CULTURE and TECHNOLOGY

A STUDY
on the 1997 theme

by

Professor Andrew O. Urevbu

The ideas and opinions expressed in this volume are those of the author and do not necessarily represent the views of UNESCO

CLT-96/WS/13
# CONTENTS

## INTRODUCTION

### SECTION I

1. THE NATURE OF CULTURE AND TECHNOLOGY
   - What is Culture? ...
   - The nature of Technology ...
   - Latent and manifest functions of Technology ...
   - The political nature of Technology ...

### SECTION II

2. APPROPRIATE TECHNOLOGY AND THE CULTURE OF MAINTENANCE
   - Introduction ...
   - What is appropriate Technology? ...
   - Why do developing countries need appropriate technology? ...
   - Maintenance Technology as appropriate technology ...
   - Implications: levels of technological choice ...

### SECTION III

3. CULTURE AND TECHNOLOGY IN SELECTED COUNTRIES OF THE WORLD
   - CULTURE AND TECHNOLOGY IN JAPAN
     - The origin of Japanese technological development ...
     - Culture and indigenous technology in Japan ...
     - Cultural values and technological development ...
     - Contemporary change in culture and technology ...
     - Private enterprise and culture of Japanese management ...
   - CULTURE AND TECHNOLOGY IN WESTERN EUROPE ...
   - CULTURE TECHNOLOGY AND WESTERN GERMANY'S WIRTSCHAFTSWUNDER ...
     - Culture and the German technological tradition ...
     - Three views about culture and Germany's technological and economic miracle ...
   - CULTURE AND TECHNOLOGY IN BRITAIN ...
     - Technology and party politics ...
INTRODUCTION

The purpose of this study is to stimulate a reflection on the relationship between culture and technology, and the role of culture in technological development. It also seeks to raise issues pertaining to culture and technology against the background of the World Decade for Cultural Development, which was launched by UNESCO (1988-1997) with the principal objective of promoting cultural awareness and cultural development.

Analysis of the relationship between culture and technology have in recent years examined how cultural factors affect the level and mastery of technological development. Increasingly though, there has been considerable emphasis on other concerns as well: for instance, the issue of appropriate technology and the culture of maintenance, the importance of which have been amply demonstrated in recent literature, the question of technology and management cultures in various societies, and the relationship between technological awareness and technological choice. This study thus attempts to provide a systematic and comprehensive general treatment of culture and technology and their role in development. The themes examined in this study include the nature and actual practice of culture and technology, the issues surrounding appropriate technology and the culture of maintenance, the examination of culture and technology in selected countries of the world, and what lessons we might learn from the experiences of these countries.

The examples and illustrations given in this study were drawn from a wide range of cultures and societies in order to help lead to a rethinking, especially in the developing world of the role of technology in development and the significance of the cultural context in which technology is developed.
Other issues related to the role of technology and the importance of the environment were also examined in order to understand the nature of cultural changes taking place in a particular societies. Especially important in this context is a reconsideration of the extent to which traditional cultural values affect the transfer of technology and the development of indigenous technology as well as how cultural factors affect the proper exercise of technological choice, and the implantation of a technological culture.
SECTION I

THE NATURE OF CULTURE AND TECHNOLOGY

A cultural system of some sort is found in all human societies. In every human society there are networks of values and attitudes, customs and behavioural patterns that define the way of life and world in which men and women act, decide and solve problems, secure food, clothing shelter and whatever goods and services they require. Every human society possesses its own distinct culture, so that the members of one society behave differently in some significant respects from members of every other society. Furthermore, human societies are also distributed over very varied regions differing markedly in climate and environment.¹ There are also large ethnic, social and cultural differences between the various human communities and their economic conditions.

As Dunn² has pointed out, roughly one-quarter of the world’s population is generally regarded as developed and the remaining three-quarters is described variously as developing, underdeveloped, emerging, low-income or third world countries. A common feature of these countries, however, is that they are regions in which most of the people are poor, and live largely in rural areas, have a low, sometimes a very low quality of life with many, still returning to their traditional cultural practices. Some writers have argued that the basic problem of developing countries is that of combating poverty and particularly, poverty in the rural areas. Yet others have suggested that the choice facing developing countries is between retaining traditional cultural practices and
the discontinuous jump to a modern technological society.

