at modern science. Baconian empiricism was certainly an important step in the birth of modern science. But it didn't stay with it. If it had done that, something on the level of Chinese science would have been the result. The empirical method is a pillar of modern science, but experience is not mainly used in the Baconian way. Certainly in classifying plants and animals inductive method dominates. In this case Chinese medicine reached the same level. But the major achievements of modern science lie in physics, with the establishment of universal

laws. Here experience is not used as the base of induction, but the confirmation of grand theories. Deduction is more important than induction. In this respect we see the influence of the fundamental Christian thought. In the Christian worldview there are two worlds. Behind the everyday world we currently live in there is also the other world. This other-world is not only the destination of this world, but also controls it. The world of God is eternal whereas that of human beings transient. When this thought is applied to nature the Christians would believe that behind the phenomena there must exist something that controls them. This something finds its embodiment in the universal laws. Most founding fathers of modern science were devout Christians. They had a natural tendency to attribute the universal laws to God's power. When modern science grew mature, it finally could live without God. The universal laws became the new Gods. And when finally scientists are getting closer to a GUT, a new almighty God is again in sight. A different kind of metamorphosis is about to be completed. The angels are transformed into great scientists. The almighty God is transformed into the theory of everything. Supernaturalism is transformed into materialism. Human beings as servants of God are transformed into servants of universal laws and material goods.

Viewed from this perspective the dichotomy between the "Dark Age" and the Enlightenment is not that sharp. Although modern science has dismissed many Christian believes, it took its fundamental thought from Christianity. To a certain extent Western modernity is a radical break-away from the past, but on the fundamental level there exist significant continuity. Back to the Needham Problem. If we answer the major question from the perspective of religion and fundamental thoughts, we seem to have a better solution. Since it starts with the principal difference between Chinese and Western cultures, it passes the China test automatically. The biggest hurdle preventing China from generating modern science is phenomenalism. Based on this basic thought Chinese traditionally didn't believe that there are things controlling the phenomena behind them. This obviously made modern science impossible. On the Western side, we have to admit that this is only a major factor. Besides we also need to take social-economic factors into account. These other factors may further explain why modern science originated in Western Europe but not the Muslim world, although they had a similar religion, and even why it first budded in the Italian city-states.

9.1.2 Major achievements

The choice of the following areas is based on these considerations. Mechanical engineering is the most straightforward technology and has the biggest scope. A majority of the Chinese inventions lie in this area. Although navigation generally didn't have much significance in traditional China, it's chosen in comparison with Columbus's age ushering voyages. Gunpowder is chosen because of its fundamental importance for the whole mankind. It doesn't only have military value, but also widely used in production. Ceramics is a Chinese technology caught up with by the West only very late. Chinese medicine is a unique technology even beyond the interpretation of modern science. It represents the highest sophistication in Chinese technology.

9.1.2.1 Mechanical engineering

Mechanical phenomena are the most direct natural phenomena. Force and motion, space and time belong to our first experience. Mechanical engineering bears primary significance to our daily life. It's no accident that modern science originated in mechanics and the Industrial Revolution was featured by mechanical machines. Also, in the hundreds of Chinese inventions Needham lists those that belong to the field of mechanical engineering occupy by far the largest portion. Reading through his volume about mechanical engineering even a Chinese gets many surprises. Under the impact of Western modernity China apparently has lost some of its memory. And it's

ironic that a Westerner has helped to regain some of the memory. Highlighting several of the surprises I personally got would serve the purpose here.

As most of the modern machines came from the West people tend to think that all the components also originated from the West. But the fact is that some of them were already used long time ago in China. The wheel is an ancient human invention, but a gear-wheel has much more sophistication. The latter is an indispensable component of modern machines. Archeological evidences show that the use of gear-wheels in China can be traced back to at least the Qin and Han dynasties, which was over two thousand years ago. Gear-wheels were mostly used in motion transmission. Other ways of motion transmission adopted in China included driving-belts and chain-drives.

On the basis of various components and basic principles, machine building also reached a significant level in traditional China. Generally speaking automation is far from a new invention in the Industrial Revolution. Automatic machines were already widely used in China long before the Industrial Revolution, ranging from the simple trip-hammers to mechanical toys, including the interesting south-pointing carriage. In the latter case a differential gear mechanism was used to compensate the different rotations in the foot wheels, so that however the carriage moved a pointer would always point to the south. The biggest change that happened in the Industrial Revolution lay more in the field of energy than automation, although the new steam engine based on fossil fuel made further automation possible. In the pre-industrial society the most popular driving force was from humans and animals. Due to the character of instability, with these two energy sources automation is very difficult to implement. Therefore automation was normally associated with another major energy source – water. Compared with humans and animals, rivers are much more stable. The variance is only seasonal. Water has the same advantage over wind, although wind may be as powerful. The use of water mills in China also has a very long history. Driven by the water wheels that turned steadily, automatic machines can be built.

In connection with technological development in Western modernity two technologies in traditional China have prominent significance. The first is the air blowing box, which plays a pivotal role in metallurgy. The continuous compressed air blowing into the stove makes possible a much higher temperature. The box is normally made of wood and has a shape of elongated cuboid. A piston operated through a handle moves back and forth in the box and pushes the air in it alternately out through a mouth at either end. Valves are used to guarantee that when the piston retreats it takes air from outside and when the piston advances it pushes air through the mouth. This simple mechanism is actually adopted in Watt's steam engine. The process is just essentially reversed. While in the blowing box the blowing of air is initiated by the alternate motion of the piston, in the steam engine the alternate motion of the piston is caused by steam blowing into the engine. Second, the imperial clock probably represents the highest achievement in the field of mechanical engineering in China. This is also a total surprise to me. Before I learned this I had always believed that clocks were first invented in Europe. But in fact Chinese built a complicated clock several centuries before the first European clock. Unlike modern clocks which are driven by weights or springs, the Chinese clock was driven by water. But all the clocks share the same mechanism of escapement, so that the ticking is possible. The Chinese clock also drove a celestial globe, so that it turned around once every day. Thus the globe essentially models the rotation of the Earth.

9.1.2.2 Navigation

The traditional Chinese culture is generally an agricultural one. Agriculture dominated the economic scene, but it would be a big mistake to think that Chinese only had interest in the land.

Chinese culture originated in the northern Yellow River valley, which is far from the sea. However people in the south have a long seafaring tradition. Even in the north contacts with foreign cultures started a long time ago, in which the famous Silk Road was an important part. When Chinese society expanded to the south, curiosity, trade and seafaring tradition combined to promote high-sea navigation. In Chinese history people can see a tension between the adventurous seafaring activities and the Confucian moral codes that are based on agriculture. While the former always has to do with trade and commerce, the latter looks down upon commerce. Of course the latter occupied the dominating position, but the former also had the chance to flourish in some periods. Government sponsored seafaring can be traced back to the Tang dynasty, but it culminated in Zheng's seven expeditions to the Indian ocean in the Ming dynasty.

In terms of technology seafaring consists of ship building and navigation itself. High-sea navigation first has much higher requirements on the ships. High seas have much bigger waves than inland rivers or lakes. Stability is the foremost requirement. Size certainly matters here, but it's not the only stability factor. The shape of the body, the rudder, the keel and the position of the masts all contribute to the stability of the ship. Although paddle-wheel ships driven by treadmills had been invented in traditional China, the driving force for high-sea navigation had to come from the wind. So the moving of a heavy ship demands multiple tall masts and big sails. High-sea navigation itself doesn't just involve the maneuver of the rudders and the sails. Weather forecast, position and direction recognition are more crucial. Big storms should be avoided, but beneficial wind need to be utilized to drive the ship. Both are dependent upon weather forecast. The land is out of sight in the high seas. Sailors used the Sun during the day and stars in the night to recognize the direction. Obviously bad weather caused problem for this method. The compass came into play in this case. It's a crucial invention in navigation. Without it the ship had to wait in bad weather.

Columbus's first voyage to the New World in 1492 is thought by many to have ushered the Modern Age. About a century earlier Chinese led by Zheng He 郑和 under the auspices of Emperor Yongle 永乐 launched several expeditions to the Indian Ocean in a much larger scale. A straight comparison can demonstrate the technological edge China had during that period. In terms of ship size, Columbus's flagship was about 25 meters long and had 3 masts, whereas Zheng's flagship had a length of over 100 meters and 9 masts. The latter had 4 decks. It's built with a V-shaped hull, at the bottom of which a keel ran across. This design helped cut through large waves in order to increase stability. Other innovations on the ship included bulwark compartments, stern posts and balanced rudders. Drydocks were used in the ship building process. In terms of fleet size, Columbus's second voyage involved the most ships, with the number of 17. The number of passengers carried was about 1,200. In contrast, Zheng's biggest fleet contained over 300 ships and close to 30,000 passengers and soldiers. Eyewitnesses recorded that when the fleet came to shore the sails looked like clouds on the horizon. With that scale the vessels in the fleet were very specialized. There were water tankers, horse ships and battle ships. The most important ones were certainly the treasure ships loaded with silk, porcelain, art works and other treasures, which were used as gifts or in the trade. With that many people on board the crew members were also diversified. There were doctors not just to take care of the passengers, but also collect herbs in foreign countries, military commanders and soldiers to protect the fleet, secretaries to take logs, diplomats and translators to contact the hosts visited, and astrologers and geomancers to forecast the weather and provide other scientific advice. Of course the supply for the fleet was huge. It took months to prepare a voyage. But once in the sea the fleet was able to sustain itself for a month. Various reasons caused later emperors to discontinue the

voyages. So China's technological edge in navigation was gradually lost. But it still took several centuries for the West to reach that highest point.

9.1.2.3 Gunpowder and ceramics

Gunpowder is one of the most important contributions of China to mankind. Fire making endowed humans with unprecedented power. The making of gunpowder is a similar event on a higher level. The atomic bomb is the next step in the same line. Gunpowder as seen in the current form has undergone a long history of gradual improvement. The first half of the history happened in China. The story began with Taoist alchemists, who searched eagerly for elixir by mixing all sorts of material in various combinations. It was a sheer accident that some alchemists got their hair and beard burnt when doing their daily mixing and heating job. At the beginning there were explicit instructions in the alchemists' books which warned with dangerous effect against mixing sulphur, saltpeter and certain source of carbon. The use of this effect was later realized, apparently first in combat. As Needham points out, it's a misconception that Chinese mostly used gunpowder peacefully, as in firecrackers and fireworks. Certainly China has a long history of making sophisticated fireworks, but since the beginning gunpowder has been used in wars. As recorded gunpowder was not that explosive in the first phase. The reaction then was slow and the gunpowder gave out sparks continuously. Only when the ratio of nitrate was raised did the explosive effect appear. We see both effects in today's fireworks. When soldiers used swords and spears some weapon that could give out continuous sparks might be really intimidating.

Gunpowder certainly played a pivotal role in the Western modernization. The use of the bombard greatly changed the power balance in the West and undoubtedly paved the way to the Modern Age. The modernization itself is heavily dependent upon gunpowder, especially as used in mining. But before gunpowder spread to the West and underwent its modern phase of development, China had improved the technology to a significant level. After the explosive formula was discovered all kinds of explosive weapons were invented, including landmines, bombs, grenades and finally cannons. Up to this day Chinese still take a leading role in making fireworks. Gunpowder was even used to propel objects in China. There was a weapon literally called a "fire arrow," in which case an arrow was propelled by attached bamboo tubes filled with gunpowder. Legend has it, there was a person called Wan Hu 万虎, who even tried to go to the Moon by sitting on a chair. To the legs of the chair were also fastened thick bamboo tubes filled with gunpowder. When the gunpowder was lit, there was a big smoke. Then nothing could be found. Some believed that he really flew to the Moon like a fairy. Where did he go was not very important, but the idea of space travel was probably true.

Ceramics is another inorganic compound that was well developed in China. It's roughly a general term referring to all the artifacts that are made of clay through heating. Normally the clay is an artificial compound, made by mixing various materials. Bricks which are directly made of ordinary clay are not counted as ceramics. Still there are ceramics of different quality. Chinese explicitly distinguish two classes of ceramics, pottery and porcelain. Again the boundary is not crystal clear. Normally pottery is thick, matt and dark-colored, mostly reddish, whereas porcelain is thin, glossy and light-colored, mostly white. The latter is apparently deemed to have higher quality than the former. It's much more favored and expensive. In traditional China ceramics was a material as widely used as metal and wood. Earth was one of the Five Elements. Ceramics was most popularly used as containers, from dining ware, through water jars and flower pots, to jewelry containers. But it's also used to make art works. Chinese have been making ceramics for millenniums. The history can be traced back to the Neolithic period on the basis of existing archeological evidence. Pottery dominated the earlier phases. The famous Terracotta Army of the First Emperor was a good example. But what made China special was the high quality porcelain

produced in the later phases. Great technological improvement happened especially in the Ming dynasty. The porcelain became much finer and complex paintings could be ingrained in it. Another feature of the Ming porcelain was that foreign motifs were widely adopted. Porcelain exportation was also encouraged, so that the influence of Chinese porcelain grew fast. Porcelain was directly called china in English. In the 19th century when Hegel almost regarded every aspect of China as backward, he had to admit that China was still the leader in making ceramics.

9.1.2.4 Medicine

When we reach medicine we have moved from physics through chemistry to biology. But as we will see Chinese medicine is more than biology. Medicine is concerned with the human body. In the Chinese world of organic naturalism the human body plays a pivotal role. In a sense we may say that the world is modeled after the human body and is treated as an organism. Because the human body is closely related to the worldview, we see in medicine the most sophisticated theory building in traditional Chinese science and technology. Mechanical engineering and the making of special chemical compounds, such as gunpowder, ceramics and paper, can be based on direct experience. On the other hand, although medicine is also heavily dependent upon experience, it tries to postulate something beyond direct experience. The concepts of *jing* 精 and *qi* 气 may be too abstract and vague, but *jing* 经 and *luo* 络 are much more concrete and precise. The latter are based on reproducible specific empirical evidence. Even in medicine the theoretical postulates are not far from experience. In light we cannot experience properties of electro-magnetic wave. But the theory of *jing* and *luo* are more like a summary of connections found among various body parts.

The fundamental theory behind Chinese medicine is a holistic view of the human body. In fact this holistic view goes well beyond the human body itself. The holism is indicated in several aspects. First, all the parts in the human body are interconnected. They influence one another and it's impossible to isolate one part from the rest of the body. Second, there is no dichotomy between mind and body. They interact with each other. Third, there is no dichotomy between nature and human body either. Good health presupposes a harmonious relation between man and nature. And finally an individual cannot be isolated from society, from his social relations. The social relations directly have an impact upon a person's health. Now we can see Chinese medicine is much more than biology. The holism is in stark contrast with the mechanical view of the human body in modern Western medicine. When a disease appears in this case it would be analyzed and the direct cause isolated, and then drugs and surgery would be used to remove that particular cause.[36] Given this fundamental difference Chinese medicine still shares with modern medicine two other basic ideas, naturalism and empiricism. It adopts natural methods instead of invoking supernatural spirits, like in shamanism, to cure the disease. It also has the highest respect for empirical evidence, although it doesn't have to be quantifiable and accurate.

Chinese medicine has been practiced for thousands of years. Its effectiveness is undoubtable. It's still the case in modern China when Western medicine is widely adopted. There are cases where a disease cannot be cured with Western medicine, but is finally cured with Chinese medicine. In such cases very often a particular cause cannot be diagnosed, so Western medicine is at a loss. When a holistic approach is adopted sometimes it turns out to be very effective. In Chinese medicine a disease doesn't have to have a particular cause, it could be just an unbalanced body. In diagnosis the patient as a whole human being with his life history and social relations is treated as the target, not just a specific body part. The most fascinating diagnostic method is pulse feeling.

[36] Modern medicine will be further discussed in Chapt. 11.

Long before Harvey Chinese doctors already had the idea of blood circulation. For an experienced doctor the patient's pulse tells a lot. A surgery performed long time ago could be detected. The curing method ranges from physical (massage and acupuncture), through chemical (herbs and food) to psychological (advices on life style and social relations). Except extreme cases like the massage of strained muscle, the cure is targeted at more than a particular body part. People have tried to explain the effects of Chinese medicine in terms of modern medicine. The effect of the herbs may well be explicated in terms of chemistry. But some of them are just too incalcitrant. Acupuncture is a good example. It's based on the theory about *jing* and *luo*, which are theoretical nets of connections within the body. *Xue wei* 穴位 are nodes on the nets that are close to the body surface. Acupuncture is carried out through putting a needle in certain *xue wei*. A body part far away may be affected. Attempts have been made to interpret the effects of acupuncture with modern science, but none is successful. *Jing*, *luo* and *xue wei* have no anatomical bases. They are not nerves. Just how two remote points in the body are connected seems to be beyond modern science. Acupuncture has been successfully used for anesthesia in modern surgery. In this case the effect is undeniable.

9.2 The Place of Technology in Traditional Chinese Culture

In the last section we discussed the technological achievements in traditional China. We can see, technology was well developed in traditional China. To a large extent this good development can be explained by the philosophical foundations of science and technology. The naturalist worldview and the empirical method were the two major contributors. Now we will put Chinese technology in a larger cultural context and examine its place in it. First a general characterization of Chinese culture is necessary.

9.2.1 The general characters of Chinese culture

When we talked about the philosophical foundations of science and technology in the previous section, we briefly discussed the sublimational metamorphosis of shamanism. This can be used to interpret the whole Chinese culture. What resulted from the metamorphosis was not just naturalism, but more importantly a very unique type of humanism. The basic feature of this humanism is what I call "immanent transcendence." It strives for transcendence and tries hard to go beyond everyday life; however this transcendence is not supposed to be achieved outside of this life, but within it. This type of humanism is the core of Chinese culture. It may be elaborated in the following aspects.

9.2.1.1 Cultural monism

Cultural monism here refers to the belief that there exists only this world, the world we currently live in. On the contrary, all higher forms of religion hold cultural dualism. Christianity is a perfect representative. Besides this human world Christians believe that there also exists a world of God. When a human dies his soul will leave this world, be judged and finally put in heaven or hell based on his deeds in this world. Buddhism also teaches dual worlds. This world is a phase in an endless series of cycles. Beyond this series there also exists an eternal world. Asceticism is their common practice. For Christians abstinence increases their chance of going to heaven after death. They believe a sharp dichotomy between body and soul. Body is assumed to be the burden of soul. For Buddhists desires are the source of pain in this life. They want to avoid pain as much as possible through controlling desires. This also increases their chance of escaping the series of cycles and entering the eternal world. It's hard to say whether shamanism holds dual worlds with such distance in between. The spirits in shamanism have intimate relations with humans and they

interact with each other. Anyways when shamanism underwent metamorphosis in Chinese classical philosophy the spirits were transformed into spontaneous nature. The other-world became impossible, because nature obviously belonged to this world.

In order to put this basic idea in a bright light we need to dispel a very influential confusion. In particular, we have to handle the seeming dichotomy between Confucianism and Taoism. It's argued that Confucianism focuses on human affairs, especially ethics, whereas Taoism focuses on nature. While the former emphasizes the importance of ceremonies *Li* 礼 and encourages people to get involved in social affairs, the latter regards ceremonies as a burden and teaches people to follow nature and live a simple life. So even a dichotomy between this-worldliness *ru shi* 入世 and other-worldliness *chu shi* 出世 is proposed. The Chinese words are already biased, but the English translations are more misleading. They could easily mislead a Western reader to think that Confucianism is about human ethics, whereas Taoism is a religion like Christianity. Hegel, for one, thinks that *Analects* is just a collection of moral rules. The facts are that Confucianism is far from just about human ethics and that Taoism is essentially not a religion, such as the one about the Jade Emperor, which is created under foreign influence. While Confucianism and Taoism have different emphases on human life, on a fundamental level they are much more similar. They are both the results of the same metamorphosis of shamanism and constitute the two pillars of Chinese culture. And due to their somewhat contradicting emphases they complement each other and make a harmonious whole. The Chinese spirit is also clearly demonstrated in the relation between Confucianism and Taoism. Unlike in Western thought, good and evil are not two opposing poles for Chinese. *Yin* and *Yang* are the poles, but good is the balance and harmony between them. In a sense we may say that good always resides somewhere in the middle. On the other hand, evil represents unbalanced and inharmonious state.