From these arguments arise a number of questions related to culture and technological change and the role of culture in technological development: for instance, what does culture do to technological development? Is cultural development a stimulus to technological change or is technology culturally neutral? Does a society’s level of cultural development have an effect on technological development? What forms of technologies are “appropriate” for developing countries? Is the “culture of maintenance” borne out of a society’s level of cultural and technological awareness?³ What lessons might we learn from the experiences of industrialized societies as well as from an examination of culture and technology in selected countries of the world?

These questions probably make clear the reasons why we must address the relationship between culture and technology, especially against the background of UNESCO’s World Decade for cultural Development, and the role of culture in technological development.

Developments in technology have become in recent years, important elements in World politics with widespread international, economic and socio-cultural ramifications. Thus by situating technology within a broader cultural, political and socio-economic context, we get the ‘real’ relationship between culture and technology.

But first let us examine what is meant by the terms ‘culture’ and ‘technology’

WHAT IS CULTURE?

The word culture has been used in different ways and many definitions abound in the literature on the meaning of culture.
One definition is that culture is “behaviour peculiar to Homo sapiens, together with the material objects used as an integral part of this behaviour”; Specifically culture consists of language, ideas, beliefs, customs, codes, institutions, tools techniques, works of art, rituals, ceremonies and so forth.  

This definition derives from the semantic origins of two related words “culture” and “civilization”. Both “culture” and “civilization” derive their original meaning from the Latin words, Cultura which refers to “the soil”, and from Civis which refers to “the status of citizenship”. Both of these definitions were later extended to philosophy or learning, generally describing the aesthetic and intellectual civilization of the Roman citizenship over the primitive condition of the foreigner or barbarian. From this early usage of the term, the word culture thus came to be described as the learned portion of human behaviour, the ways of thinking, feeling, and doing those things that man in his own capacity has developed as part of his environment.  

On the other hand a contemporary writer Raymond Williams, in his book Culture and Society regards the concept of culture as consisting of four jointly applicable meanings:

1. a general state or habit of mind, having close relations with the idea of human perfection;
2. a general state of intellectual development in a society as a whole;
3. the general body of the arts: and
4. a whole way of life, i.e. material, intellectual, and spiritual.

An obvious link between culture and technology as implied in Raymond William’s definition of culture is that, technology is an element of culture. In other words, every
Culture has its technology and it is this technology that enables man not only to adapt to, but also to transfer his socio-physical environment of man’s life in a given society, to his entire social heritage and whatever he may add to it.

The definition by Raymond Williams clearly coincides with the definition stipulated at the UNESCO world conference held in Mexico city in 1982:

“(Culture) comprises the whole complex of distinctive spiritual, intellectual and emotional features that characterize a society or social group. It includes not only the arts and letters, but also modes of life, the fundamental rights of the human being, value systems, traditions and beliefs.”

Culture is thus the totality of the technological, sociological and ideological features of a given society. Culture is necessary and intended for evolution towards increased security and expansion of life, by demarcating boundaries between beneficial, injurious and neutral phenomena in man’s environment (especially when still young); and by enabling him to control or live within the environment. Thus, culture is indeed a man-made environment external to any Homo sapiens born into it.

A powerful force in all societies, therefore, is its, own culture, and regardless of where we live we have no doubt seen how both culture and technology affect our lives. The conditions under which men and women work, the ownership and management of tools, techniques and machines with which they work, and how the goods produced are to be finally delivered into the hands of the consumers, are matters which are governed by the culture of a society.

What then is the relationship between culture and Technology? The culture of a society determines the nature (form and content) of technological development and the
evolving technological culture. Technology is thus a cultural enterprise which exists in varying degrees in all societies. In some societies a highly specialized sub-culture, that of the scientist has grown up, although in the eye of the layman, there is no distinction between science and technology. Technology has played an ever-increasing role in people’s lives. Technology certainly produces a well-defined world view and well-defined attitudes which is manifest in each society. As Claxton, aptly describes it:

“There is a natural inter-dependence between technology and culture which requires that the relationship be an essentially authentic one. Since it exists to satisfy man’s immediate and particular needs as well as to enable him to live in harmony with his very own environment. Indeed tools are the interface between man and nature. The development of new technologies is linked to a society’s evolving needs. to the relative importance accorded to satisfying them, and to the application of new and different solutions to existing practical problems based on the society’s creative capacity and its particular knowledge and experiences. The introduction of a new technology often creates new social situation, which in turn, creates new needs and values, thus stimulating further technological development”.

It is thus accepted that technology has had an important influence on Western civilization for the last 300 years. But partly because of the diverse cultures found in human societies, the contribution of some cultures to the pool of technological advances has been comparatively modest. However technology has, always been too important to be measured purely in terms of the activities of technologists. Just as history is not made by historians, but by society, so technology is not developed only by technologists but by the wider community.
THE NATURE OF TECHNOLOGY

Technology is not something that suddenly appears. It is an integral part of human activity. In a general sense, technology is the systematic application of various branches of knowledge to practical problems. These problems would vary in nature from one region to another, because of climate or geography or other factors governing the living environment.

Technology is thus the accumulated fund of techniques, experiences and applied knowledge by means of which a people attempts to master their environment and to solve the problems posed by their relationship with it. It is one of mankind's fundamental cultural attributes, which to be effective must be in harmony with man.

In a recent study Nji examined the anatomy of technology. The concept of "technology" as Nji point out, cuts across many disciplines. For example, while an engineer may regard the concept of technology from the point of view of machines and tools, the same concept may symbolize to the economist a mechanism to minimize costs and maximize benefits. To an anthropologist, it is a cultural concept. A Sociologist may see the same concept as a symbol of social change. Yet, in the eyes all of them, the concept fulfills a purpose - the transformation of the environment in which they live. As Nji explains it, earlier anthropological studies have used the word technology to refer to the tools used by primitive man to survive in his environment. Today, the word technology is being used mainly to refer to technical implements such as machines, tools and equipment, cars, ships, buildings, highways, among others. The implication of such a view is that technology is a large-scale deterministic phenomenon.
These divergent definitions often weaken, rather than help scholarly discussions and proper understanding of technology. Some scholars have stated that these semantic and operational divergences over technology can be solved by espousing a characterizational approach that distinguishes between the form and the content of technology.

As a means of expanding the realm of practical human possibility, technology can be characterized as “the cultural traditions developed in human communities for dealing with the environment, including man himself. Technologies are the bodies of skills, knowledge and procedures for making, using and doing useful things and for accomplishing recognised purposes. Technology includes not only modern industrial technology i.e. techniques, tools and machines but also crafts the artifacts, what is sometimes referred to as the “material culture.”¹³ Crafts include all activities that produce or modify objects by manual means, with or without the use of mechanical aids, such as looms or potters’ wheels, the range of study is broad. There is an equally wide range of social forms within which the craftsman operate. In most traditional societies “craft” is synonymous with “guild”, a term commonly used in contemporary sociology, and is applied to occupational associations. Within this meaning the status of the craftsman differs by culture, epoch, and craft.

Technology had its beginnings in practical things¹⁴ and some scholars have identified various forms or types of technology Nji.¹⁵ for example makes a distinction between two types of technologies: material and non-material technology. Material technology refers to all tangible objects - e.g. machines, tools and equipment-used by
people in their environment. Non-material technology refers to ideas and frameworks embodied in social processes. For example education and training, political, religious or economic ideologies, organizational procedures (e.g. bureaucracy) and all other intangible aspects of human activity are classified as non-material technology. According to Nji’s interpretation, the policies a country develops to guide the day-to-day activities of its political, economic, social, and cultural institutions, the network of rules and regulations, the processes by which the members of a society are socialized into societal norms (the acquisition of skills, etc) are dimensions of the non-material aspects of technology.