Li offers a very interesting interpretation of Confucianism. He starts with shamanism and claims that Confucianism is a rationalization of it, but the final goal is an aesthetic state, which he still calls "religious". On the other hand, evidences show that he generally treats Taoism as escapism. Feng's interpretation of the three stages of Taoism is insightful, but his interpretation of Confucianism is not that wonderful. For instance, he holds that the rectification of names *zheng ming* 正名 is definition of them. And he thinks that the relation between Confucianism and Taoism is roughly that between classicism and romanticism. It's my general impression that while Song-Confucianism was under the great influence of Buddhism, modern Confucianism is under the great influence of Western thought. Due to the scope limit of this essay it suffices here to point out the basic commonalities between Confucianism and Taoism. The basic feature of the metamorphosis of shamanism is not rationalization, but the despiritualization of spirits and the sublimation of humans. Reason was never separated from its context in Chinese thought. The opposite of reason is not supernaturalism – otherwise the proof of God wouldn't be possible – but emotions, desires, etc. The dichotomy between reason and emotion doesn't exist in Chinese monistic world. Hence such a dichotomy as that between classicism and romanticism is impossible. In fact Confucianism emphasizes emotions and desires no less than Taoism, and on the other hand Taoism honors rules and regularities no less than Confucianism. They even cannot be divided along the line of *ru shi* vs. *chu shi*. If Confucianism just had its sight on moral regulations in everyday life, it wouldn't have dominated Chinese culture for centuries. What's more important is its distinct pursuit of transcendence, that is, going beyond everyday life. The central Confucianist idea *Ren* 仁, human-heartedness, actually is not an ethical concept (altruism), but has much cosmic connotation. The Confucianist transcendence is most explicitly expressed in Mencius' notion of *hao ran zhi qi* 浩然之气. It's no other than the unity of heaven, Earth and humans. On the other hand, if we may still characterize Taoism as escapism in a very narrow sense, it's absolutely not in the sense of asceticism. Even in the first phase, Yang Zhu 杨朱, by

becoming a hermit, tries to preserve life from the pollution of society. He may regard the society as a burden, but never his body. In fact both body and soul are important for Chinese. There is no dichotomy here either. In the third phase, Zhuang Zi even doesn't encourage people to become a hermit. One may achieve transcendence in everyday life and live everyday life with transcendental insight. In this case even the dichotomy between *ru shi* and *chu shi* itself disappears. Generally when we consider the relation between Confucianism and Taoism, compared with their fundamental similarities their differences are secondary. Their common basic feature is immanent transcendence.

On the basis of Christian dualism there are a variety of dichotomies in Western thought. To name a few most fundamental, there are matter vs. mind, body vs. soul, subject vs. object, reason vs. emotion and individual vs. society. All these don't exist in Chinese monistic world. When Chinese cultural monism is under the impact of foreign dualist culture, one direct reaction is that it tries to assimilate it. The best example is no other than Chanism 禅宗. Asceticism and meditation belong to the cultivation method required by the orthodox Buddhism. In contrast Chanism, as a new school, discards this method and holds that Buddhahood exists in our daily life. So to reach Buddha one doesn't need to go to the temple and refrain from a list of desires. One may live a normal everyday life and see Buddhahood in a state of so-called "sudden enlightenment." In this way, Chanism is very close to Zhuang Zi's philosophy.

9.2.1.2 Unity of naturalism and humanism

Cultural monism directly resulted from the despiritualization process in the metamorphosis of shamanism. When the spirits were naturalized, the supernatural other world was abandoned. In this way the Chinese culture became irreligious. However, the Chinese monistic world is not just any naturalistic world. As we've discussed, Chinese naturalism is organic naturalism. It sees the world as an organism. This can also be explained by the metamorphosis of shamanism. Unlike in Christianity, where humans are just the servants of God, in shamanism humans play a much more active role. A shaman doesn't just listen to the spirits, he may influence them and in extreme cases he even can punish them. When this role is sublimated a very prominent humanism is the result. Humans stand at the center of Chinese culture. It's natural that they are used as the model of the world. The organism as the model of the world is in fact the human body. Not only is the whole universe treated as a human body, but also many of its parts, such as the society. In this way the Western dichotomy between human and nature doesn't exist in Chinese culture. They are all interconnected and inseparable.

The relation between humanism and naturalism is closely related to that between Confucianism and Taoism. A popular view holds that the former is about human ethics and the latter nature. We've shown above that this is a major bias concerning Chinese thought. Here we look at it again in a different perspective. The main support for this view is probably the fact that most part of *Analects* talks about human affairs, whereas *Dao De Jing* contains many statements about cosmology. This seems to be the only evidence we may find in this respect of support. Later Confucianists almost all are concerned with cosmology too, starting with Han-Confucianists' *Yin-Yang* and Five-Elements, through Song-Confucianists' *Li* and *Qi*, to modern Confucianists' ether. On the other hand the central concern of *Zhuang Zi* is apparently human affairs. The core question it tries to answer is how one can live a happy life in this world. We focus on the first two books here. Confucius tries to preserve Zhou customs and ceremonies, so they occupy a significant part of *Analects*. Are those customs and ceremonies all artificial? This seems to be the dividing question of Confucianism and Taoism. While Taoism answers Yes to this question, the answer from Confucianism is negative. There are evidences in the book showing that Confucius believes that they are a natural order people should follow and the chaos people experienced at

his time was the result of disobeying that order. The rectification of names is just going back to the order. The principle of *jun jun cheng cheng fu fu zi zi* 君君臣臣父父子子 asks the emperors, ministers, fathers and sons to all behave as what they should. But what one should behave is just his proper function in the society. And the society is understood as an organism just like the whole universe. In this way the proper function of a certain social role is a natural function. So an emperor should be a sage who can lead people, a minister should follow the emperor, a father should take care of and guide his child and a son should respect and obey his father. All these look so natural for a certain historical stage. In a sense we may say Confucius also teaches people to follow nature. Although this now needs to be called human nature, in Chinese classical philosophy there was no clear distinction between human nature and cosmic nature. Certainly a social order that seems to be very natural in one stage could turn out to be very artificial in another. This is the basis of the Taoist negative attitude toward Zhou customs and ceremonies. And after Confucianism was used to build the new social order in the Han dynasty, Taoism has been a dissenting voice ever since. But that doesn't mean Taoism has little human concern. Even in *Dao De Jing*, when we take a closer look we will find that it talks about human affairs more than cosmology. And very often the talks about both are connected and put in the same chapter.

Organicism is obviously the foundation of the unity of naturalism and humanism. When the world is viewed as an organism, human and nature as two components become inseparable, because different parts of the organism are interconnected. Further, as the world is modeled after the human body, humans gain priority and become the center of the world. So in this unity humanism also has priority over naturalism.

9.2.1.3 Poetic philosophy

The central status of humanism in Chinese culture further determines the style of Chinese thinking. Specifically Chinese philosophy is poetic philosophy. In this respect we see another sharp contrast between the West and the East. In many of Plato's dialogues he tried hard to reach a clear definition of the key concept. Based on this Aristotle later developed a sophisticated system of formal logic. This has been dominating the Western thinking ever since, through scholasticism in the Middle Ages to scientific thinking in the Modern Age. On the contrary formal logic never dominated traditional Chinese thinking. It budded in the School of Names (*Ming Jia* 名家), but never had a chance to further develop. There were various criticisms on the School of Names, among which that from Zhuang Zi was probably the most prominent. The chapter of *Qi Wu Lun* 齐物论 in *Zhuang Zi* contains the specific critique of the concepts of Yes, No, I and Other (是非彼我) of that school. The gist of the critique is, the School of Names assumes that Yes, No, I and Other are all static, but the real world is dynamic and undergoing incessant change. Hence the principle of Yes is Yes and No is No cannot capture the real world well. Yes can change into No; No can also change into Yes. The same thing may be Yes when looked from one perspective but No from another. This critique can be applied to formal logic generally.

Another of Feng's main ideas provides a good reference here. He maintains that Western philosophy adopts a positive method whereas Chinese philosophy uses a negative one. In his words, "The essence of the positive method is to talk about the object of metaphysics which is the subject of its inquiry; the essence of the negative method is not to talk about it. By so doing, the negative method reveals certain aspects of the nature of that something, namely those aspects that are not susceptible to positive description and analysis." (Feng 1948: p. 340) While the characterization of negative method captures an important aspect of Chinese philosophy, it has two drawbacks. First, it's somewhat misleading. Chinese philosophy in fact doesn't avoid talking

about the subject directly. For instance, there are dozens of places in *Analects* where the core concept of *Ren* is discussed directly. Second, how the negative method reveals certain aspects of the subject is not clear. Instead of the positive-negative distinction I propose the formal logical-poetic distinction. I believe that the poetic method better captures the style of Chinese philosophy and this also makes it more relevant for the current time.

The poetic method of Chinese philosophy was best represented in *Analects*, *Dao De Jing* and *Zhuang Zi*, the three major Chinese classics, and permeated in later works. The three classics represent the exemplary method, the aphoristic method and the metaphorical method, respectively.

Contrary to Feng's idea that *Analects* tries to provide definitions of the major ethical concepts, such as *Ren* and *Yi*, it actually adopts an exemplary method. As we mentioned, there are dozens of places in *Analects* where direct statements about *Ren* are offered. Those statements are definitely not definitions of *Ren*, because they are so different and sometimes even look inconsistent with each other. This cannot be the case with definitions in formal logic. Instead of abstract definitions those statements are about *Ren* in concrete examples. What is *Ren*? A general definition is impossible. A definition presupposes an essence, but such an essence doesn't exist in the case of *Ren*. So an alternative approach to it is through various examples in concrete cases. With dozens of concrete examples we should be able to obtain a general idea of *Ren*. If *Ren* looks inconsistent in different cases, it's not a contradiction in the sense of formal logic, but just reflects the complicated character of it. The whole *Analects* generally consists of records of the life fragments of Confucius and his disciples. It's not a collection of ethical rules and regulations, as Hegel holds, or a rationalization of Zhou customs and ceremonies through definitions of various ethical concepts, as Feng maintains, but instead an embodiment of humanism with the core character of immanent transcendence in the example of a prominent sage. Since it's an example we should not blindly follow its words, but first try to reach the spirit through the example and then apply the spirit to our own cases.

Dao De Jing adopts a quite different approach. It contains direct statements about the subject matter, but its statements are short and insightful. This kind of statements is called aphorisms and the method of *Dao De Jing* is aphoristic. An aphorism doesn't try to spell out everything, but is a thought provoking stimulus. So the thought it aims at is not explicitly stated but left open for the reader. Very often the thought it aims at cannot be stated explicitly, or once it's stated it becomes static. *Zhuang Zi* adopts yet another method. It contains many fables and therefore many of its central ideas are expressed metaphorically. It holds a famous theory about language, which is articulated in the statement *yan bu jin yi*, *de yi wang yan* 言不尽意,得意忘言, language cannot spell out all the meaning and when we get the meaning we may forget the language. This vividly depicts the metaphorical character of language.

The exemplary, aphoristic and metaphorical methods are frequently used in poems. They constitute the distinct way of saying of poetry. So they may be generally called poetic method. The poetic method is negative in a sense, in the sense that the thought is *not* expressed directly or explicitly, but not in the sense that it tries to avoid the subject matter and intentionally gets into mysticism. Hence on the other hand it's also very positive. Given that the thought aimed at cannot be stated directly or explicitly, it still tries hard to approach it in an alternative way. Therefore the distinction between the Western and Chinese thought in terms of methodology is not a positive-negative one, but a logical-poetic one. And although the logical method has dominated Western thought, there is no lack of poetic method. Anyways all the poets have to adopt the poetic method in their poems and many poems obviously are loaded with profound thoughts. Goethe's *Faust* contains much philosophy in it and Eliot's *The Waste Land* offers much more insight on Western

modernity than many standard philosophical treatises. Further the poetic method has also been adopted by Western philosophers, with Nietzsche and Wittgenstein as two prominent cases. In Wittgenstein we see the clear distinction between the logic and poetic methods of his earlier and later phases of thought, respectively. Also in Wittgenstein we see some convergence of the Western and Chinese thought. His non-essentialist family resemblance and ladder metaphor of language are two salient converging points. When looked in this way the method of Chinese philosophy gains much significance for the current time.

9.2.1.4 Meritorical elitism

The poetic philosophy is based on humanism because the poetic method is the best approach to human affairs. As we said, Chinese humanism is a special humanism, with the basic character of immanent transcendence. This determines another general aspect of Chinese culture, meritorical elitism. When transcendence lies in the other world, elitism is also possible in this world. Historically the clergy were the elites in the Western medieval society. They were elites because they were thought to be closer to God. But on the other hand egalitarianism is also compatible with this kind of transcendence. When this world is regarded as a transient phase leading toward the eternal world, what essential difference can exist in this world? Human beings are essentially the creation of the almighty God. Thus the principle of "All men are created equal" is a natural derivation from the Christian thought. The modern egalitarianism starting with the Religious Reformation and flourishing in democracy may be seen as a direct descendent of Christianity. On the contrary, when transcendence lies in this world egalitarianism is very unlikely. Naturally people are born with different talents, and further with different cultivations they arrive at different levels of development. Immanent transcendence implies inequality in this world.[37]

The basic idea of elitism is that some people are better than others. Two issues immediately arise. One is what the criteria of good are and the other is what the implication is. The criterion of good could be just birth. In a hereditary aristocratic society a child born into a noble family is better than many others just by birth. That's not the case in Chinese traditional society. The criterion it adopted is instead merit, so Chinese elitism is meritorical elitism. Further, merit itself is a vague concept. It may have different criteria in turn. Specifically in Chinese tradition merit is interpreted as the cultivation with humanities (literature, philosophy and history) and the ability to handle human affairs. Given that some people are better than others in terms of merit what does it mean? The answer from Chinese tradition is that meritorious people should lead or rule in the society. This is actually meritocracy. Meritorical elitism is embodied in the ideal of the sage, with the slogan of "sageness within and kingness without" (*nei sheng wai wang* 内圣外王). The sageness is the expression of immanent transcendence and can only be reached through learning and personal cultivation. Feng divides four spheres of living: the innocent sphere, the utilitarian sphere, the moral sphere and the transcendent sphere. These are in fact four rungs of personal cultivation, with immanent transcendence as the highest goal. When the sageness is approached by a person, he has the natural duty to influence others and contribute to society. In this way he may share the light he's obtained with others and help others move toward the highest goal. The ideal of the sage is not just a corner stone of Chinese philosophy, but also incorporated into the value system and social management. The dominating Confucianist ethics values learning and personal cultivation and teaches people to respect and follow the sages. The examination system picks learned and capable people to fill the management positions from ministers down. One may wonder what Plato would think had he realized that a couple of centuries after he wrote *Republic* a powerful state would be established in the other end of the Old Continent which was essentially ruled by philosophers.

[37] Obviously the word "inequality" is used in a broader sense than political inequality.

In summary all the four basic aspects of Chinese culture revolve around humanism of immanent transcendence. Cultural monism is the foundation of humanism. The Chinese monistic world is the human world. The unity of naturalism and humanism is a result of this special kind of humanism. Organicism is the middle link between naturalism and humanism. Poetic philosophy is also determined by humanism, because human affairs are essentially poetic. And finally meritorical elitism is the expression of immanent transcendence.

9.2.2 The place of technology

With Chinese culture characterized we are ready to examine the place of technology in it. After sufficient preparation this has become an easy task. Since humanism stands at the center of Chinese culture technology only plays a subordinate role. But this doesn't prevent technology from being well developed. Generally we see a perfect historical model of the embracing-controlling-stance on technology in traditional Chinese culture.

9.2.2.1 Central humanism and practical naturalism

We have seen that the core of Chinese culture is humanism. In traditional Chinese society, government official was the most prestigious profession. And government officials were often selected with examinations on literature, philosophy and history. So traditional Chinese society was mostly ruled by poets and philosophers. The central concern of culture was to keep a harmonious social order. This order has to be based on proper interpersonal relations. Ethics, which contains values and regulations concerning interpersonal relations, was at the core of culture. It teaches people how they should behave in society. On the other hand, engineers, who were the driving force of technological development, were mostly illiterate and thus played a subordinate role. In Chinese monistic world there seems to be only one fundamental dichotomy, that between mental scholars and manual workers. Poets and philosophers mostly use their brains while engineers mostly use their hands. The Confucian doctrine of *lao xin zhe zhi ren*, *lao li zhe zhi yu ren* 劳心者治人,劳力者治于人 (Those who use their brains rule and those who use their hands are ruled.) is a straight reflection of the order in traditional China, specifically the order between humanities and technology. Generally humanities are central whereas technology subordinate.

But this doesn't mean that technology was not important. Needham points out, given the fact that Chinese population has for most part of history been about a quarter of the world population and therefore China had abundant source of human labor, it still took every chance to improve technology in order to save labor. As early as the Tang Dynasty the ministry of engineering (*gong bu* 工部) was one of the six ministries of the government. Occasionally higher officials in this ministry were picked from prominent engineers, bypassing the examination system.

Naturalism is an essential part of Chinese thought. As this naturalism is closely related to humanism, it is directly put to practical use. The doctrine of following nature is adopted by both Confucianism and Taoism. But following nature is not a blind following. It's not incompatible with taking advantage of natural knowledge for the benefit of humans. Although there is no distinct concept of conquering nature in Chinese thought, grasping the regularities in natural phenomena is an important part of immanent transcendence. And the study of nature is generally for a human purpose. In the general frame of cultural monism Chinese philosophy doesn't regard material life and spiritual life as two opposing poles. While valuing spiritual life it doesn't look down upon material life, or even see it as a burden or sin. So to improve material life is also a

teaching of Chinese humanism. Technology is obviously good at improving material life. This practical naturalism is the philosophical foundation of technological development.

9.2.2.2 A perfect historical model

Central humanism and practical naturalism combined determined the place of technology in traditional Chinese culture. On the one hand humanities, higher culture stood at the core of society. On the other hand material culture was not neglected. Therefore, while technological innovation was encouraged, technological development was under the great influence of core culture. As one indication, technologies that were closely related to central social management were unproportionally well developed, such as the calendar and clock. As another indication, technologies that were deemed to have potential threat to social order were prohibited, such as firearms.

Going back to the central idea of this essay, here we can clearly see an embracing-controlling-stance on technology. Compared with modern technology, premodern technology was not powerful enough to cause such huge damage. However this doesn't mean that technology would be necessarily embraced. Technology primarily improves material life. So when material life is looked down upon, people are not well motivated to make technological innovations. This might to some extent explain the technological lagging-behind in medieval Europe. Technology was embraced in traditional China because material life was also honored along with spiritual life. In Chinese culture material life itself doesn't represent evil, but only material life to an inappropriate degree does. As long as spiritual life is kept in charge the improvement of material life is always good. So technological innovation was generally encouraged. The only condition was that technology had to conform to the central values of culture. In other words technological development was controlled according to those central values. In general traditional China provided a perfect historical model of the embracing-controlling-stance on technology. This doesn't mean that all the old values should be kept. What's relevant today is the general stance. This leads us to the topic of Chinese modernization.

10. Technology in Chinese Modernization

Chinese modernization started rather passively, under the impact of the Western political/military and economic expansion. When the Western missionaries first came to the Qing 清 Empire, they admired the prosperity of its society and the luxury of its court life. While the Industrial Revolution was under way in the West, Chinese never thought of following suit. Then the Western industrialized nations got upper hand over a weakened Qing empire, partly due to internal social turmoil. A bunch of ports were forced to open to Western colonization and trade.

A primarily military modernization in the Qing dynasty was short lived. Then came the Chinese revolution which overthrew the Qing dynasty and finally founded the People's Republic. During the revolution China was feeling more and more influence of the Western culture. Science and democracy were the core themes of the New Culture Movement at the beginning of the 20th century. Then there was the famous debate between Chinese philosophy and Western science. That definitely provides some insights for Chinese modernization. No matter what the actual route looks like, the basic goal of the People's Republic is to modernize China. Science and technology always play a predominant role. That's one of the most consistent features we can see in its several decades of history. Scientism and technocracy is obvious in its culture.

Generally Chinese modernization so far is a process in which Chinese culture is under the great influence of Western modernity. Science and technology is one of the main focuses in it. Westerners had labeled their traditional history as a "Dark Age." Accordingly Chinese soon got into a complete self-denial. Compared with all the advantages of Western modernity, everything traditional was regarded as backward. For many people modernization was equivalent to Westernization. However for a unique and enduring culture like Chinese, modernization cannot be that straightforward. An effective modernization can only be based on a synthesis of tradition and modernity.

In the previous case study we've seen that traditional China provided a historical model of the embracing-controlling-stance on technology. This case study is a continuation of the previous one. Specifically I show first that this well balanced stance was gradually lost in Chinese modernization under the influence of Western modernity, and second that the stance can be recovered on the basis of a more fundamental synthesis of Chinese tradition and Western modernity. So after a thought historical survey of Chinese modernization I talk about how China could contribute to alternative modernity.

10.1 The Thought Path of Chinese Modernization

How the West started to break away from the past and got on the path of modernization has been a very important topic of study. Many people agree that Columbus's voyage to the American continent was an age ushering event. It disclosed a whole new world before the eyes of Europeans. The trigger of Chinese modernization couldn't be more different. To a large extent we can say that China was forced by Western imperialism onto the path of modernization. And when that happened Western Europe had already undergone the major part of the Industrial Revolution and was about to enter its heyday of overseas expansion. However on a more fundamental level the two cultures share something common. In both cases the break-away needed an unprecedented impact from outside. Evidently the overseas exploration brought unprecedented impact upon the European society. But a similar event couldn't provide the same impact upon

Chinese society. As we discussed in the previous chapter, about a century before Columbus Zheng had led overseas expeditions on a much larger scale. The expeditions reached Africa and brought back black diplomats and all sorts of foreign goods, including the most fascinating giraffes, which for a long time Chinese have misidentified as the legendary animal *Qilin*. For all the fascination that came with the event, Chinese society kept intact. Anyways Chinese had been in contact with foreign cultures for centuries. The Silk Road was probably not the earliest incident.

The closed, static image of China is just an illusion based on the impression of a modern China in comparison with the West projected onto its whole history. If it's a misconception of the Christian medieval West as a "Dark Age," then traditional Chinese society was far from closed and static. A straightforward counterargument is that a closed and static culture can't be so enduring. The key to the long survival of Chinese culture is its power of adaptation. This requires both open-mindedness and dynamic. The ironic thing is that Chinese themselves gradually fell into that illusion under the impact of Western modernity and later Western sinologists helped a lot with dispelling that illusion. In a sense we can say, the reason why the break-away in China came late was not that its culture was closed and static, but on the contrary, just because its culture was open and dynamic it needed a much stronger impact to initiate that event.

The contact between China and Western modernity has a much longer history than Chinese modernization. Western missionaries came to China as early as in the 16th century. They brought the clocks and modern science to China. These two things played such an important role in Western modernization, but they caused minimal effect in China. The clocks were only treated as toys and modern science was used in building the royal observatory. Beyond that everything went as usual. The relations between China and Western Europe were peaceful for a long time. The missionaries acted as the main channel of cultural exchange. They introduced European culture to China and Chinese culture to Europe. For a short period of time there was even a Chinese fashion in France. While Leibniz was fascinated with the binary system in *The Book of Changes* (*I Jing* 《易经》), Voltaire took every chance to attack French absolutism in comparison with China's enlightened monarchy. Shortly before the Opium Wars the Chinese society still looked so far so good. The reason why the British imported opium to China was that China had gained upper hand in bilateral trade. The damage the opium had caused enraged Chinese people and officials. On the other hand more and more confident Europeans couldn't bear the arrogance of Chinese government any longer. When Lin Zexu ordered thousands of chests of opium from British traders confiscated and destroyed conflict was inevitable. In the following decades Chinese culture finally felt an unprecedented impact from outside. But it's a bitter experience. The industrialized West demonstrated its advantage in one conflict after another. For the first time China also fell victim to Western imperialism. For a culture that had dominated for centuries, it could only be a double humiliation. The humiliation was so deep that almost two centuries later Chinese are still living in the shadow of it.

With this great impact started the Chinese modernization process. In this process we clearly see how Chinese culture reacted to the impact. This is an unprecedented test of its power of adaptation. Before this Buddhism constituted the biggest impact, but Western modernity was a much more dramatic one. So far we've seen the open-mindedness and dynamic of Chinese culture displayed to their fullest. Compared with Japan China's adaptation to Western modernity may seem to be too sluggish. However in comparing two cultures we shouldn't forget about their historical background. For centuries Chinese culture had been a dominating one. Therefore it had much more inertia to change course. A powerful and successful tradition may turn out to be a big burden in a new context, but the richness of a culture just constitutes the basis of its future potential. On the other hand an adaptation presumes the keeping of identity. The modernization

process won't be complete until Chinese culture regains its clear identity. What follow are the three steps in the thought path of Chinese modernization. When a superficial reform was proved futile, it swung to the opposite, complete self-denial. So the current struggle becomes the search for its identity. The next section is a preliminary attempt toward that direction.

10.1.1 The reform in the late Qing

Shortly after the humiliation elites in the Qing responded with reform. The advantage of modern technology was demonstrated patently in the conflicts. So the core of the reform was to adopt Western technology. As the humiliation directly came from the military conflicts, military reform was a major focus. Students were sent to foreign colleges, foreign technicians were hired, and arsenals and shipyards were built. Within a couple of decades a navy was put up. Of course military was not the only focus. Besides, mines were opened, telegraph cables were extended and railways were paved. In the meantime modern science and technology were introduced into the new curriculum. The reform was mostly championed by three prominent scholar officials Zeng Guofan 曾国藩, Li Hongzhang 李鸿章 and Zhang Zhidong 张之洞. After Emperor Xianfeng 咸丰 died, with two consecutive child emperors the absolute power was actually grasped in the hands of Empress Cixi 慈禧. The reform of the scholar officials was approved by Cixi, to some extent because that was proved to be an effective way to suppress the Taiping and Nian uprisings. Unfortunately the reform led by the scholar officials received its fatal blow in the Sino-Chinese War, in which Li's north fleet was devastated. Some scholars were infuriated by the ensuing Treaty of Shimonoseki and persuaded now grown-up Emperor Guangxu 光绪 to carry out more radical reform. It's essentially to follow the Japanese model of constitutional monarchy. This was apparently beyond the tolerance of Cixi. She ordered six leading scholars executed and Guangxu put under detention. The dynasty thus got into an impasse and was doomed.

Several decades since the Opium Wars Chinese society had greatly changed. Before that it still went on its traditional track. If the influence of Western culture was also discernible it was at most peripheral. Several decades later many Western elements were absorbed. In late Qing we see the first attempt of Chinese culture to cope with the impact of Western modernity. The thought of reform was best expressed in Zhang's *The Only Hope of China* (*Quan Xue Pian*《劝学篇》) . In it we can read a synthesis of tradition and modernity. Although it may look very shallow and straightforward according to today's standard, it's a very meaningful preliminary endeavor. In my opinion its general stance is still valid and it contains quite a few insights. The synthesis Zhang proposed could be summarized in the catchword "*zhong ti xi yong* 中体西用" (Chinese learning is the core whereas Western learning is the instrument.) His Chinese learning referred to Chinese philosophy centered on Confucianism, which had been the dominating thought in China for centuries. His Western learning mainly referred to modern technology. So the gist of this synthesis was to keep Chinese traditional philosophy and social order intact, but at the same time adopt modern technology. In terms of technology this was a slight variation of the traditional embracing-controlling-stance. Obviously here technology was still regarded as an instrument. The variation lay in technology, and only traditional technology was replaced with modern technology. Zhang explicitly maintained the continuation between modern and traditional technologies. Given China's long tradition of technological development, this synthesis was quite straightforward.

According to the central idea the book was clearly divided into two parts: the inner part and the outer part. The inner part was about Chinese learning and the outer part Western learning. The book title literally meant "persuasion to learn." Its aim was to persuade the readers to learn from the West. But in learning from the West people ought first to hold on to Chinese core values. In

accord with the current situation he put a distinct emphasis upon keeping the traditional social order. In the third chapter of the inner part titled *Ming Gang* 明刚 he repeated the importance of the social orders between emperor and subjects, father and sons, and husband and wife. He argued that there existed similar orders in the Western society, although particularities were different. The sixth chapter titled *Zheng Quan* 正权 talked about democratic thought. First he listed several points to argue against it. The main argument was that most of the citizens were still ignorant and near-sighted, so there's no use to set up a parliament. The other arguments boiled down to the necessity of the government. Companies, factories, schools and military all needed the sponsorship of the government. This didn't mean Zhang was totally against democratic thought. He at the same time emphasized the importance of the laws. He stated *min quan bu ke jian*, *gong yi bu ke wu* 民权不可僭, 公议不可无 (the rights of the people cannot go beyond their governors, however common discussions are necessary). For the time being the people's opinions could be submitted, but the governors discussed them and decided. Only after the majority of the people were well-educated would open debate be possible. Another central idea was expressed in chapter five entitled *zong jing* 宗经. Here he stressed the dominating status of the Confucian classics *Analects* and *Mencius*.

If the inner part was about what should be kept then the outer part was about what should be changed. The central idea of change was to increase people's knowledge and skills, certainly through learning from the West. This was the content of the first chapter titled *yi zhi* 益智. At the end of the chapter a popular idea was refuted. That idea was that Chinese are not as intelligent as Westerners, due to the rule of the emperors in the past. This was actually a major foundation of the self-denial dominating later. So Zhang's refutation of it was very remarkable. He pointd out that the idea was not in accord with China's history. China had been taking a leading role in the past. And the current lagging-behind was caused by the fact that people now stopped learning things diligently. In order to catch up with the West we had to learn from them. The following chapters mostly handled a particular area, including studying abroad, setting up schools, translating extensively, reading newspapers, reforming the examination system, learning agricultural, industrial and commercial technologies, learning military technologies, mining and railway. Several points are worth highlighting. The first is Zhang's general stance on reform, as discussed in chapter seven entitled *bian fa* 变法. He stated what should be kept are *lun ji* 伦纪 (ethics), *sheng dao* 圣道(philosophy) and *xin shu* 心术 (morality) and what might be changed are *fa zhi* 法制 (laws), *qi xie* 器械 (machines) and *gong yi* 工艺 (technologies). Second, he distinguished *zheng* 政("politics") from *yi* 艺("arts") in Western learning. "Politics" referred to social technologies, such as laws, taxation, etc. "Arts" referred to natural technologies, such as mathematics, mining, medicine, etc. And finally he advocated that Chinese should be tolerant to Western missionaries, not slander and attack them.

Looked from today's perspective Zhang's synthesis is rather conservative. When all the traditional values and social orders are kept intact modernization is impossible. Modernization is not just about modern technology. On the basis of China's traditional stance on technology adopting modern technology in China's value system doesn't cause much theoretical or practical difficulty. Anyways for centuries technology has been treated as a useful tool and innovations encouraged by Chinese culture. However there are more fundamental reasons than technology for the advancement of the West. And that just points to the basic flaws in Chinese traditional society. Zhang should have realized how far China could go when the course of the whole society was to a large extent based on the will, or just the whim of an Empress Cixi. On the other hand, when we put Zhang's ideas in the historical context they resided in, they were very open and forward-looking. It's a little amazing that right after China fell from a dominating nation with haughty arrogance to a pitiful victim of Western imperialism its elites could quickly respond and take a

peaceful and modest attitude to learn from the West. In Zhang's book it's not difficult to feel a strong confidence. That confidence definitely came from the power of culture. What's more important, I think, is that his general stance is what Chinese modernization should finally adopt. The general spirit of *zhong ti xi yong* is valid although the particularities should be adjusted. In my opinion, Chinese modernization should have Chinese culture as the core and elements from Western modernity assimilated.

10.1.2 The debate at the beginning of the 20th century

Chinese history in the first half of the 20th century was no less eventful than in the second half of the 19th. The latter was featured with humiliation and reform, whereas the former was featured with revolution and further humiliation. A final constitutional attempt couldn't resolve the crisis in the Qing society. Elites from Han Chinese, especially those overseas, more and more put the blame of humiliation upon the Manchu authority. Although some were still moderate and wanted to keep the current social order, the revolutionaries led by Sun Yat-Sen 孙逸仙 gathered more and more support. Preliminary assassination attempts finally grew into a large scale uprising. The Qing dynasty was toppled, which ended over two thousand years of Chinese imperial history. Right after the revolution nationalists under Sun was not strong enough to take over the central power. Soon the power vacuum resulted in a warlord period. Most of the warlords came from factions of the New Army created at the end of Qing. Only after the successful North Expedition did the nationalists defeat the warlords and assume central authority. Further humiliation came from the Japanese invasion in the Second World War. The atrocities the Japanese imperial army performed in China even shocked many Westerners who lived there at that time. There was no lack of stories in which Westerners came to the rescue. This time the nationalist government had to bear part of the blame of the new humiliation, due to their bad performance in the war. On the other hand the communists managed to grow much stronger in the anti-Japanese guerrilla war. Viewing the communists as a challenging power, the nationalist government had been trying to suppress them for a long time. But after the Second World War the communists were posed to participate in a peace talk with the nationalist government. When the talk broke a civil war was unavoidable. Weakened by the Japanese invasion and internal corruption the nationalists were defeated, even with heavy support from the US.

Between the fall of Qing and the Japanese invasion there was a flourish of thought. With the ending of the authoritarian traditional society scholars were rethinking about the way of Chinese modernization. Most of the cultural elites came back from studying abroad. Compared with the scholar officials in Qing they had a wider vision and therefore were able to think about the issues deeper. Certainly the flourish of though was featured with hot debates. The one we discuss here is the most significant for the modernization theory. It's the famous debate between the school of science and that of *xuan xue* 玄学, briefly called *ke xuan lun zhan* 科玄论战 in China. Science is modern science. The core idea of the school of science was scientism. Expressed in a simple sentence, modern science is almighty and can explain all the phenomena. The school of *xuan xue* tried to clarify the boundary of science and point out that some areas are beyond the reach of science. The word *xuan xue* was a derogatory name given by the rivals. It alludes to mysticism. In the eyes of the proponents of scientism, those who claim the boundary of science advocate mysticism. The general result of the debate was that the school of science claimed a big victory, and the school of *xuan xue* were labeled as ghosts (*xuan xue gui* 玄学鬼) and their ideas suppressed. Hence the derogatory name also became popular.

The school of *xuan xue* had an explicit aim to defend Chinese philosophy against scientism. However the debate was not just a conflict between Chinese philosophy and Western science, but

had a wider background. With the rise and development of modern science the materialist, mechanistic worldview became dominant. But there was no lack of dissidents in the West. Among those who had influenced the school of *xuan xue* Bergson was a prominent figure. He put more emphasis on intuition than reason. Even in the camp of scientists there were also opponents of the standard worldview. The German biologist-philosopher Driesch was in China during the debate. He proposed a neo-vitalist philosophy based on his study in embryology, which is totally against materialism and mechanism. In this way the debate in China was closely related to the humanism-scientism and holism-mechanism dichotomies in Western thought. This double background and the fact that they were intertwined make the debate even more meaningful for the modernization theory, especially what this essay is concerned with.

The debate was initiated by Zhang Junmai 张君劢, who published a paper titled *Ren Sheng Guan* 人生观 ("View of Life"). He was acting as the interpreter for Driesch at the time. In the paper he pointed out five basic distinctions between science and non-science, which he vaguely called the "view of life". This vagueness turned out to be a major flaw of his idea and partly led to the mysticism accusation. Specifically his five distinctions can be listed as follows:

Science	**Non-science (View of Life)**
Objective (Universal)	Subjective (Diverse)
Logical	Intuitive
Analytic	Synthetic
Causal	Free Will Related
Uniform	Unique

With a little clarification and adjustment this is a very accurate list. When he talked about objectivity and subjectivity he actually meant universality and diversity. His subjectivity had little solipsistic flavor as some accused. On the other hand, he seemed to confuse universality with uniformity, although the two are closely related. A more appropriate correspondence should be universality vs. uniqueness and uniformity vs. diversity. Besides the vagueness in the concept of non-science he was not clear with a logical aspect of the distinction. To demarcate strict science the features on the left side have a conjunctive relation, and so the features on the right side are disjunctive. Opponents brought up counterexamples of non-science which didn't have *all* the features on the right side. However this would be invalid, had he made it clear that they were disjunctive. It's not Zhang's final goal to reveal the boundary of science. His central concern was to defend Chinese philosophy. In the scientistic world there is no place for Chinese philosophy to reside. On the contrary, if science has a clear boundary, if there is a big realm beyond science in human life, then Chinese philosophy still has its significance in the Modern Age. In the paper Zhang pointed out the importance of the method of Confucian philosophy, which he characterized as the "cultivation of inner life" (*nei xin sheng huo zhi xiu yang* 内心生活之修养). He thought this is the basis of spiritual civilization in contrast to material civilization. He writes, "The view of life has no objective standard, therefore we have to resort to ourselves. There is no way for us to take somebody else's view of life and treat it as ours." (Zhang et al. 2009: p. 4) This was a distinct statement of defense, but it at the same time manifested the solipsistic and relativist flavor.

Zhang's paper set the framework of the debate. From today's perspective the debate around science was rather rudimentary. The study of science constitutes a significant endeavor of Western learning in the 20th century. Chinese then still had a preliminary understanding of modern science, although most of the participants had strong Western background. On the other hand, considering this historical context one may still be amazed by some of the ideas brought up in the debate. An interesting pattern in the debate was that those participants on the side of science mostly came back from England and the US, whereas those on the side of *xuan xue* mostly came back from the European continent. So it to some extent reflected the dichotomy

between Anglo-American analytic philosophy and European continental philosophy in the Western thought. The major meaning of the debate lies in Chinese modernization and the modernization theory in general. The reform in the late Qing was a first response of Chinese culture to the impact of Western modernity. The synthesis proposed was to keep the traditional social order while adopting modern technology. This had been proved to be futile. With the collapse of the traditional social order it got into the second phase. Now the synthesis moved onto a deeper level, that of philosophy. Zhang was just a prominent representative of a grand endeavor to synthesize Chinese and Western thought. This is an on-going endeavor. But unfortunately the special historical situation in China determined that the self-denial of Chinese culture became more and more dominant. The self-denial already manifested itself in this debate. Scientism in the school of science was to a large extent based on this self-denial. It's evident that many participants in the school of science had an instinctive contempt of Chinese traditional culture and an admiration of Western culture. In their eyes China had just moved away from a backward stage and we had to learn everything from the West in order to modernize China. This self-denial reached monopoly status in the next phase.

10.1.3 Scientism and technocracy

The humiliation from the Western imperialism and the further humiliation from the Japanese invasion created a humiliation complex in Chinese national psychology. The basic symptoms of the complex are a strong sense of victimization and fervent nationalism. The communists were good at playing with this complex to their own favor. According to Marxist historical theory, every culture goes through five stages of development: primitive communism, slavery, feudalism, capitalism and communism. With the feudal tradition condemned and the capitalist imperialism hated, communism seemed to be the best way for China to go, the best way for China to recover some sense of superiority over the West. Therefore the communists claimed that they were launching a new revolution with the slogan of "Anti-Imperialism and Anti-Feudalism" (*fan di fan feng* 反帝反封). In this way both Chinese tradition and mainstream Western culture became enemies. After the People's Republic was established, in the international environment of Cold War, for the first time in its modern history China turned completely hostile to Western powers. But it still didn't forget its main task of modernization. If the major damage of imperialism to China was partial loss of sovereignty and this had been regained with the establishment of a new China, an underdeveloped economy remained the central concern. This was the major motivation behind the Great Leap Forward. China's hostility to its own tradition reached its peak in the Cultural Revolution, in which people were trying to destroy almost everything old. The reopening to the West and adoption of capitalism might look dramatic in the communist rule, but when one views China's modern history as a whole this is more norm than exception. Taking advantage of the globalization trend at the turn of the century China has achieved an economic miracle in a couple of decades. As Chinese gradually move out of the shadow of humiliation, a natural question they ask themselves is *Who are we*?

In a sense the complete self-denial in the third phase was a continuation of the previous one. Shortly after the collapse of the Qing dynasty there was a small scale of enlightenment movement in China. In the famous New Culture Movement "Mr. D" (democracy) and "Mr. S" (science) were worshiped by forward-looking scholars. It seemed, with the ending of the imperial history all of China's traditional past should be broken away from, just like the Western Enlightenment was thought to be a complete break-away from the medieval "Dark Age." From the view of these scholars a synthesis was not necessary, even impossible. The only way for China to go was to follow the West. As we have seen, in the previous phase there were still scholars who tried to defend Chinese culture. That no longer meant traditional social order, or even certain traditional value. But for them the core of it should be kept. So some kind of synthesis was necessary. In the

third phase any such attempt was suppressed, and thus the self-denial became a complete self-denial. The adoption of simplified Chinese characters was an effort toward that direction. But the craziest idea in this respect was to abandon Chinese characters by Romanizing them. *Pinyin* 拼音 was meant to *replace* Chinese characters, although it ended up a very useful phonetic help.

Communists had no interest in Mr. D, and therefore Mr. S gained predominant favor. When it was believed that a more advanced social system had been established and all the important philosophical and social thoughts could be found in works of several paramount leaders, the only task left in competing with the capitalist West was to develop economy through modern science and technology. The creation of an atomic bomb and the launch of a satellite were proved to be able to bring so much glory to the nation. Now that science was so useful, scientism was the natural result. The difference was that this time scientism was not debatable, but part of the framework. In fact the word *ke xue* 科学 (science) gained many positive meanings: good, correct, appropriate, advanced, etc. Einstein was revered in China no less than in the West. Students were educated under the slogan "If we study mathematics, physics and chemistry well, we will fear nothing wherever we go." The most intelligent students automatically chose a field in science and engineering. Social science and art were looked down upon.[38] Science didn't just dominate people's carriers, but also their thoughts. In a debate about a topic far from science participants would ask opponents to provide proof, which meant empirical evidence.

In the reopened China humanities, social sciences and arts had a slight chance to develop, but science and technology still dominated. People with engineering background were selected as leaders. Tons of money was poured into the space program in order to continue to win glory for the nation. The society developed under the Marxist slogan "Science and technology are the first power of production." Even a balanced development was called "scientific development." Students now admire Bill Gates instead. They are fascinated with all sorts of hi-tech gadgets.

Looking at the whole process of Chinese modernization one can find a general pattern. Chinese culture has gradually lost ground to Western culture. And due to special historical circumstances what China has absorbed from Western modernity is unevenly predominated with science and technology. Specifically, in the first phase we see Western technology absorbed in an untouched traditional value system and social order; in the second phase there was a significant amount of effort to synthesize Chinese and Western philosophies, but it was suppressed by a self-denial of tradition with a salient scientism; and finally in the third phase the self-denial moved to its extreme, with the monopolization of scientism. So far the impact of Western modernity has caused the first swing in Chinese culture. It has greatly deviated from its original course, and is apparently close to the limit. As *Dao De Jing* states *fan zhe dao zhi dong* 反者道之动 ("Reversal is the movement of *Dao*"), evidences have shown some reverse movement. After several decades of dramatic economic development China's GDP is posed to surpass that of the US. Now Chinese are refocusing on their traditional culture. Prior to the Modern Age China had been enjoying a leading economy with leading technology for centuries. Yet that's not what China is essentially about. Without its philosophy China can at best look like a soulless strong man. The recent fashion of Chinese classics was one indication of that reversal.

However China cannot keep swinging between the two poles of tradition and modernity. What's needed is a synthesis of the two, so that the impact of Western modernity could be absorbed and

[38] Personally I was fascinated with Einstein's grand unification theory of the universe in high school and for a long time I had been aiming at the physics department at University of Science and Technology of China, which is a direct subordinate of Chinese Academy of Sciences. There one could meet top students from all the provinces.

China could step on a new stable path. The syntheses that were done in the second phase are especially helpful toward the final goal. Generally the synthesis has to be on a more fundamental level. The next section contains my personal attempt. In connection with the core issue of this essay, the traditional embracing-controlling-stance on technology has been gradually lost in the three phases of modernization. The recovery of the stance is dependent upon refocusing on traditional humanism.

10.2 How Can China Contribute to an Alternative Modernity?

Needham points out six aspects in which Chinese culture may contribute to the cure of modern malaise (Needham 1954, 7.2: Chapt. 50 (d)). They are 1) organic humanism as a counter weight of materialism and scientism, 2) immanent ethics as a potential alternative to address the modern moral issues, 3) organicism as a way to go beyond the matter-spirit dichotomy, 4) co-operative mentality as a cure of atomic individualism, 5) non-formal logic as an important complement of rigid formal logic, and finally 6) the harmonious relation between human and nature as a correction of the domination of nature. No wonder this is a list coming from a prominent China expert. It contains the most fundamental elements in Chinese culture which may be used to handle modernity issues. But what I see here is more of comparison than solution. If, facing the problems in Western modernity, we just show that China has something quite different in its traditional society, that wouldn't help a lot in solving those problems. If it's very unlikely for the Western society to go back to its own traditional stage, it's even more so for it to follow the Chinese way. The aspects listed are at best a starting point and something more needs to be done. Anyways China needs to modernize itself. In doing so it has to pick certain elements from Western modernity. Both point to some kind of synthesis, a synthesis of Chinese tradition and Western modernity. This is what's most important. Hopefully with this synthesis the West could gain some insights to cure some of the modern malaises and China could have its own modernity without some of the existing problems. To achieve a good synthesis, first the right elements from both sides need to be identified, and second all the elements have to be integrated into a harmonious whole. A preliminary attempt will be made in this section.

On the basis of the theory of alternative modernity, what elements to pick from Western modernity are very clear. Individualism and industrialization are identified as two essential features of modernity. Further, industrialization is based on modern science and technology and the fundamental thought behind them is materialist naturalism. So from the Western side we pick materialist naturalism and individualism. The study of Chinese traditional culture has revealed its two fundamental thoughts, organic naturalism and humanism with the core feature of immanent transcendence. These are the two elements we pick from the Chinese side. Therefore the synthesis is the integration of these elements. Materialist naturalism and organic naturalism are integrated into organizational naturalism, so that they become two parts of it. While materialism holds the lower end of the organizational spectrum, organicism grasps the middle of it. Both are biased. Our known universe is neither just a huge conglomerate of elementary particles, nor a giant organism. They only represent two different levels of organization, but we have a spectrum of five levels. Individualism and humanism are integrated into elitist diversity. In fact Chinese humanism is compatible with individualism. The ideal of the sage is mostly about an individual. However the individual embodied in a sage is not a rational being pursuing its own interest, but a natural human being with rich emotions, pursuing immanent transcendence, with social responsibility as one of its essential parts. So it's elitist by nature. The reform of Chinese humanism under the individualist principle is more about emphasizing tolerance and diversity and restructuring the social relations. Generally elitist diversity is the opposite of egalitarian universalism. While the latter tends to foster dubious individualism, the former promotes genuine

individualism. And finally organizational naturalism and elitist diversity go hand in hand. Organizational naturalism values complexity, but at the same time admits that there are different levels of complexity. Similarly elitist diversity honors the pursuit of transcendence and perfection, but meanwhile respects different forms of perfection and tolerates different levels of perfection individuals can reach. The key in organizational naturalism is organization and complexity. The key in elitist diversity is the determination to go beyond and the effort paid toward that.

Therefore, we may draw the following diagram to illustrate the synthesis here proposed. The origin of Chinese tradition and Western modernity in shamanism and Christianity respectively is also demonstrated.

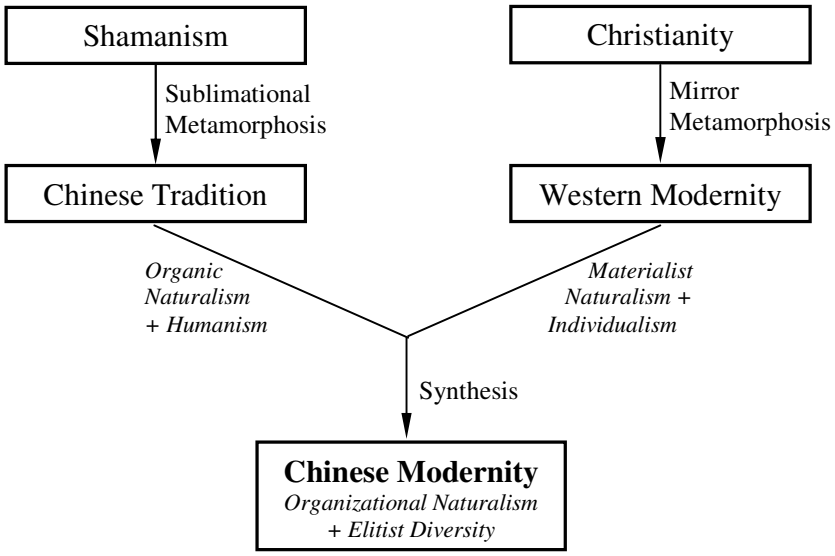

Fig. 10.1 Chinese modernity as a synthesis of Chinese tradition and Western modernity

We can see here a distinct parallelism between the histories of thought at the two ends of the Eurasian continent. But there is no correspondence between Chinese tradition and Western tradition. In terms of ideas Chinese tradition in fact corresponds to Western modernity. This may appear to be a very astonishing position, but several basic evidences support it. First, Chinese tradition and Western modernity share some fundamental ideas. Naturalism is the most salient. And Chinese humanism contains much individualist element. The difference between them more reflects horizontal cultural difference than vertical stage difference. Second, they both came from a form of religion through a certain kind of metamorphosis. Chinese tradition was created from the primitive shamanism through a sublimational metamorphosis. Western modernity was created from Christianity also through a metamorphosis. We may call this a mirror metamorphosis from the view of the organizational spectrum. When the transcendental existence was moved for spirit (God) to matter (elementary particles), a mirror image was created on the spectrum. Basically we go from one end to the other end. Both metamorphoses share the common feature of moving away from supernaturalism. Third, in terms of social structure the equivalent of the hereditary feudal society in the medieval West ended in China right before Chinese classical philosophy was created. The social structure in traditional China was quite different from that in the West. Only the emperor was hereditary, whereas all the ministers and lower officials were selected through examinations. Certainly it's not modern either. But there is more correspondence between the Zhou dynasty and the Middle Age. So in terms of time line this parallelism is really uneven.

While Chinese traditional society started over two thousand years ago, Western modernity was born only about five centuries ago. This unevenness to some extent explains the lagging-behind of the former. It started that early and had been running well, so if there was no significant impact from outside, it wouldn't change its course. In this way very old things could be kept for a long time. The long history of Christianity is a similar case.

In light of this parallelism the synthesis of Chinese tradition and Western modernity doesn't seem to be that difficult. But to reach this parallelism is the crucial part. When traditional China is regarded as the equivalent of the medieval West, it is treated as a "Dark Age" that should be broken away from. This view has gradually dominated the Chinese modernization process, although there are people, especially the modern Confucianists, who have tried hard to keep Chinese thought. For those who hold the radical view, a synthesis doesn't make sense, for everything has to start from scratch. Very likely they end up with copying everything from the West. Even the syntheses provided by the modern Confucianists are too Westernized. Basically they stand in the Western framework and try to make sense of Chinese thought. What this essay tries to do is stand outside of both to make sense of both. Then a synthesis is much easier.

From the perspective of Chinese modernization, it needs to take modern science and technology and individualism from Western modernity. Given China's naturalist and humanist tradition the major reformation needed is in social structure. The philosophical integration of both is not too hard. Specifically naturalism is expanded and humanism is generally kept. In this way the core of Chinese tradition doesn't change. In the end coping with the impact of Western modernity will be similar to Buddhism. Chinese culture will adapt itself a little and then the impact will finally be absorbed. What can this synthesis contribute to the Western side? Organizational naturalism is not culture specific. It has direct meaning for the West too. But it implies a fundamental paradigm shift from materialism. Elitist diversity may be too unique to Chinese humanism. But the West definitely needs some kind of humanism to get out of egalitarian universalism. Otherwise there is probably no way to regain meaning.

In the rest of this section we discuss the elements in details.

10.2.1 From organic naturalism to organizational naturalism

The synthesis starts with metaphysics. Organic naturalism is the metaphysics of Chinese traditional thought. It's a major result of the sublimational metamorphosis of shamanism. Shamanism as a primitive religion involves supernatural spirits. But the role of humans in shamanism is far from subordinate and passive. Shamans don't just listen to and follow the spirits. They may also influence the latter through various kinds of magic. In this sense humans are on a par with the spirits. They communicate and interact with each other. In the sublimational metamorphosis the supernatural spirits are despiritualized whereas humans are sublimated. The result is a nature intertwined with humans. On the one hand nature is modeled after humans, and on the other hand humans strive to follow nature. So humans and nature are unified. Organic naturalism in Chinese classical philosophy (predominantly Confucianism and Taoism) goes hand in hand with humanism. Since the model of the organic nature is the human body, from the view of Chinese philosophy nature is a giant organism. It's connectivistic and holistic.

Shortly after Chinese classical philosophy was created out of shamanism, it started to dominate Chinese culture. This had been generally the case for over two thousand years before the great impact of Western modernity. Higher forms of religion existed in Chinese culture, but all under heavy foreign influence. The Taoist religion was to a large extent based on Taoist philosophy, so it contained the most native elements. But the core of Taoist religion, that is, the assumption of a

powerful supernatural Jade Emperor was beyond Taoism. This central idea had to be taken from foreign cultures. The exact source was vaguer than other cases. Buddhism came later and had a clear origin. The introduction of Christianity into China was a relatively recent event. Before the Modern Age the Taoist religion and Buddhism were the two dominant higher forms of religion. But the religious situation in traditional China was that, no religion could take the monopoly role. Besides these two higher forms of religion, residue of shamanism was also prevalent. And generally religion was not the core of culture. That place was occupied by classical philosophy.

The story is quite different in the West. Christianity originated in the Middle East. In a sense it's also foreign to Western culture. But since it's officially adopted in the Roman Empire it's been dominating Western culture. Some people claim that Western culture is inconceivable without Christianity. This is no exaggeration. Similarly we may say Chinese culture is inconceivable without its classical philosophy. Therefore the big contrast arises. Compared with shamanism Christianity is a much higher form of religion. Fundamental changes can be found on both sides. On the supernatural side, multiple spirits are turned into a single God and spirits with moderate capability are transformed into an almighty God. On the human side, human life becomes a transient preparation for an eternal life and humans are degraded to obedient servants of God with an original sin to redeem. Humans and spirits have even statuses in Shamanism and they closely interact with each other like peers. With the balance between the two sides tilted in Christianity a distinct dichotomy emerges, the dichotomy between the human sphere and the divine sphere. The former is changeable, transient, subordinate and contaminated whereas the latter timeless, eternal, dominant and pure. This fundamental dichotomy is the basis of almost all the dichotomies in Western thought.

Western modernity may look to be a complete break-away from Christianity, but in fact it's further development through a metamorphosis. On the fundamental level there is distinct continuity. Western modern philosophy started with three major dichotomies: subject vs. object, emotion vs. reason and mind vs. body (matter). Western intellectuals have been struggling with them ever since. All of them were derived from the above fundamental dichotomy. In these three pairs the first item corresponds to the human sphere and the second the divine sphere. In epistemology the object was first regarded as reality independent of humans. They were deemed as the foundation of truth. The subject's knowledge was just a representation of this independent reality. The subject is essentially an image of the object, just like humans are images of God. In the subject itself a gap was put between different parts of it. Reason was regarded as the sole path to objective reality, desires and emotions were treated as impure and contaminating, even illogical intuition and insight as mysterious. And finally in metaphysics we see the mirror metamorphosis. In the Christian worldview the soul is active and immortal whereas the body passive and transient. So the body is subordinate to the soul and even seen as a burden. In the modern scientific worldview the order is reversed. Here body, or more accurately matter, becomes primary whereas mind or soul derivative. Matter as embodied in elementary particles is eternal. In contrast mind is not only transient, but a sham that can be reduced or eliminated. What we see is a mirror image. In this mirror image supernaturalism is replaced with materialist naturalism. However, just like in the metamorphosis of a caterpillar into a butterfly, although the look greatly changes the identity is kept, in the metamorphosis of Western culture we also see some fundamental continuity. If we consider elementary particles metaphorically as the new gods the situation in the dichotomy between the human sphere and the transcendental sphere (the physical sphere in this case) is kept all the same. In the scientific worldview the human sphere is still changeable, transient, subordinate and contaminated whereas the physical sphere timeless, eternal, dominant and pure.

Although materialist naturalism is the dominating view in Western modernity, there's no lack of dissenting voices. From Leibniz's monadology to Whitehead's process philosophy scholars have brought up alternatives to the standard mechanical materialism. Post-Newtonian physics and embryology gave much force to the dissenting voice, although the standard view was further solidified in molecular genetics and artificial intelligence. Particularly Needham is a strong proponent of organicism based on his study in embryology. What's more meaningful is that he tries to associate traditional Chinese metaphysics with modern organicism. I don't agree with all of his specific discussions in this association, but I admit they share some general common characters. Unlike mechanical materialism they both compare the world to an organism, instead of a machine. The most salient distinction between a machine and an organism is that, the former can be analyzed into independently-defined, standalone parts whereas the latter cannot. When we take apart a clock and then put all the parts together again we get the clock back. In contrast we cannot do this to an animal, or even a plant.

Organic naturalism is an alternative to materialist naturalism, but it cannot replace the latter. If the whole world is not a giant machine, it's not a giant organism either. Machines and organisms are just different kinds of entities in our known universe. We need a better view to accommodate both. This brings us to organizational naturalism. It treats organization as a separate dimension besides matter. Organization is said with reference to a system. It consists of not only the structure of the system, that is, how matter is arranged in the system, but also the relations and interactions among the parts. Strictly speaking materialism cannot abandon organization altogether. If it reduces the whole world to elementary particles, then nothing beyond them could be generated. Physicalism would be a more appropriate characterization. Even machines certainly have their organization. It's just a physical organization. But when materialists claim that life is nothing but DNA controlled protein and mind is nothing but neurons' firing they are definitely very stingy in granting metaphysical significance to organization. To some extent even the organization in machines is ignored. So what's left in sight is only matter. Hence the concept of materialism. On the contrary organicism emphasizes organization. An organism cannot be taken apart and reassembled like a machine.[39] It cannot be analyzed into standalone parts. There is something extra than the addition of parts in the whole. That extra thing is organization. However an organism still only represents a special kind of organization. If we project that organization to the whole universe, we get yet another biased view. Let's revisit that famous Indian fable. In an analogy we could say supernaturalism grasps the trunk (spirit) of the elephant (world), materialism the tail (matter-energy) and organicism the side (organism). They all hold on to the part they get and project it to the whole body. What we need is a comprehensive view.

Organizational naturalism holds there is an open-ended spectrum along the dimension of organization. The dimension is measured with complexity and the spectrum is based on the measurement. There is continuity on the spectrum, but it can be roughly divided into five segments: the physical, the chemical, the biological, the psychological and the social. While the law of conservation holds in the dimension of matter, the law of evolution holds in the dimension of organization. The direction of evolution is toward higher complexity. So we expand Darwin's biological evolution to cosmological evolution and cultural evolution. The above five segments represent five milestones in the general evolution history. We can see the bases of supernaturalism, materialism and organicism are all incorporated into this comprehensive worldview. In terms of the organizational spectrum they each hold the higher end, the lower end and the middle of it, respectively. In this view there is no gulf between nature and culture. There

[39] This is the case of a mature organism. A developing organism, such as an embryo, demonstrates the holistic character in a different way. Take away a part from an embryo in the early phase, the remaining part will develop into a complete organism nonetheless. This is the major basis for modern organicism.

exists much continuity between them. Further there is no dichotomy between matter and mind. Mind is the function of highly organized matter. On the one hand mind cannot exist outside of matter (supernaturalism is false), on the other hand mind cannot be generated with matter organized on the physical level (materialism, physicalism, strong AI are false).

When organic naturalism and materialist naturalism are synthesized in organizational naturalism the metaphysics of Chinese tradition and Western modernity are synthesized. Modern science has greatly expanded the traditional worldview. But we shouldn't lose sight of the old territory. This comprehensive worldview provides the foundation for further synthesis.

10.2.2 Humanism as the core of culture

Now we leave the whole picture and focus on the higher end of the organizational spectrum. The higher end has priority not just because of its higher complexity, but also because we human beings reside in the higher end. In terms of the status of human beings the Western culture can be no more different than the Chinese culture. While humanism had slight chance to flourish in Western culture, it constituted the core of Chinese traditional culture.

The Christian culture centered on God. In the face of God humans were humble and obedient. Human life was just a transient path leading to heaven or hell. The aim of life lies outside the human sphere. In the unbalanced dichotomy between the human sphere and the divine sphere, the former is totally subordinate. In this context humanism was impossible. Humanism grew out of the decadence of medieval Christianity and championed in Renaissance. In Renaissance cultural elites tried to follow the ancient Greek model and put more focus on humans. Christianity was still dominant at that time, but the secularization process began. In the first half of the modernization process medieval Christianity gradually lost ground to modernity. In this transition period the rise of modern science and the Enlightenment movement both helped a lot with lifting the status of humans. However, as modernity was established, as modern science and technology became dominant in the second half of the modernization process humanism found its new rival in scientism, as embodied in scientific rationality. Generally we can say that science and reason liberated humans from divine dominion, only to dominate them in their own way. It ended up with a new unbalanced dichotomy between humanism and scientism. In the modern scientific worldview human life was again degraded. It's deemed not just as transient and subordinate, some radical materialists even claim that the whole human life is merely an illusion on top of mind-independent, objective reality. All in all humanism was let to flourish in the West only during the transition period from Christianity to modernity. It was suppressed in both stages.

The case is the opposite in traditional China. Here on the basis of cultural monism the human sphere was mostly the central focus of culture. On the ground of the organic naturalist worldview any supernatural existence was denounced by scholar-officials, who constituted the backbone of society. Organic naturalism not only dismissed supernaturalism, but also modeled nature according to the human body. However there was no subjecting nature to humans. The concept of men conquering nature was strange. A basic teaching of Chinese philosophy was to follow nature. But in order to follow nature one had to study nature well. So following nature in no sense meant a passive activity. Technological innovation was fully in line with the spirit of following nature. The seeming paradox goes away when we take the fact into account that there didn't exist the dichotomy between men and nature in Chinese traditional culture. On the one hand nature was treated like a human body, and on the other hand the entire human sphere was regarded as part of nature. Therefore following nature was not just about following cosmic nature, but also following human nature. In this way the central status of human sphere was determined. Under these circumstances the modern Western drama of men being conquered in conquering nature was very

unlikely to happen. The traditional Chinese learning consisted mostly of philosophy, literature and history. Officials were selected with examinations on those areas of humanities. Yet technology was encouraged in this special kind of humanism.

A synthesis in this respect would be for the West and the East to learn from each other. The central status of humanism saved Chinese culture from divine and technological domination. But domination still existed in the human sphere. Chinese were not subordinate to God or technology, but they were still obedient to humans. In a totalitarian political system they had to unconditionally obey the emperor. The hierarchical social order went beyond the political area and spread to every aspect of daily life. There were orders in almost all of the social relations. Children had to obey the father, wives had to obey their husbands, sisters had to obey brothers, younger brothers had to obey elder brothers, students had to obey teachers, and in a random group younger members had to obey older ones. These social orders were so natural in a certain historical stage that they were inscribed in moral codes. These moral codes were fervently maintained in Confucian classics. And when Confucianism was generally adopted to establish the new social order those moral codes became entrenched. In a certain historical stage bodily power and sheer experience mattered the most, so sex and age counted. However there was something new in the new social order. Specifically learning started to be honored more than sheer experience in selecting officials. This reform on the one hand granted vitality to Chinese culture, but on the other hand solidified the old moral codes. The success of this social order made the gradually outdated moral codes all the more tenacious. A break-away had to be initiated by a great impact from outside. This impact came from Western modernity. The French Revolution brought about a social upheaval in Europe. Several decades later the industrialized Western powers were strong enough to shake another much more rooted social order. What Chinese humanism can take from Western modernity is its individualism. What should stand at the center of culture is not just the whole human sphere, but further each individual. Each individual has her dignity and should be respected. This principle is expressed in the slogan “man is the aim.”

However, as Western modernity grew mature it didn’t seem to be able to live up to its own essential principle. When human life is regarded as a reducible existence that doesn’t have independent reality, how can man still be the aim? When humans are used as a resource of production and consumers of products, they are apparently treated as a tool. When humans become voters that can be easily influenced by a propaganda run like a commercial advertisement, they don’t seem to be the aim either. Under these circumstances individualism becomes dubious. The dialectic of Western modernity is that it aimed at liberating humans from the traditional restrictions, but ended up creating new ones. Modern technology is easily blamed as the culprit of various modern malaises, but it’s just a scapegoat. There are deeper cultural issues behind it. To get out of those modern malaises that are centered on the modern subjection of humans, there is no way to go back to medieval Christianity. The subjection of humans can probably only be corrected with a certain kind of humanism. In this respect the central status of humanism and the traditional stance on technology in Chinese culture may offer some insight and inspiration. This doesn’t mean to let the West adopt Chinese humanism, which is featured by immanent transcendence and very unique to Chinese culture. As mentioned above, during the transition period from Christianity to modernity, the West also established some humanist tradition. Humanism mainly flourished in Renaissance and Romanticism. So focusing on humanism in the West probably means putting more emphasis on da Vinci, Shakespeare and Goethe.

As we have seen, humanism is consistent with neither supernaturalism nor materialist naturalism. While the former holds that the whole world is dominated (controlled or even created) by multiple or a single supernatural spirit, the latter maintains that the whole world is nothing but

matter physically arranged. In either case humans have a subordinate status. In contrast organic naturalism grants humans the central status. In traditional Chinese culture nature and humans were even unified in a special kind of humanism. However in organic naturalism humanism is based on a phenomenalist prejudgement. It starts with human life and stays with the phenomena, without chasing things behind them. With an expanded worldview we now can put humanism on a more solid ground, although an absolutely solid ground doesn't exist. Organizational naturalism incorporates materialist naturalism and so greatly expands organic naturalism. Instead of viewing the whole world as a giant organism like a human body, it admits that there are several levels of organization. Organism is a later development out of things with lower level of organization. And the most part of the universe stays on the physical level. On top of organism there are still mind and society. Even in this expanded worldview the priority of humans is obvious, because they occupy the higher end of the organizational spectrum. Humans are the result of millions of years of natural and cultural evolution. Further humans have an ontological priority. This world can only be the world as we humans view it. The expanded worldview is still a human view. Although the frontier has been enormously pushed forward, we can all the same only stay with the phenomena. But now phenomena are in the Kantian sense.

10.2.3 From egalitarian universalism to elitist diversity

So much for man's place in the world. Now we move on to his place in the society. The sociopolitical theory is also based on the general worldview. In the materialist worldview of Western modernity a society can be reduced to its individual members and humans can further be reduced to elementary particles. This has two direct results: atomic individualism and egalitarianism. Atomic individualism is the core idea of liberal economic and political theory. Both start with atomic rational individuals. Economic liberalism holds that each member in the society should be allowed to pursue their own interest and a wealthy society will be created on the ground of this through the so-called "invisible hand," the law of supply and demand of the free market. Political liberalism also presupposes stand-alone rational individuals, and then a society has to be constructed out of atomic individuals. Social contract is the most popular way of construction. Egalitarianism is derived from Christianity. The statement "All men are created equally" is an indication. The case is the same when supernaturalism is transformed into materialist naturalism. When humans are regarded as arrangements of elementary particles they are also essentially equal. On the contrary, in the organic worldview of Chinese tradition a society is also treated as an organism. An individual exists as an organic part of the society instead of on his own. So a society is not defined by its members, but on the contrary an individual is defined by his social relations. The construction of a society out of atomic individuals is not necessary in this case. On the other hand, when a society is treated as an organism the different parts of it have different importance and status. Therefore individuals as social members are not equal. Some are more important and have higher status than others. This is the foundation of elitism. A basic feature of elitism in Chinese tradition is that it's based more on merit than birth, or even wealth. Cultivation and learning in humanities is an essential part of the merit. So we have atomic individualism and egalitarianism on one side and communitarianism and elitism on the other.

The relation between individual and community has been a topic of hot debate. In the debate liberals put strong emphasis upon personal freedom, whereas communitarians stress the framework of personal action as determined by the community. A basic fact is that there are many things an individual cannot choose, but they greatly influence his habitual actions and conscious choices. Native language and basic values of life are obvious examples. Atomic individualism is based on a biased view of individual. It sets up an artificial dichotomy between reason and other psychological faculties, emotion, imagination, intuition, etc. And personal freedom is one-sidedly interpreted as rational choice. Since such abstract reason is universal,

personal freedom so interpreted is also deemed to be universal. Egalitarianism is implied from this kind of universalism. If personal freedom is based on universal abstract reason then everybody should be treated the same, regardless of her other qualities. On the other hand communitarianism overemphasizes the social determination of an individual and the subordination of individuals to community. This seems to be based on a biased view of community or society. A human community is not like an ant colony, where straight organization counts the most. Humans have mind, so ideas and creation are more important to community development. And personal freedom is crucial for creation.

In fact the dichotomy between individual and community is probably as artificial as various other dichotomies. If we start with a natural view of individual then the seeming dichotomy disappears. An individual is foremost an existence in a community, in a cultural context. Without a community or culture even the cognitive faculty of a child cannot be developed. Reason itself is not atomic, but community and culture dependent. Compared with reason other psychological faculties are more dependent upon particular cultural context. And reason cannot be isolated from those other faculties. Therefore, when a person grows mature and is able to make his own rational choice, the cultural context he grows in has already been internalized in his mind. This doesn't mean he has little personal freedom, but that freedom has to be realized in a predetermined framework. In a sense we may also say that personal freedom is only possible in a cultural context. Contractual liberalism puts rational individuals prior to society. It obviously has the order reversed. A social organization, such as a company, is created out of rational individuals through contract. It's not the case for any natural community. Individualism based on this natural view of individual doesn't need to treat community as a hurdle of personal freedom. On the contrary, personal freedom presupposes community and culture.[40]

A natural view of individual also runs against egalitarianism. From conception to maturity individuals diversify in various aspects. Major aspects include genetic factors, pregnancy, child care and education. So before individuals obtain the ability of rational choice, supposedly at maturity, they are neither created equal nor ended up equal. We've discussed above that the identity of an individual is to a large extent shaped by her community and culture. Now we see that individuals diversify in the same community and culture. Since people live in different cultures, they also diversify on the cultural level. So we have two levels of diversity, the cultural level and the individual level. Egalitarianism is more of a political than a natural theory. It's more about whether people should be granted equal rights than whether they are actually equal. However, if we base political rights on a natural view of individual rather than an abstract one, in which only the will on the ground of abstract rational choice is taken into account, then the egalitarian principle is still not tenable.

Merit-based elitism in Chinese tradition constitutes an opposing principle of egalitarianism. The basis of this kind of elitism is humanism featured with immanent transcendence. It views human life as a process leading toward the realm of transcendence. This is a spiritual state which needs to be reached through education, learning and much personal effort. Merit is naturally expected from that life endeavor. It recognizes the fact that different people may reach different levels of merit. And then political rights are granted more to people with more merit. Leading positions in the society are normally filled with talented and capable people. A major flaw of traditional Chinese elitism is that it contains a closed standard of merit. So everybody has a single path to excellence. This is one aspect of lacking tolerance. Another aspect is that it tends to look down upon those who cannot climb high up the standard ladder. When more respect for diversity and

[40] In fact, personal freedom interpreted as rational choice itself presupposes a particular cultural context.

more tolerance are introduced to Chinese elitism we have a competitive alternative to egalitarian universalism.

Let's call the reformed Chinese elitism "elitist diversity." A break-down comparison with egalitarian universalism helps make the ideas clearer:

- Egalitarian universalism is based on an abstract view of individual. It separates reason from other psychological faculties. When all these faculties are ignored except the abstract reason, an individual becomes a universal entity that can exist independent of a community. Egalitarianism is a natural result. On the contrary, elitist diversity doesn't accept the dichotomy between reason and other faculties. Therefore individuals diversify on both the cultural and individual levels. Further some aspects of diversity can be measured according to certain criteria. This leads to elitism.
- Egalitarian universalism interprets personal freedom as freedom of choice based on reason. Very often this results in relativism, because the basis of choice is only required to be personal reasoning. Even if major flaws are found in somebody's reasoning, nobody is entitled to interfere with her choice. It's essentially voluntary liberalism. In contrast, elitist diversity interprets personal freedom as the pursuit of transcendence. On the one hand it has clear criteria of what's bad or what should be moved beyond. So relativism is avoided. On the other hand it leaves open what's good or what should be pursued. So absolutism is also avoided.
- Egalitarian universalism interprets equality as either principle equality or distributive equality. Principle equality is just equality in principle. It only declares that all men are equal without any correction of the unequal preconditions. For instance, this kind of equality allows a child from a poor family to be deprived of normal education due to unaffordable tuition fees. Distributive equality tries to equalize people's living standard with heavy redistribution. Elitist diversity on the other hand supports equality of opportunity. It's the opportunity to develop various talents of individuals. Talents are beyond the control of a society without coercive eugenic measures. Except talents other unequal preconditions, from medical care in pregnancy to education, may be corrected. This would imply free medical care for child birth and free education. Besides redistribution required for this equality, redistribution for other purposes should be kept to minimum.
- The favored polity of egalitarian universalism is democracy, whereas that of elitist diversity is meritocracy. Democracy as a modern rival of traditional authoritarianism includes some essential modern institutions such as the rule of law, power balance and freedom of speech. But the basic principle of democracy is still egalitarianism, according to which every citizen has the same say in common social affairs. On the other hand, although meritocracy was historically embedded in authoritarianism, it has no principal conflicts with those modern democratic institutions. The elitist principle could be easily combined with democratic institutions. The principle may be reflected in the law. The elites may also be checked by the law, among themselves and by public media.[41]

I believe elitist diversity could be an effective synthesis of Chinese humanism and individualism. Instead of an atomic, egalitarian, universal individualism, it's a culture-laden, elitist, meritorical individualism. Instead of an authoritarian, monotonic elitism, it's a tolerant, diversified elitism. Organizational naturalism, central humanism and elitist diversity combined could provide the

[41] In a sense meritocracy may be criticized as the tyranny of the elites, but that's in the same sense in which democracy is criticized as the tyranny of the majority. The elite rule and the majority rule are based on different principles. Democracy is directly against authoritarianism. Meritocracy doesn't have to coexist with authoritarianism.

foundation to build an alternative modernity on. It's meant to keep the two essential features of modernity, individualism and industrialization on the basis of modern science and technology, and at the same time avoid the existing problems in Western modernity. One major problem in them is scientism and the dominance of modern technology. From the perspective of Chinese culture this synthesis is a way to absorb the impact of Western modernity while essentially keeping the identity of it. The core of its identity is humanism of immanent transcendence. In this synthesis the traditional embracing-controlling-stance on technology will be recovered.

Generally speaking Chinese culture still lies in the shadow of the impact of Western modernity. Under this unparalleled impact it first was humiliated, then got confused and finally lost most of its identity. Only when the unique ancient wisdom reasserts itself in this Modern Age, can we start to talk about something like a "Chinese Renaissance." Only then will China, as a major contributor in the past, be able to make significant contribution to mankind again.

11. Medical Technology

In the previous two case studies I discussed the place of technology in traditional Chinese society and Chinese modernization. In those cases technology is treated generally as a whole. As a complement the remaining two case studies handle two specific technologies. Here the general embracing-controlling-stance on modern technology is applied to particular cases. We consider modern medical technology in this chapter. Modern medicine directly follows modern science. It adopts modern scientific worldview and develops on top of scientific knowledge. On the other hand, the object of medicine is the complicated human body. So modern medicine constitutes a good test case of modern science. The success and limit of modern medicine is a faithful indicator of the success and limit of modern science. The study of modern medical technology is carried out along this line. The application of the embracing-controlling-stance to modern medical technology reflects a balanced view of modern science.

In fact modern medicine originated contemporarily with modern science. A brief historical survey of modern medicine reveals the close relationship between it and modern science. The historical survey at the same time delineates different facets of modern medicine, on which our assessment of it can be grounded. Starting with anatomy and physiology modern medicine is based on the dive-in empirical study of the human body. This new scientific approach finally bore significant fruits in the last two centuries and brought about marvelous diagnosing and curing methods. Given the great success of modern medicine, the acceptance of it came out without much difficulty, although there was no lack of resistance. As part of the balanced stance I first defend modern medicine by endorsing its scientific method, invoking its benefits and addressing the criticisms of it. But on the other hand we should also be fully aware of the particular worldview it commits itself to. The limit of this worldview has put some restrictions on modern medicine and made it blind, even hostile to alternative approaches. Besides, its great success has fostered a utopianism, which has been proved to be both ungrounded and harmful. The harm partly results from the over-confidence in modern medicine. Therefore a wise attitude toward modern medicine calls for some control, both conceptually and practically.

11.1 Brief Historical Survey of Modern Medicine

Medicine is as old as human civilization. Falling ill in one way or another is an inevitable incident in human life. Since the very beginning of civilization humans have tried different ways to handle this incident. The birth of modern medicine was very similar to that of modern science. Before the Modern Age people's knowledge of the world was dominated by Aristotle's theory in the West, although it was mixed with and adapted to the Christian world outlook. The birth of modern science was marked by the break-away from the age old dominating theory formulated by Aristotle in ancient Greece. The situation in medicine is very similar.

In ancient Greece Hippocrates set up the humoral theory. According to this theory the human body contains four basic fluids called humors. The four humors are blood, phlegm, bile and black bile. The fundamental concept of health and disease was that they were some forms of balance or imbalance in body fluids. Some diseases were thought to be caused by the excess of a certain humor. For instance, summer diseases such as diarrhea was caused by bile and winter diseases such as cold by phlegm. Another basic feature of the humoral theory was that it didn't hold a clear dichotomy between mind and body. The four humors cause four temperaments directly. They are the sanguine, the phlegmatic, the choleric and the melancholic, respectively. Viewed

from the modern standard this theory is very abstract and is based on rough and general observations. Hippocrates's theory was further developed by Galen in ancient Rome. He combined the theory with Plato and Aristotle's thoughts and made a synthesis. Aristotle's practical investigation and logical reasoning were an important part of it. This might look close to modern medicine in methodology, but the basic concepts were still taken from Hippocrates. In this way Hippocrates's theory was solidified in Galen's synthesis and dominated Western medicine up to the eve of modern medicine.

Modern medicine began with the experimental exploration of the human body. In terms of methodology this was more revival of the ancient empirical approach than a completely new invention. Galen also performed many anatomies. The revolution in modern medicine lay more in conception and precision. Hippocrates based every mind/body phenomenon on the four fundamental body fluids. This was now proved to be inadequate. In the general mechanistic conceptual atmosphere the human body was more and more regarded as a complex machine. Compatible with this mechanistic worldview is the dualism of mind and body. As a result of dualism human mind was gradually excluded from the scope of medicine. Besides, the revival of experimental method gained more significance in that particular historical context. While the empirical approach was once adopted by the ancients, people had gotten used to following authorities at the eve of the Modern Age. In this context experimental method was glorified against authority.

Many authors would agree that the birth of modern medicine was marked by Vesalius's anatomy. Vesalius may be compared to the Galileo of modern medicine. Just like Galileo challenged Aristotle's authority with his experiments in kinematics, Vesalius challenged Galen's authority with his anatomies of the human body. Performing his anatomies with higher precision he was able to point out some mistakes in Galen's view. Porter summarizes his work accurately (Porter ed. 2001: p. 157):

> Vesalius's great contribution lay in creating a new atmosphere of inquiry and in setting anatomical study on solid foundations of observed fact. Although his work contained no startling discoveries, it induced a shift in intellectual strategy. After Vesalius, appeals to ancient authority lost their unquestioned validity, and his successors were compelled to stress precision and personal, and first-hand observation.

Galen's authority was further challenged by Harvey's study of the mechanism of the circulation system. Some aspects of blood circulation had been noticed since long ago. In fact blood was considered to be one of the fundamental humors in Hippocrates's theory. And Galen had a theory of the production and motion of blood, but it was based on rough anatomy and speculation. Strictly speaking, the revolution Harvey made was not in the experimental method itself, but in precision and conception. On the basis of his experiments with the veins of the forearm and the study of the structure of the heart he developed the theory that blood circulates in the body and the heart is the source of the circulation, functioning like a pump. This revolutionary idea of circulation could better explain the observed phenomena. More importantly it's a mechanistic model, which seemed to be able to dispel all the mystery and vagueness in the previous authoritative theory.

Vesalius's anatomy was about the structure of the human body, whereas Harvey's study was focused on the function. Further, the function of the human body was interpreted in accord with mechanical principles. This set the standard for the next two centuries. During this period researchers did comprehensive studies of various parts of the human body. Anatomy was performed on dead bodies. As long as there was abundant supply of corpses the technique was relatively easy. So anatomy could be advanced quickly. In comparison the study of the function

of the body, which was later called physiology, proved to be a much bigger challenge. When a body is dead it functions no more, so physiological study needed to be performed on living bodies. Besides, moral concerns restricted the study to animal bodies. The mechanistic view of the body made muscle the most important object. But even in this salient mechanistic object the mechanistic view was soon proved to be inadequate. Muscle is the source of body motion, but the contraction of muscle is not an effect of mechanistic causes. This inadequacy was mainly responsible for the rise of vitalism, the view that there exits certain force of life which lies beyond mechanical laws.

The next phase of development was to overcome vitalism. To do that researchers had to move beyond the mechanistic view. This was achieved in the transition from mechanics to chemistry. The first milestone was reached in Lavoisier's study of respiration and oxygen. He demonstrated that oxygen was incessantly necessary for the living body and the function of respiration was to supply oxygen to the body. In this way the analogy of the living body to a mechanical machine was replaced with an analogy to normal combustion. Apparently this new analogy was not sufficient to undermine vitalism. Combustion still couldn't provide a good explanation of muscle contraction. However Lavoisier's study started the transition from mechanics to chemistry. Chemistry took the center stage of medical research in the 19th century. Liebig was a prominent figure during this period. He tried to reduce physiology to chemistry and explain various functions of the body, such as muscle contraction, in terms of chemical reaction.

In the transition to chemistry people saw a trend to dive deeper into the micro world. The chemical physiology was paralleled with cellular pathology and bacteriology. When people's knowledge of the human body was rough and vague, diseases were thought to be general problems of the whole body. Precise post-mortem anatomy started to pin down the problems in particular organs. Through Bichat's introduction of the notion of tissues Virchow finally pushed pathological study down to the level of cells. Another great achievement of medical study in the 19th century was bacteriology. Before people recognized the crucial role microorganisms played in disease formation the traditional notion was that they were caused by miasma and chemical poison. Pasteur's germ theory of disease disproved the traditional notion and revealed that the real causes of many infectious diseases were microorganisms called germs. The germ theory proved to be fundamental to the knowledge of disease. Koch further improved the germ theory and set up specific procedure to identify the cause of a disease. Soon the germs that were responsible for many popular diseases were identified.

The development of medical research in the 20th century built on the achievements in the 19th, but there were many new breakthroughs. Immunology was a further development of bacteriology. While the causes of diseases were disclosed it was also found that the same germ didn't cause disease in every human body. Some bodies have resistance to germs. It was then figured out that the human body has a sophisticated immune system. The system can distinguish a variety of germs from the body's own tissue and selectively fight the former. The great success of the germ theory for some time promoted the general notion that all diseases were caused by some foreign item. This turned out to be false after the discovery of deficiency diseases. Different vitamins were identified as the deficiencies in those cases. So a disease doesn't have to be caused by something foreign, but something lacking as well. Another progress was made in neurophysiology. It's about the functioning of the human brain. Since the brain is the material base of consciousness and thought, neurophysiology bears much significance. Sherrington pioneered the work at the beginning of the century. Later the mechanisms in the periphery of the nervous system, such as color vision, were uncovered and the modular theory of the brain was formed. The greatest breakthrough in the 20th century was probably in genetics. In 1953 Crick and Watson disclosed the double-helical structure of the genetic material DNA, which essentially

contains a code in it. On the ground of this discovery the causes of many hereditary diseases could be pinned down on the molecular level. We can see chemistry still dominated medical research in the 20th century. With the achievements people's understanding of health and disease has become deeper and deeper and more and more comprehensive.

So far we've been focused on basic medical research. However medicine is more about diagnosis and treatment. The patient-facing medical practice has a quite different story. In general we see significant lagging-behind in the development of medical practice. While Vesalius started to challenge Galen's theory in the 16th century, doctors in the 19th century were still under the heavy influence of the humoral theory and had little science at their disposal. Under the assumption that diseases were associated with body fluids popular traditional treatments in the West included sweating, vomiting, even bleeding. In addition to salivating, urinating and purging, these methods were believed to be able to get rid the bad humors from the body. The corresponding diagnoses could only be learned from the experience of past generations.

Their techniques might look primitive, but traditional doctors kept a good rapport with patients. A family doctor that visited families on demand was often treated as an old friend. When the doctor diagnosed he often asked about many aspects of the family life. As modern diagnostic technologies were introduced one after another, the traditional doctor-patient relation gradually diminished. The first milestone on the path was the invention of the stethoscope. The stethoscope was invented by Laënnec in 1816. Due to the inappropriateness in examining the chest of a female patient directly he came up with the idea of using a tight paper roll to check the sound from the chest indirectly. The stethoscope was later improved. But the original idea was very meaningful. It's the first step away from direct doctor-patient relation. The stethoscope acted as something in between. With the stethoscope the doctor's attention moved from the patient to her body. The invention of X-ray at the end of the 19th century was the second milestone in the development of modern diagnostic technology. The invention resulted from Röntgen's study of emissions from a type of vacuum tube. While the doctor still needed to use the stethoscope directly on the patient's body, X-ray even made this contact obsolete. The doctor could let a nurse take the X-ray first and then examine the developed sheet. In this case the doctor even didn't need to pay direct attention to the patient's body. Various scanning technologies, such as ultrasonic scanner, CAT-, PET- and MRI-scanner were introduced in the 20th century. These can be regarded as further development of X-ray.

Medical treatment is divided into surgery and drug treatment. Generally speaking, surgery is a physical approach whereas drug treatment is a chemical one. Modern surgery in the strict sense was not possible until anesthesia and antisepsis were established in the second half of the 19th century. Operations before that were accompanied with excruciating pain. And postoperative infection and even death were normal. With these restrictions surgery was limited. It's confined to the limbs and the surface of the body. The fast hands of the surgeons counted the most. Traditionally surgery basically meant the removal of bad body parts. Anesthesia and antisepsis made protracted operations possible and so enabled the surgeons to venture deeper into the body. Based on this surgical revolution the development in the 20th century went along two major lines. First, the operations became more and more complicated. Operations on crucial organs such as the brain and the heart were possible. Also the removal of body parts was extended to repair and replacement. Organ transplantation was one of the greatest surgical achievements in the 20th century. Second, recently operations became less and less invasive. For instance, with the so-called "keyhole" technology the patient may leave the hospital on the same day after an operation of gallbladder removal.

Drug treatment has a long history. Major civilizations all used some kinds of drugs. But traditionally all the drugs came from plants. Drugs based on chemical synthesis only have a very short history, also began in the second half of the 19th century. The study of how traditional drugs worked preceded any chemical synthesis. The parts of plants used as drugs contained many components. The analysis of their function boiled down to identifying and isolating the active components. It normally ended up with some chemical compounds. When the working of drugs was uncovered, synthetic drugs became a possibility. As it happened, synthetic drugs were born from dyestuffs. Ehrlich's compound called Salvarsan was the first synthetic drug, which was active against syphilis. Later sulphanilamide was found to be able to check streptococcal bacteria. The discovery of penicillin by Fleming proved to be a milestone, because it's virtually non-toxic and kills bacteria. The use of penicillin and similar antibiotics has been extended to today.

In summary we can conclude that modern medicine is closely related to modern science. It shares the reductionist, materialist worldview. When the mechanistic view was proved to be inadequate it tried to explain health and disease in terms of chemistry. In the last two centuries medical research were more and more dependent upon chemical research. Compared with basic research medical practice, including both surgery and drugs, was advanced rather late. Both presupposed the high development of chemistry in the 19th century.

11.2 Embracing Modern Medical Technology

Modern medicine strives to be scientific, but due to its particular object it's especially strenuous. Modern science was born in mechanics, the study of force and the motion of objects. When Newton disclosed the basic mechanical laws he was glorified as an angel. There was no doubt about his success. Modern science later expanded to other areas, but physics has always been the model of science. Compared with physical objects, the object of medicine is the complicated human body, bearing a more intricate human mind. Even in the Western medical tradition the mind was not separated from the body. Now following modern science modern medicine tries to put aside the mind and only pay attention to the body. This definitely has brought about much resistance. It's not a surprise that significant resistance came from the fields of humanities, which are concerned with the spiritual side of human life. The Romantic poet Coleridge once condemned the doctors' degenerating somatism and accused them for blindly focusing on gut and body. This sharply contrasted with Pope's ode to Newton.

When modern science demonstrated its triumph in the material world it's warmly accepted. But once it tried to encroach on the spiritual world resistance came up. Finally the opposition between the so-called two cultures came into shape. The general attitude of this essay toward modern science is that, as an innovative and effective way to explore the material world modern science should be wholeheartedly embraced, but at the same time it has a limit and should be restricted to its appropriate scope. In other words, science should be accepted, but scientism should be refuted. This is essential to dispelling the antagonism between the two cultures. After all, the two cultures actually are concerned with different areas of the same world. At the bottom there are no real conflicts between them. Modern technology is closely intertwined with modern science. It no longer makes much sense to claim the priority of one over the other. One thing is for sure: they are inseparable. Scientism partly contributes to the dominance of modern technology. So the general stance of this essay on modern technology is similar to that on modern science. Modern technology should be embraced, but meanwhile it should be controlled, so that it would stop dominating.

Applying the general stance to modern medical technology, we first need to defend adopting the scientific method in medicine. The scientific method is successful in the material world because it's suitable for the objects. For an object that is simply organized, the interactions among its parts are uncomplicated. So its components are easy to isolate and its behavior demonstrates uniformity. Correspondingly the scientific method is featured with analysis and universality. Take the solar system for example. The interactions among the Sun, the planets and the satellites are predominated by gravitation. Hence, a celestial body could be easily isolated and studied separately. In this case the motion of a celestial body could also be accurately predicted. The object of medicine is apparently not as simple as the solar system. The parts of the human body are interconnected in various complex ways. It's much harder to isolate an organ from the rest of the body because the interface between them is convoluted. And the behavior of a human body is impossible to predict precisely.

However the complexity of the human body doesn't exclude scientific method. Higher forms of organization build on lower ones. A highly organized object also contains the lower forms of organization. So a human body not only demonstrates intentional behavior and generates thought, but also has physical and chemical properties and follows physical and chemical laws. Intentionality and thought on the one hand and physics and chemistry on the other don't lie side by side, but one builds on top of the other. So they are different aspects of the same object. The complicated human body also has its aspects of lower organizations. The study of these aspects is meaningful for a couple of reasons. First, it provides a basis to understand higher organizations. Second, it has its own merit, as shown in the benefits modern medicine has brought about.

Traditionally people's understanding of the human body was superficial and shallow. The observations were mostly external and restricted to the macro level. There was much speculation about the structure and function of the body. Modern medicine first brought the observation closely inside the body and then down to the micro level. This greatly expanded the view. Now people have a much clearer picture of how the human body is constructed and how its various organs work. Certainly a major criticism of modern medicine is aimed at its neglect of the spiritual aspects of the patient. But the scientific study of the body has shed some light on the psyche. One example is the hormonal basis of emotions. Human emotions are so complicated that there doesn't exist a straightforward correspondence between chemicals and emotions. However the study of hormones does improve people's understanding of emotions. Further neurology has even revealed the foundation of certain perceptions, with color vision as a salient case. Painters and dye makers have long noticed that there are three basic colors from which other colors can be generated. This phenomenon found its explanation in three types of cone cells on the retina, each having peak sensitivity to a particular wavelength of light. Although the wavelengths don't exactly correspond to red, green and blue, the phenomenal structure of color space can be explained on the basis of the neurological foundation.

The human body as a complicated organism may malfunction in various ways. Generally speaking, any malfunction of the body can be called a disease. As said above the body involves different levels of organization. A disease may happen on any level, from physical disability to mental disease. This gives the scientific method a stage to perform on. Physical injury and chemical poisoning can both disturb the smooth functioning of the body. But traditionally the major type of disease was infectious disease, the one that's caused by microorganisms. The most significant infectious diseases were contagious and had severe consequences. Sometimes an epidemic, or even a pandemic broke out and many people lost their lives. All these turned out to lie in the scope of scientific approach.

Before the birth of modern medicine, there was no effective cure of the infectious disease. For centuries the relation between human beings and disease causing microorganisms had been one of mutual selection. In the age of gatherers and hunters the population was sparse and had a high mobility. Under these circumstances microorganisms had little chance to survive and it's even harder for them to spread. So infectious disease was rare. The major challenge for human beings then was to gather enough food. The agricultural revolution greatly improved food supply, but at the same time created a new environment for microorganisms to thrive. New conditions included fixed residence, higher population density and living together with domestic animals. Many new microorganisms could live and reproduce fast under these conditions. When a severe species appeared and started to attack people, the selection in one direction began. Those who were highly susceptible to the corresponding disease were killed. Those survived either were originally immune to the disease, or had developed immunity on the way. In this way the microorganisms selected human beings. When microorganisms killed a person they also lost a particular living environment. Once all the susceptible people to whom it could spread finally died the microorganisms themselves couldn't survive. Generally people got rid of a particular type of microorganisms with a high cost, sometimes a dreadful population reduction. This is the selection in the other direction. As the population gradually recovered an equilibrium would be reached until the next severe species came up. This kind of cruel natural selection depicts the general picture of the premodern disease history, although the severity of the disease varied. For example, the Black Death was probably the severest disease in Europe and once wiped out over a half of the population.

One of the greatest achievements of modern medicine is to put an end to this history of cruel natural selection. This was reached only in the later phase. In the Modern Age, especially after the Industrial Revolution, infectious disease became a bigger problem. The growth of population and the development of cities further raised population density. The ever changing environment as a result of industrial production fostered new species of microorganisms. And once they infected humans it's much easier for them to transmit among people who lived together in unprecedented number and had much more frequent contact with each other. A fundamental solution came into existence first with bacteriology, which identified the causes of a variety of infectious diseases, and then antibiotics, which offered a low risk, effective kill of most of the bacteria responsible. With vaccines and antibiotics infectious disease no longer takes the center stage of medicine. Having uncovered the causes of the most serious diseases in the past modern medicine went on to disclose other types of diseases. Deficiency diseases are caused by the lack of necessary nutrients. Hereditary diseases are passed from generation to generation through genetic material. Any other organ malfunction is categorized as physiological disease. Effective treatments were also found for many of these new diseases.

Modern surgery is another major achievement of modern medicine. In surgery an organ, or part of the organ, is removed, repaired, or even replaced. The human body is basically treated as a machine. The success of modern surgery certainly cannot prove that the body is a machine, because surgery even cannot cure all the diseases. But it does demonstrate that some aspects of the body may be handled mechanically. When a blood vessel with clots is successfully expanded through mechanical means, we can see the point distinctly. Surgery has been practiced for a long time. However, only modern medicine has made it so bold and delicate. It's unimaginable without the comprehensive exploration of the human body.

Given the great success of modern medicine and the enormous benefit it has brought to the patients, there have still existed criticisms of it. The condemnation from Romanticists might have a haughty look, but other criticisms were more realistic. One of them is the charge that modern medicine pays sole attention to the disease in the body and puts aside the patient as a person. The

diagnostic evolution from stethoscope through X-ray to scanners and lab tests has gradually increased the distance between the doctor and the patient. Traditionally the diagnosis was done through the interactions between the two parties. Now what the doctor faces in diagnosis are test results and scan images. On the other side, what the patient gets into contact now are mostly cold machines operated by specialized technicians. The care that accompanied the cure provided by a traditional doctor seems to disappear in modern medicine. In fact, there was a patient-as-a-person movement even in the second half of the 19th century. The spirit of the movement was perhaps best expressed in Nothnagel's claim that "medicine is about treating sick people and not diseases." (Porter ed. 2001: p. 143) At that time X-ray was still not invented. The criticism is certainly still valid for the contemporary primary care.

Against this criticism I would argue that the problem in this case lies in the medical practice, not the core of modern medicine. The disregard of the patient as a person may be influenced by the scientistic view that the whole human being can be reduced to the physico-chemical processes in the body. Disapproving this view we may still admit that certain aspects of the body can be handled with the scientific method. This doesn't entail the neglect of the patient, just like scientism is not a necessary result from the approval of modern science. Therefore, the scientific treatment of the disease and the humanistic care of the patient can go hand in hand in principle. If there is a problem in the worldview then people need to reflect on that. And if it's a problem with the practice then people need to fix that too. Such problems don't justify the refusal of modern medicine as a whole.

Another major criticism of modern medicine is directed at its high cost. Advanced devices and sophisticated drugs significantly raise the cost of diagnosis and treatment. But that's just part of the story. The final cost that's loaded on the patient is determined by various factors. Medical insurance is an effective way to distribute the burden of cost. But too profit-driven insurance companies could make the insurance unaffordable for many people. The total medical cost could also be increased by the profit-driven drug companies and medical equipment companies, which try their best to promote expensive drugs and devices. And doctors might be encouraged by certain insurance policies to perform unnecessary examination and treatment, in order to demonstrate the importance of their work. Generally this is an issue related to how the medical system is socially run, not the function of modern medicine. Reducing cost should be one effect of technological advancement. When the system is properly operated the cost doesn't have to be so high.

The justification of the scientific method in modern medicine, the enumeration of its success and benefits and the analysis of major criticisms all support the embrace of modern medicine.

11.3 Controlling Modern Medical Technology

Despite the great success of modern medicine, it has been under heavy attack in the last several decades. If the resistance in the previous centuries contained much conservative defense of tradition, the recent attack were more aimed at its foundation and scope. This happened in a general atmosphere where modern science was besieged by critics. When the scientific edifice was shaked, the scientific worldview and method in modern medicine were put under close scrutiny. Due to its complicated object medicine is a field where the examination can be favorably carried out. In fact, the examination quickly showed the limited scope of modern medicine. The recent trend toward complementary and alternative medicine was not just a result of a poorly practiced and mismanaged modern medicine. It's also an indication of the recognition

of its limit. When a patient comes to a doctor who cannot find any abnormality in terms of biology, going for something different is probably the only choice.

In the previous section I tried to defend modern medicine as practiced in its appropriate scope. However, wild extrapolation and utopianism have accompanied most major achievements in modern science and technology. Modern medicine is not an exception. For instance, the triumphant application of antibiotics once prompted people to predict the end of infectious disease. But it's never come true. The control of modern medicine first needs to be carried out on the conceptual level. This is no other than undermining scientism and utopianism in it. Against biomedicine which is based on the scientific worldview we shall discuss the nascent post-modern medicine. Post-modern medicine tries to integrate modern medicine into a much bigger picture through incorporating other aspects or dimensions of human life. Once the boundary of modern medicine is marked utopianism is dispelled. Unfortunately utopianism has caused over-confidence, over-reliance and arrogance. The over-confidence in drugs has resulted in unexpected damages. The excessive use of antibiotics and scanners has brought about severe consequences. Another effect is insensitivity to moral issues. So the control of modern medicine on the practical level requires appropriate regulation.

As the brief historical survey of modern medicine shows, it's built on top of the scientific worldview and method. It adopts the materialist and reductionist worldview of modern science. It first reduces the illness of a person to the disease in the body and then further reduces the body to physico-chemical processes. So a fundamental critique of modern medicine has to start with criticizing the scientific worldview. This constitutes an important part of Foss's book *The End of Modern Medicine*. He points out three fundamental shifts in the transition from Aristotelian to Newtonian science (Foss 2002: p. 211):

> First is the shift from one method of science to another: thus, qualitative to quantitative. Second is the shift from one body of theory or laws to another: thus, the "law" that all sublunar bodies seek their natural place at the center of the earth, to the law of gravitation. Third is the shift from one concept of nature to another: thus, from the view that essential to understanding the full spectrum of observed natural phenomena are final as well as efficient causes, to the view that natural phenomena are understood as governed by impersonal mathematical laws.

He calls the third shift "quasi-metaphysical." And that's the main supposition of modern science he wants to challenge. Instead of a materialist world he proposes a self-organizing one. According to this view the universe organizes itself on different levels. A higher level of organization has emergent properties which cannot be reduced to a lower one. Besides matter and energy he introduces information as another fundamental dimension of nature. Such a view is called "post-modern naturalism." Modern naturalism is monistic and reductive, whereas post-modern naturalism is monistic but nonreductive. Foss's attitude toward modern science is eclectic. While challenging its worldview, he tries to keep its method and theory. As he puts it, "we might contest the prevailing model's viability while still accepting much of its quantitative method and many, if not all, of the empirical discoveries of modern science." (*ibid.*: p. 212)

Due to the striking similarities between Foss's post-modern naturalism and the organizational naturalism we've discussed in previous chapters, it's necessary to point out the nontrivial differences between them. First, although both presuppose a self-organizing world the extra dimensions proposed are different. Post-modern naturalism introduces the dimension of information whereas organizational naturalism brings up the dimension of organization. Information suggests an informing process. It's what a source may inform a receiver. So it's a rather relative concept. It seems inappropriate to talk about the information that an object contains independently. Further, information bears much epistemological flavor and implies a subject.

This makes information an unsuitable metaphysical concept. In contrast, organization is a neutral concept. The organization of an object may be characterized with its structure and the interactions among its parts. In fact information processing only appears when organization reaches a certain level. Second, as for the attitude toward modern science there also exists significant difference between the two views. Post-modern naturalism endorses the scientific method, whereas organizational naturalism confines its application to lower levels of organization. Quantification presupposes a simple ordering relation. Another basic principle of scientific method is uniformity. Both become problematic in higher levels of organization. Is a person with IQ 100 twice as intelligent as one with IQ 50? Or are even two people with the same IQ intelligent in the same way?

Post-modern naturalism is notably connected with the particular field of medicine. Information processing already plays an important role in the human body. And there the scientific method still finds its suitable application. In the general framework the central aim of the book is the "construction of a medical model at once scientific and humanistic." (*ibid.*: p. 286) On the one hand the narrow focus of the conventional biomedicine on the body needs to be expanded. Mind is introduced as an effective factor into the medical equation. Psychological experience is no longer the epiphenomenal episode as some materialists claim, but it may cause explicit effect in the body. This is the so-called downward causation. The placebo effect clearly demonstrates the downward causation. In the phenomenon even fake substance has curing effect. So the cure doesn't originate from the chemicals, but the patient's belief of its curing effect. On the other hand the final effect of the mind is still explained in scientific terms. The downward causation goes from the mind to the body, but the final effect in the body has intermediate bodily cause. In the placebo effect certain chemical is still generated in the body and causes the final curing effect. The difference from a normal cure lies in the fact that in this case the production of the intermediate chemical is induced by psychological factors.

Foss calls his successor model to biomedicine "infomedicine." Infomedicine doesn't regard the human body as a machine that directly reacts to the external environment. Instead the body exhibits mindful self-regulating behavior. Changes in the environment are interpreted as symbols and the organism then responds accordingly. The ability of interpretation indicates subjectivity. In other words, the subject converts the signals into information about the environment. With this mediator the environment doesn't have to be a physical one. Psychological, social and cultural factors may all have an effect on the body through the interpretation of the subject. In transcending the narrow scientific worldview in modern medicine Foss emphasizes the effective role of the mind. With the bidirectional causal relations mind and body are inseparable.

Compared with infomedicine integral medicine is more comprehensive and tolerant. Integral medicine should be distinguished from integrative medicine. The latter is a union of conventional and alternative medicines, whereas the former aims to offer a general theory. Wilber's four quadrant theory is the most influential. It divides being-in-the-world into four dimensions. These dimensions can be arranged along two axises interior-exterior and individual-collective, forming four quadrants. The upper left quadrant interior-individual is the intentional subjective dimension. The upper right quadrant exterior-individual is the behavioral objective dimension. The lower left quadrant interior-collective is the cultural intersubjective dimension. The lower right quadrant exterior-collective is the social interobjective dimension. The theory grants each quadrant equal priority and holds that none of them can be reduced to another. It provides a consistent map to locate every medical approach, conventional, complementary or alternative. Apparently the conventional biomedicine is located in the upper right quadrant. In contrast complementary and alternative medicines normally involve other quadrants. With a comprehensive picture integral medicine advocates an open mind in the practitioners and aims high. As Dacher writes: "The

result will be an uncommon life and health that will emerge from a post-modern integral medicine. Its foundation will be an expansion in consciousness. Its focus will be human flourishing rather than human survival." (Dacher 2005: p. 19)

No doubt both infomedicine and integral medicine try to go beyond modern medicine and incorporate it into a larger picture. While infomedicine expands to the mind, integral medicine equally brings the social and cultural dimensions into the picture alongside mind and body. Due to its wider scope integral medicine's attitude toward modern science is not as favorable as infomedicine. While it pleads for evidence and rigor in complementary and alternative approaches, it doesn't require scientific explanation of everything. By putting modern medicine in a larger picture both post-modern medical movements can be deemed as effective conceptual control of the former.

Post-modern medicine is to a large extent a reaction against the scientism and utopianism in modern medicine. To control modern medicine it's not enough just to mark out its limited scope. Even within its appropriate scope control is necessary, because unbridled application has caused or could cause undesired damage. And the unbridled application of biomedicine has partly resulted from scientism and utopianism. People have learned many bitter lessons from over-confidence in using drugs. Among them the thalidomide disaster probably had the most shocking effect. The drug was introduced as a safe sleeping tablet at the end of the 1950s. Two years after the introduction a rare birth deformity, undeveloped limbs, was observed in Europe. Study later showed that the culprit was thalidomide, taken at the early phase of pregnancy. By that time thousands of babies had been affected. The US Food and Drug Administration had already been established before the incident happened. It had doubt about the drug and didn't license it. That saved the country from the disaster. Shortly similar regulatory authorities were set up in many other countries. From then on the license of a new drug had to be preceded by comprehensive safety tests and clinical trials.

The regulatory authorities tend to pay more attention to the introduction of new drugs than the application of existing drugs. The latter is as important as the former. The inappropriate use of even well-tested drugs can bring about unexpected consequences. One major complaint about modern medical practice is the imprudent use of antibiotics. Once antibiotics were proved to be a safe and effective cure of infectious diseases they were consumed without constraint. However, unnecessary prevalent use of antibiotics could cause disaster. It creates more chance for bacteria to mutate into antibiotics resistant species. In that case there would be bacteria that no existing antibiotic can kill. When the issue became obvious and its severity was well recognized, regulatory authorities also started to put restrictions on antibiotic use. Today antibiotics are only obtainable through doctors' prescription in many countries. A more current complaint is about the imprudent use of all kinds of scans. Contemporary scanners are mostly the descendents of X-ray. Hence they all generate certain kind of radiation. Frequent exposure to radiation definitely can cause disease. Due to its health care system Americans are more likely to perform tests and scans than other nations. Insurance companies there only care about how many tests or scans are performed, not how many diseases are cured. Studies even show that some patients' cancer is directly caused by frequent scans. Here again we have some clear cases which testify how bad advanced technologies without proper regulations can get.

The introduction of harmful new drugs and the inappropriate application of drugs and scans can cause damages. But those damages are still confined in the field of medicine. Some recent developments in medical technology have greatly expanded the scope of impact. In those cases consequences could reach far beyond the field of medicine itself. Since reproduction is the origin of life, several reproductive technologies have created hot debates and the issues involved are

ethical rather than medical. In the last several decades different treatments for infertility have been developed. All of them were meant to fix certain deficiency in the natural reproductive process. If the issue was just interference with the natural process, it wouldn't have been so significant, although this is already unacceptable in certain cultural context. For Christians birth is sacred and shouldn't be artificially interfered at all. What makes the issue more complicated is that the technologies are applied not for fixing deficiency, but voluntarily. When artificial insemination is used to help an otherwise infertile couple have a child, most people would accept it. But when a woman voluntarily chooses to be a single mother through using sperm from a donor, much more people would feel uncomfortable. *In vitro* fertilization offers more possibilities, but at the same time brings about more issues. Artificial insemination separates birth from the relationship between parents, but *in vitro* fertilization further separates birth from parents. It makes surrogate motherhood possible. Again, using a surrogate mother just to avoid the burden of birth would let much more people feel uneasy than adopting it as the only way to have a child. Finally, cloning technology would escalate the issue even further. Cloning would fundamentally change the traditional notion of parent and directly disturb the meaning of life. Here I don't want to take side in the ethical debates. Generally I believe ethics is a cultural and historical matter. Ethical standard varies across cultures and changes over time. For the purpose of this case study suffices it to point out, once a technology bears ethical implications, it needs to be regulated according to the current moral standard.

Therefore, we've applied the general embracing-controlling-stance on modern technology to modern medical technology. Adopting the scientific worldview and method modern medicine has made great advances in exploring the human body and curing many traditional diseases. Its ground-breaking effort and success justify the embrace of it, despite various criticisms. But on the other hand, modern medicine also needs to be controlled conceptually and practically. Conceptually we should realize its limited scope. Practically it should be regulated with medical prudence and according to ethical standard.

12. Information Technology

In this chapter we look at another specific technology and see how the balanced stance on modern technology may be adopted concretely. Undoubtedly information technology is one of the most important technologies in contemporary life. The current age is often called "the information age." The impact of information technology can be felt in almost every area of the society, no matter whether it's military or civilian, governmental or entrepreneurial, scientific or artistic, production or everyday life related. The computer is arguably the most widely used tool beyond human basic needs. Many people even claim that they now cannot live without a computer. However this ubiquity was formed only in a very short period of time. In fact the modern computer merely has about seventy years of history, and the ubiquity wasn't developed until the last phase. A brief historical survey provides the background on which we could discuss the philosophical issues more easily. Generally we may divide the modern computing history into the following three phases from the perspective of application: computation, information manipulation, and information sharing and exchange.

On top of the historical background information technology is similarly examined in the two aspects of the balanced stance. Of the three phases above the last one is the focus. Here the approach adopted in part III is closely followed again. In embracing information technology we need to refute the dystopian view of it. Borgmann applies his general view of modern technology to information technology particularly. Hence his specific discussions offer a good target in this case study as well. In controlling information technology, first some utopian views of it are rebutted. Dreyfus also extends his critique of the second phase of information technology to the third phase. He addresses several major issues related to the internet. His new ideas are endorsed and used again to show the limit of information technology in the third phase. The need of practical information control becomes clear after some issues with the current information practice are analyzed.

12.1 Brief Historical Survey of Information Technology

Information technology is the technology to handle information. Information may take various forms, mainly including numbers, texts, pictures and sounds. The handling of information also has different forms. Information may be stored and retrieved; it may be processed and transformed; it may also be transferred across different locations. The current information technology contains the handling of all sorts of information in all kinds of ways. But it was very restricted even several decades ago. Information technology then meant solely computation in the strict sense, that is, the calculation of numbers. Calculation is a special form of processing. Although computation has a limited form, it turns out to be universal. First, all types of information are reduced to numbers. Since the Latin letters and some popular symbols were encoded in ASCII, the scripts of many natural languages have been encoded in numbers. Later pictures and sounds were also easily represented in sequence of numbers. Second, all kinds of information handling are reduced to a limited set of basic operations, which are also encoded in numbers.[42] These basic operations go beyond calculation, so computation has been extended. But the major part was already contained in the original form of computation. Now we see computers do a full variety of things, but on the machine level all boil down to the processing of numbers, binaries in this case. Therefore information technology is often called "modern computing."

[42] The basic operations are instructions. These constitute the instruction set of a computer.

Thus, computing technology is the ancestor of information technology. Using tools to aid computing has been practiced by human beings for a very long time. Abacus was a popular computing tool in the ancient cultures. Viewed from the perspective of a modern computer, it's essentially the memory component. In abacus computing the processor was still the human brain. Automatic computing machines were designed in the 19th century. Babbage's difference engine was a typical example. It's used to calculate the value tables of polynomials. Once the initial values were input the rest of the table could be generated with the method of difference by the engine. Two basic characters distinguish modern computers from previous computing machines. First, modern computers are based on electronics instead of mechanics. The difference engine is a mechanical machine consisting of metal columns and geared wheels. The transition from the mechanical to the electronic design took place during the Second World War. And that's the birth of modern computing. The primary advantage of the electronic design over the mechanical one is in speed. The speed of mechanical relay has a limit that can be easily reached. By contrast electronic signal may be transmitted much faster. Other advantages soon came out in later development. Second, modern computers are general-purpose machines. The difference engine was designed particularly for generating the value tables of polynomials and was almost impossible to put to different uses. Some more advanced machines designed in the war period were also only for special purposes, such as breaking the Enigma codes. In contrast, modern computers are based on the von Neumann architecture with the key feature of stored program. With this architecture, in order to let the computer perform some different task people don't need to redesign the machine, but only change the program. This clear separation of program from machine had fundamental consequences. The birth and development of software was one of them. It has apparently had much impact on philosophical thinking as well.

Before we move to the application, let's look at the stages of hardware and software development in turn, corresponding to the two basic characters above. What replaced mechanical components in the original modern computers are vacuum tubes. This replacement brought about some gain in speed. But the size of the computer stayed on the same level. A computer built with vacuum tubes still needed a whole room to hold. In fact vacuum tubes caused a new problem. Compared with a mechanical computer, a vacuum tube computer was much hotter. Legend has it, someone even used the computer to cook eggs. The invention of the transistor soon made the vacuum tube obsolete. The transistor could perform the same function as the vacuum tube and had obvious advantages. Its size was smaller and its energy consumption was lower. The revolution in speed and size didn't come until the third stage of computer component development. This stage was featured with the integrated circuit, where a whole complicated circuit was etched into a small piece of silicon based chip. The greatly increased condensation led to higher processing speed and significantly reduced size. In the integrated circuit the advantage of the electronic design over the mechanical one became prominent. It's unimaginable to shrink a mechanical processor to the size of a chip. The development of the whole computer went hand in hand with the advancement of the component. Modern computers have undergone the stages of mainframe, minicomputer, and finally workstation and personal computer. Today a portable iPad has much more computing power than the original mainframe computer.

Once the program was separated from the machine it obtained its own life. Thus, a different evolution history started. The original program was written in machine code, consisting of binary bits. It was input into the computer memory through punched cards, or even switches set manually. Anyways much manual work was involved and programming was an inefficient, error prone and tedious job. This binary code is called machine language, which is the first generation. The second generation language is assembly language. The assembly language still stayed on the instruction level. In other words, it corresponds to the machine language instruction by instruction.

The difference was that the instructions in assembly language were written in meaningful symbols. In this way it made programming more interesting and less error prone. Before an assembly program was run it's still first transformed into machine codes, through an assembler. This guaranteed higher performance. On the basis of assembly language high-level programming languages were developed. This is the third generation. This generation moved beyond the instructions and introduced high-level concepts of structures and controls. Popular data structures are arrays, lists and trees. Basic control flows are branches, loops and subroutines. These high-level concepts are much closer to the problems that computer programs try to solve. For the sake of performance, programs written in high-level languages were normally still transformed into machine codes before they were run. Now on top of the assembler a compiler was also needed. The task of a compiler is much more complex than that of an assembler, which is a straightforward translation. In the third generation of programming languages a new separation appeared. Besides the separation between program and machine, now there was also the separation between high-level and low-level programs. Mediated by a compiler, a high-level program was freed from a particular instruction set. Parallel to this second separation is another one between system and application programs. During the early phase of modern computing programmers had to take care of everything, including loading programs, performing I/O operations, managing memory and scheduling tasks. Later special programs called "operating systems" were developed to handle these basic tasks particularly. An operating system acts as a platform on top of which application programs are run. This is another kind of liberation of programming. Even higher levels of programming languages have been developed to imitate natural problem solving more closely. These are called the fourth and the fifth generations. But unfortunately these have been proved to be only applicable to special purpose tasks. Human programmers have to take a major part in general problem solving. However, compared with programming with machine code software engineering today is much more complex, efficient and convenient. Generally the importance of software has exceeded that of hardware in the later phase of modern computing. The dominance of hardware companies such as IBM and DEC has been taken over by software companies such as Microsoft, Google and Facebook.

On the ground of the hardware and software development we now may focus on the application. Computers were invented to compute, or perform mathematical calculations to be precise. The intensive building of large computers was motivated by military needs during the Second World War. One need was to break the codes used in military communication. Another was to calculate the trajectory of artillery projectiles. Modern computers were born in this period. After the war ended computers were soon commercialized to serve civilian purposes, although the military still occupied an important part of the market. The US Census Bureau was among the first customers. Others included big manufacturing and insurance companies. With the stored-program architecture the machine didn't need to be rewired to solve a different problem. But in this first phase of information technology the general purpose was still restricted in the area of mathematical calculation. This focus was even reflected in the first high-level programming language FORTRAN, released in 1957.

Major alternative applications of computers came out when the research of AI was launched. Specifically computers were used for control in robotics and text processing and rule following in other areas, such as logic theorem proof, chess playing and knowledge representation. Simon and Newell developed a program called "Logic Theorist" in 1956. This was the first logic theorem prover. McCarthy's approach to knowledge representation was also heavily dependent upon logic. In 1960 he even created a particular LISP language to meet the special needs of AI programming. In terms of information format numbers are the central content of the first phase of information technology. In AI we saw symbols and texts become more important. The introduction and popularization of personal computers greatly expanded the application area of

information technology. While computation was mostly used in big governmental and industrial institutions, and AI research was mostly carried out in academic and research institutions, now information technology entered people's everyday life. Of course calculation was still part of everyday life, but it no longer played a crucial role. The focus of text processing also shifted to daily application in the form of a word processor. Sounds and pictures as new forms of information were paid more and more attention. From office work to home entertainment computers started to serve individuals' needs. From the perspective of information handling applications in AI and individual life belonged to the same phase. Information manipulation, such as transformation, editing was involved in both cases. This is the second phase.

The third phase began with the invention of the internet. The predecessor of the internet was the US military sponsored ARPANET, where different computers started to be connected through packet switching networks. Later the TCP/IP protocol was developed. The ARPANET became congested in 1980s and was decided to be shut down. The National Science Foundation took over the job and connected multiple regional networks together to form the NSFNET. The interest in the NSFNET grew rapidly and soon became international. Then Advanced Network Services was founded in 1991, to commercialize the internet. The ANSNET was supported by commercial providers instead of the US government. The internet attained popular use with the invention of the World Wide Web. The core elements in the World Wide Web are: a universal resource locator (URL) to locate a resource universally, a hyper text markup language (HTML) to present a web page, a hypertext transport protocol (HTTP) to access a resource, and a web browser to display a web page. Before the coming of the World Wide Web electronic mails had been sent on the networks for a long time. And after the internet got popular new ways of communication were invented on it. Instant messaging and video call are two most important ones. We can see in this third phase the application of information technology has shifted its focus to information sharing and exchange, although computation and information manipulation coexist with the new application. On the internet information sharing and exchange become more and more intertwined. On the one hand many web sites are interactive, so when some information is shared feedbacks could be collected from the receivers. On the other hand text communications may be easily recorded and put on the web for sharing.

In its several decades of short history, from computation through information manipulation to information sharing and exchange, the landscape of information technology has dramatically changed. It's hard to predict what the next phase would look like. Generally we see that information technology has become more and more powerful and influential. Power and influence bring about issues and concerns. When computers were used solely as computing machines they were treated as helpful tools. No one would think that they could cause negative effects. But when researchers in AI claimed that human intelligence would be artificially created in a couple of decades, a fascinating utopian picture was soon followed by a dystopian worry that humans would soon be conquered by robots. As the internet grew more universal and dominant, the polarized utopian and dystopian views reemerged in the third phase. Since issues concerning AI were already addressed in part III, the focus of this case study of information technology is put on the internet.

Specifically I apply the embracing-controlling-stance on modern technology to the internet. In the next section Borgmann's critique of information technology will be analyzed. His pessimistic view is still based on substantivism. The embracing stance on information technology is supported by a refutation of this substantivism. On the other hand Dreyfus's new critique of the internet is first used to provide theoretical justification for the control of the internet in the third section. Then practical reasons for the control are discussed. The need of control is explicitly

expressed by Ceruzzi. At the end of his book *A History of Modern Computing* he writes (Ceruzzi 1998, p. 312):

> As we start to accept the World Wide Web as a natural part of our daily existence, perhaps it is time to revisit the question of control. My hope is that, with an understanding of history and a dash of Thoreauvian skepticism, we can learn to use the computer rather than allowing it to use us.

12.2 Embracing Information Technology

Borgmann's attitude toward information technology as manifested in *Holding On to Reality: The Nature of Information at the Turn of the Millennium* reflects his general pessimistic stance on modern technology. The pessimism is distinctly expressed in the following statement: "Whatever is touched by information technology detaches itself from its foundation and retains a bond to its origin that is no more substantial than the Hope diamond's tie to the mine where it was found." (Borgmann 1999, p. 5) In his critique of information technology Borgmann adopts a different approach than the general device paradigm. In this new semiotic approach his focus is on the relation between information and reality. In the device paradigm the meaning carried in the form of engagement is lost in the retreat of the machinery of a device. Now the meaning embedded in reality is lost when technological information is estranged from the latter and tries to offer its own Ersatz. However, I will show that the general idea of device paradigm is still behind his critique of information technology.

Borgmann compares technological information with natural information and cultural information. The relation between natural information and reality is based on natural connection. The example of smoke as a sign of fire may best explain the notion of natural information. In this case smoke is natural information *about* fire, a natural reality. The relation between cultural information and reality is based on convention. Text is the most important conventional sign. Most cultural information is carried in text. Besides letters there are also other symbols, including mathematical symbols, diagrams, musical notes, blue prints, etc. Cultural information can still be about reality, such as in the cases of records, reports, maps and charts. But it at the same time has a new function. It may be used to create cultural reality. Borgmann calls this information *for* reality. He particularly talks about reading literature, playing music following a score and building according to a design. In these cases literary reality, music and buildings are created from the text, score and design. According to Borgmann, technological information still includes the two types of information mentioned above, but it introduces a new kind of information. In fact almost all the cultural symbols can now be represented in technological information. Texts, notes and diagrams can all be processed in a computer. In addition, technological information offers something more vivid. His favorite example is a music CD. With a sound system including a CD player, an amplifier and speakers the information inscribed on a CD can be easily converted into music. In this case the distance between information and reality is further shortened, so that Borgmann calls the information involved here information *as* reality.

The distinction between natural information and cultural information seems to be very obvious. The basis of natural information is natural connection, whereas that of cultural information is social convention. Borgmann doesn't see any issue in cultural information. Cultural signs are a beneficial expansion of natural signs because they are freed from the natural connection with natural reality and can refer to new cultural reality. Cultural reality is also regarded as an enrichment of natural reality. In contrast, the distinction between cultural information and technological information is not that straightforward. Let's do a comparison between a musical score and the digital file generated from the recording of a corresponding performance. The

correspondence between a musical note and a sound of a particular length and pitch is based on a musical convention. In this way the note is a sign of the sound, a sound created by humans, a cultural reality. A piece of music may be generated from a score through performance, vocal and/or instrumental. Then what about the relation between the digital file and the performance? The digital file is generated for the most part automatically from the performance by a recording device. This may suggest that their connection is direct, immediate. But don't forget the recording device is designed by humans and the digital file format is also devised by humans. With a different recording device or a different file format the digital file generated would be quite different. We can see the correspondence between the digital file and the performance is also based on some convention. So strictly speaking, when we have the CD we don't directly have the music. What lies in between is a sound system as the interpreter.

So what's exactly the difference between cultural information for reality and technological information as reality? We've shown that both the musical score and the digital music file are signs of a piece of music. The difference doesn't reside in the direction of generation. In both cases the generation is bidirectional. A digital file is generated from a performance through recording; a performance is generated from a digital file through playing. Similarly a musical score may be generated from a folk song; a performance may be carried out according to a score. Next we may try to find the difference in the variability of interpretation. A symphony with the same score may be interpreted differently by different orchestras. However the same situation also holds for a music CD. Different sound systems may play the same CD with different effects. Another possible difference is in the comprehensibility of the sign. A musical score is comprehensible to a musician. When she reads the score she can imagine the music. A composer can imagine the music first and then write down the score. On the contrary, a digital music file is incomprehensible even to a recording expert. The file has to be interpreted by a device. And there is no way in which a digital file is generated directly from imagination. However a sign doesn't have to be comprehensible to humans unaided. For example, many signs (symptoms) need to be detected by a machine in medicine. At least Borgmann's favorite example shows that from the semiotic perspective we cannot find any essential difference between cultural and technological information.

The difference can be made still on the basis of the concept of device paradigm. To turn a musical score into a piece of music first one needs to obtain the ability to read the score and then make the performance. This is definitely an engaging process. In contrast, to turn a music CD into a piece of music all one needs to do is put it into a CD player and let the device do all the work. Again the machinery retreats behind the scene and the commodity becomes salient. Only from the music consumer's perspective is technological information treated as reality. It's true for a consumer that when she has the CD she has the music, provided she also has a sound system. However from the semiotic perspective there is significant distance between a digital music file and the music. The former is a sign of the latter based on a convention no less complicated than the musical score. In this sense technological information is also for reality. After all, the distinction between information for reality and information as reality is not based on the semiotic relation, but human involvement or engagement in the interpretation of the signs. This resorts to the device paradigm.

Nonetheless, up to this point Borgmann's critique of information technology still cannot be simply reduced to device paradigm. When a traditional hearth is replaced with a modern heater, the machinery is hidden, but the commodity part, the heating, keeps the same. In contrast, when cultural information is replaced with technological information the reality referred to by the signs is not the same. Borgmann claims that the reality contained in technological information is not genuine reality, but acts as a rival of it. Certainly he admits that technological information also includes the previous two kinds of information, information about reality and information for

reality. An online news report is a piece of information about reality. A novel written with MS Word is information for reality. In these cases we don't see any fundamental difference between cultural information and technological information. The third kind of information, information as reality, is Borgmann's main concern. Under what circumstances may a piece of information counted as reality? The criterion seems to be that it has to be audio or visual information that has direct connection with reality. Generally we could say that the vividness shortens the distance to reality. If this is the case, then this type of information however doesn't only belong to technological information. Granted the most part of audio and visual recording is made possible by modern technology. But we should remember that painting is older than writing and it records reality visually too. Then arises the question, how would Borgmann categorize a painting? Is it information as reality or information for reality? If it's the former, then information as reality is not introduced by modern technology. Unless he would exclude painting from his concept of culture, some cultural information is also information as reality. If the latter, then since the reality contained in a music CD has the same status as that in a painting, it probably should be categorized as cultural reality too. In fact in sound synthesizing, digital photography and digital movie making we see similar art forms to literature, music and architecture, the three discussed by Borgmann in the part of cultural information.

I've tried to weaken the force of Borgmann's critique of information technology from the perspective of semiotics. In summary we could say that technological information cannot be distinguished from cultural information from the semiotic perspective. The relation between technological signs and reality is built on similar foundation (convention) to that between cultural signs and reality. Further, technological reality has similar status to cultural reality, no matter whether the information involved is for reality or as reality. I admit that information technology has caused problems, as Borgmann points out. And the next section is concerned with those problems. However we shouldn't blame information technology itself for the problems. Facing the problems in modern society Borgmann tends to pay unevenly more attention to the bright side of traditional society. Cultural information is normally enriching, but there also exists degrading literature, even music. The good or evil doesn't lie in the form. Information technology by itself is no more beneficial or detrimental than literature or music.

The above analysis finally reduces the force of Borgmann's critique of information technology to device paradigm. When the implementation of music through score reading and instrument playing is changed to CD playing engagement with music is lost in a sense. But when we consider that the music CD gives millions of music lovers the chance to listen to music significantly more, the engagement with music is definitely greatly increased in another sense. Against Borgmann's concept of device paradigm Verbeek brings up the notion of engaging devices (Verbeek 2002). The retreat of the machinery of a device carries away the corresponding engagement with it, but with the device new engaging activities may be created. Generally speaking, to save effort is a basic goal of technology. When some effort is saved, the engagement associated with the effort is reduced. But a new technology always creates new possibilities, with which new engaging activities can be performed.

The benefits brought about by information technology make a long list. It serves the purpose here to highlight several of them. First, computers make intelligent control in production possible. This allows more and flexible automation and makes production much more efficient. Second, application software such as word processors and image processors makes human driven tasks much easier. Compare a word processor with a typewriter and a digital darkroom with a chemical one. Third, computer network makes communication more convenient and efficient. The advantages of an electronic mail over a traditional mail are obvious. Fourth, the internet revolutionizes information sharing. The information sharing in a radio or TV broadcast is

scheduled and passive from the perspective of the receiver. On the contrary, the information sharing on the internet is on demand and active from the perspective of the receiver. The information process has turned from pushing to pulling.

Further, the new possibilities don't have to conflict with traditional values. In some cases they even promote them. A personal experience well illustrates the idea. I have been studying and working abroad for many years. Ten years ago I called my parents back home to talk with them. Now I can have video calls with them through the internet. The video calls are free of charge and more importantly we can see each other thousands of miles away while we talk. If family bond is a central traditional value, information technology may definitely help foster such values.

Although Borgmann misplaces the blame for issues related to information technology on the technology itself, he makes a point when he points out the issues. To resolve those issues what we need is not repulsion but control.

12.3 Controlling Information Technology

We may talk about the control of information technology in two respects: theoretical and practical. Theoretically information technology needs to be controlled because it's not as mighty as the utopianists claim, but has a limit. Practically information technology needs to be controlled because unrestricted practice has caused obvious problems.

Technological utopianism has been a persistent thought since the Industrial Revolution, in which technology demonstrated its unprecedented power of making progress. Given the negative consequences accompanying the progress, the adoption of every significant new technology re-strengthens the belief that technological innovations can solve all the problems, new and chronic. In the field of information technology, the utopian fervor based on AI hadn't been completed dampened by the research reality, before the invention and rapid development of the internet kindled a new hope of utopia. Apparently the internet cannot directly benefit people's material life much, but it can satisfy more important needs, the social and spiritual freedom. With abundant information incessantly at their disposal people seem to suddenly become unprecedentedly knowledgeable. With the communication network spreading literally worldwide, distance has been much further shortened. As the communication turns more vivid we even can experience an event without our body being there. With some basic traditional barriers removed people are made more equal than ever before. Given an affordable computer and internet connection, everybody has the chance to visit some famous museums and attend some courses from elite universities. And finally with the on-line virtual life people seem to be able to realize their dreams without any burdens in the real life.

Dreyfus extends his critique of AI to the internet. Some people argue that Dreyfus holds a dystopian view of the internet (Brownstein 2011). This is not consistent with his general stance on technology and his particular attitude toward the internet. He welcomes the internet and is an active user of it. What he aims to do is undermine technological utopianism and show the limit of technology. He did that to AI. His target was strong AI, which claims that genuine intelligence can be achieved through technical means. He now does the same thing to the internet. His current target is still the utopian view of the internet. Specifically he addresses the following issues in his recent book *On the Internet*: information sharing, telepresence and virtual life. These issues stand at the center of utopianism of the internet. Next we discuss them in details. My approach is to demonstrate the limit of the internet through endorsing Dreyfus's basic ideas. This provides the theoretical justification for control.

Information sharing is a main function of the internet. The internet makes a piece of information universally accessible. But accessibility is just a very basic requirement for information sharing. As the accessible information explodes, the major issue soon turns into finding the appropriate information. So relevance becomes more important than availability. In order to find a piece of appropriate information quickly, the available information should better be well organized. However organization seemed to be a factor that's overlooked when the World Wide Web was originally invented. The HTML doesn't specify any restrictions for the links between web pages. Any page could contain a link pointing to any other page. In fact a self-pointing link is also possible. With this laxity of inter-page relations the whole web ended up with a flat structure. In a flat structure there exists little organization. Early-phase information retrieval treated all the web pages independently. The relevance of a page (document) had to be based on intra-documental features. The frequency of key words turned out to be the best choice. Dreyfus's critique of this approach is based on the argument that relevance needs to be defined on top of semantics, but not just syntax. A document may be very relevant to the topic although few key words are contained in it. The issue boils down to natural language understanding, which is a key AI area already criticized by Dreyfus. The success of Google and Wikipedia in the last decade has changed the landscape of information sharing on the internet. But this new phenomenon doesn't refute Dreyfus's basic position of information retrieval. On the contrary, it confirms it. Google search exploits the links between web pages and define relevance on top of them. Links are particularly added by humans. They are closer to reflect genuine relevance than key words. When these two factors are combined, the search results become much more accurate. On the other hand Wikipedia tries to rebuild the traditional hierarchical structure of information taking advantage of the flat hyperlinks. In a sense we can say it tries to bring in more organization.

Telepresence results from advanced communication mechanism. Telephone as an audio communication mechanism has been there for a long time. The addition of the video channel to real time bi-direction communication only became popular in the last several years, thanks to the internet. Since sight is the predominant information channel for human beings, this addition is substantial. Now we can attend a remote meeting through a conference call. We can talk with a relative or friend on a different continent face to face through a convenient video call. Generally we have obtained remote presence without our body being there. The utopianists would claim that we have thrown away the burden of our body and gained spiritual freedom. What Dreyfus wants to point out against this utopianism is that there is a crucial difference between telepresence and real presence. What telepresence lacks is a feel of the situation in reality, in which our body plays an indispensable role. Although we collect the major part of information about the outside world through visual and aural senses, our body is good at sensing the situation and context.

Dreyfus applies this basic idea specifically to distance learning. He divides the learning process generally into six stages: novice, advanced beginner, competence, proficiency, expertise and mastery. Starting with the stage of novice one first learns explicit rules. The advanced beginner moves beyond explicit rules and can recognize situational features. At the stage of competence the learner can handle real-life situations independently, but with much effort and little confidence. The stage of proficiency is characterized with intuitive recognition of the salient components of the current situation and explicit decision on the reaction. From this stage on risky involvement becomes necessary. The decision on the reaction necessary for a particular situation is also intuitive when the learner reaches the stage of expertise. Now performing a task becomes spontaneous and effortless. Embodiment states appear in this stage. Finally the stage of mastery is featured with creativity, that is, deliberately trying new approaches. Dreyfus's general claim is that in distance learning a learner can at best reach the third stage, because the risky involvement required for the last three stages is lacking. However we should realize that specific skills may

break this general rule. The proving skill in planar geometry may be learned passing the competence stage in distance learning, whereas driving skill can be learned only within the novice stage. The situations in planar geometry are much easier to communicate remotely than those in driving a car.

Compared with the availability of abundant information and telepresence, virtual life is the strongest claim. While the availability of abundant information is a freedom from ignorance and telepresence is a freedom from the body, virtual life is a freedom from all the burdens in real life. In virtual life on the internet one can talk anonymously, one can speak anything without bearing the consequences, and when one gets into a messy situation she may just walk away and restart the game. Generally in virtual life it seems that all of one's dreams could come true and the ultimate freedom could be experienced. Based on Kierkegaard's critique of the press and the public sphere Dreyfus argues that a meaningful life cannot be without commitment. Commitment implies vulnerability and responsibility, but they are the cost we have to pay in order to obtain meaning for our life. Just because there are risks in our life we have to try hard to prevent bad things from happening. And once bad things really happen we have the responsibility to repair the situation and strive to recover from it. These endeavor and exertion make life a much richer experience than living solely according to one's wishes and desires, without caring for the consequences. Dreyfus's basic claim in this issue is that, since on-line virtual life tries to avoid real-life commitment, in throwing away a fundamental burden in our life it throws away the central meaning of life at the same time. In this sense virtual life cannot be a replacement of real life.

Now we can see Dreyfus's critique of the internet is closely related to his critique of AI. In the latter he emphasizes the importance of the human body and the situation to human intelligence. This is carried forward in his handling of the three issues of the internet. In information retrieval relevance cannot be defined syntactically, but according to human understanding. And this has to be based on the human body and the situation. In fact there is some overlap between information retrieval and AI. The issue of telepresence also has to do with the lack of bodily interaction and the sense of situation. Finally vulnerability to a large extent results from the restriction of the body and responsibility comes out of certain situation. Here we see similar limit of the internet as a technology. Dreyfus's two critiques combined undermine the utopianism of information technology.

When information technology is regarded as a means leading toward a utopian society, the control of it doesn't make much sense. So the shaking of utopianism provides theoretical support for control. Next I argue for the necessity of control from the perspective of the content, that is, information itself. The generation and sharing of information without appropriate control may at best degrade the information and at worse cause undesired damage.

We may break the whole informing process into three components. Information is generated in a source, then transmitted and finally reaches a destination. Generally we can say the destination is informed by the source. So the three components are the information source, transmission and destination. In the traditional society the informing process was mostly transient and local. Gossips and chats in everyday life soon died away. Letters could reach far away, but were normally addressed to a particular person. Only such information as an emperor's mandate was widely distributed. In this case the informing process was very limited. The invention of the printing press greatly expanded the informing process. The printing press significantly facilitated the sharing of knowledge and played an important role in modernization. But still there were limits. Only learned people were able to write books and not everybody could read a book. And the information contained in the books was mostly about serious topics. This is the second phase.

The third phase is featured by the mass media, including newspapers, magazines, radio and TV. Compared with the second phase, the information covered much more non-serious topics, such as news to satisfy mundane curiosity and entertainment. And the information destination was intended to be everybody. However the information source in this phase was still restricted. News reports and articles were written by professional people and radio and TV programs were also produced by professional people. Finally the internet brought the informing process to its fourth phase. Now we see the information source, transmission and destination all become universal. Everybody can generate information on the internet, the information may reach everybody, and the information is transmitted globally.

On this historical background we now take a closer look at each component of the informing process on the internet. In principle everybody can put information onto the internet. The only requirements are basic literacy and computer literacy and the access to the internet through a computer. Once a piece of information gets onto the internet, it's available for the universal public. Putting information onto the internet is equivalent to publishing. Never before had publishing been within the reach of an ordinary person. It seems that the principle of freedom of speech has reached its full realization. However, as the freedom of speech grew we saw degradation in the information generated. Originally a book was based on serious study and contemplation. Then a news report became a direct description of an event, although it might be very interesting. Finally chaotic records of trivial events in everyday life were also published in unprecedented speed. Meaning comes out of relevance, which is in turn based on differentiation and selection. When everything becomes relevant in the same degree, relevance disappears. So does meaning. Gossips and trivial chats died away shortly in the traditional society for a benefit, so that people could focus on more important things. Now on the internet this kind of information has been persistently kept and attracted a significant amount of people's attention. Of course serious information from the past and present is also made available on the internet. But barring an effective differentiating mechanism all the information on the internet is treated on the same footing. In this way trivial information turns into disturbing noise. When noise grows rapidly the information in general degrades.

The freedom of speech is not just a freedom to speak publicly. The freedom rather lies in to say something worthwhile and to say it responsibly. The latter touches on another issue concerning information generation on the internet. Anonymity in publication occurred in the past. Sometimes it's used as a necessary strategy in political struggle. But it was an exception than a norm. The internet almost reverses the situation. When anonymity was used as a strategy responsibility was not neglected. By contrast, on the internet we see anonymity is closely associated with the avoidance of responsibility. Especially in those sensitive forums we can see irresponsible messages everywhere, ranging from impolite to obscene. Before the internet those messages rarely had the chance to reach the general public. The loss of control of publication on the internet brings about irresponsibility besides triviality. This is another form of degradation.

With respect to information transmission the internet is a monolithic entity. Any piece of information put onto the internet is universally and conveniently accessible. Certainly the access to some internal areas of many websites is password protected, but in this case the entrance to those areas still belongs to the gigantic, flat public sphere. With this simple information transmission structure there is little transmission control. Then problems arise. We look at several examples here. Frequent online registrations make people more inclined to divulge their personal information on the internet. Once this information reaches the public sphere it's hard to remove. With today's advanced search engines then it's easy to piece the information about a single person together. This greatly facilitates identity theft. For a second example, bomb building instructions and detailed public facility plans are both available on the internet. A newly recruited

terrorist could plan an attack, just sitting by his computer. Another example has to do with pornographic websites. It's not news for a child to run into a porn site while surfing the internet. Even the entrance is nasty enough for a child.

On the information destination side, TV watching once replaced book reading to be the main after-work activity. Now internet surfing is gradually replacing TV watching. Reading a book is possible on the internet, but that's not the typical net surfing activity. Most people spend their time reading news and other miscellaneous information on the internet. Normally the surfing is like an aimless wandering. Basic curiosity is the guide. Trivial information satisfies the basic curiosity well. On the one hand, browsing trivial information is effortless whereas serious information always needs effort to digest. On the other hand, trivial information incessantly stimulates. And unfortunately this kind of stimulation is addictive. People have reported that they become uncomfortable when they are deprived of access to some social networking sites and cannot find out what other people are doing at the moment. When the information that reaches the destination mainly consists of trivial information the quality of the whole informing process cannot be good.

The problems in the three components of the informing process on the internet necessitate information control. This suggests some kind of information censorship. We should understand censorship here in a broad sense. Censorship usually is used in the narrow sense, that is, political censorship. It often happens in an authoritarian political system, where the ruling party censors the information published, so that dissidents' voice is suppressed. The freedom of speech as a democratic principle goes directly against political censorship. When the publishing standard is much lowered on the internet, the excessive freedom gained has turned against the spirit of freedom of speech. In the information put onto the internet we often see noise rather than voice. What's at issue here is not whether the dissidents' voice should be suppressed, but whether the public information sphere should be cleaned up, or at least well organized, so that people can more easily get useful information from the internet. This is one aspect of the extended notion of censorship. Another aspect is that the broad censorship has to do not only with the generation of information, but also with the receipt of it. In the US there are laws that prohibit sending porn material to minors. This is an example of censoring the receipt of certain information. Here I just want to argue for information control in general. Specific ways of control are beyond this essay.

To summarize, the embracing-controlling-stance on modern technology is applied to information technology in this chapter. On the one hand, information technology in its current phase provides a more efficient, wide-ranging platform for information sharing and exchange, so we should embrace it. On the other hand, better information sharing and exchange require some control of the information activities based on information technology.

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