Another aspect of technology is that of scale. Small-scale (micro) technology involves a limited amount of parts and functions (in terms of tools, processes, and equipment) whereas large-scale (macro) technology which generally covers a large spatial area, involves more people and more parts. Thus material and non-material technology can be divided into microtechnology and macrotechnology. While microtechnology usually involves commercially distributed things or gadgets that become the property of individual local people, macrotechnology always involves planning and implementation on a large scale covering a large area, involving more people e.g. dams, highways, large-scale industries, national policies, democracy.16

An important difference between microtechnology and macrotechnology is that whereas an individual is capable of making alternative decisions and choices in the former, freedom of choice is drastically, if not virtually, limited in the latter. Thus, the freedom to choose between acquiring a bicycle or a radio, sewing machines or baby
bottles, deciding whether to start a small privately owned bakery, or a small-scale rice processing plant, depends on the individual entrepreneur. However, the operation and management of large-scale construction projects, industrial plants, manufacturing industries, etc., are usually handled by larger organizations that go beyond the individual or the family. The role of the individual is considered secondary in the analysis of macrotechnology.

LATENT AND MANIFEST FUNCTIONS OF TECHNOLOGY

The relationship between culture and technology can further be understood by examining the role of technology in social change or the role of technology in the social structure. This relationship is manifested in two dimensions: (i) The functions and (ii) the dysfunctions of technology.

(Adapted from Nji, 1992)

Each of these characteristics is further divided into four distinct analytical properties: manifest functions Vs Latent functions, manifest dysfunctions and Latent dysfunctions.
According to Nji’s analytic framework, function means an observed consequence of technology: Dysfunctions means the negative, anticipated consequence of the application of technology. Thus, manifest functions refer to the intended, anticipated or expected consequences of using a technology while latent function refers to the unintended unexpected consequence of that technology.

Nji cites a few examples to illustrate the manifest and latent functions of technology. When, for example, a farmer buys a tractor to increase production, the manifest function is to increase yield. The latent function is that it may serve as a status symbol for the farmer. When a new highway is built with the manifest function of providing easy means of transportation to the population, its latent dysfunction is that several farmers may be deprived of stretches of valuable farm land. On the other hand, when biological technologies are adopted by farmers to increase the yield of a cash crop, the manifest function is to increase production and productivity. But when, as a result of increased yields, labour is diverted from the production of food crops to meet the increased demand for the harvesting of the cash crop, the latent dysfunctions of the original technology is the eventual shortage of labour in the production of particular food crop.

THE POLITICAL NATURE OF TECHNOLOGY

While we admit that technology is a cultural enterprise, we must not fail to be aware of the political nature of technology as well.

In the developed world, we have applied technology to all aspects of our lives. We are dependent on machines and gadgets, not to mention the whole infrastructure of
society (including the provision of food, power, water, sewage disposal and transport and communication networks) to carry our many everyday activities. Some commentators in fact feel that we are dominated by technology and that the technology has taken over.

This line of thought has arisen because of the political nature of technology. Technologies itself is determined by political forces and is not a given neutral factor determined by the state of cultural development. Both the nature of present technology and technological innovation and maintenance are politically determined. In other words, "technology does not just provide in its individual machines the physical means by which a society supports and promotes its power structure it also reflects as a social institution this social structure in its design".

The sociologist Jack Goody\textsuperscript{21} has addressed this issue in his book Technology Tradition and the state in Africa, pointing out that differences in modes of technology are connected to differences in other aspects of the political and socio-economic system. Although his study focussed on Africa, his analysis has helped to bring to the fore, the political nature of technology which is also applicable to most countries of the third world.

Goody suggests that in order to understand the application of technology in Africa, "we need to take a closer look at the means and organization of production in Africa and Europe instead of tacitly assuming identity in these important respects". He identifies three interrelated aspect of African society which seem pertinent to technology and the State: (1) the system of exchange (that is trade and markets). (2) the system of agricultural production (especially ownership of the means of production) and (3) military
organization (and especially the ownership of the means of destruction).

According to Goody, many parts of Africa were similar to Western Europe from the point of view of mercantile or monetary economy. Metal coinage was in use on the East African coast. On the West coast, currencies consisted of gold, brass, salt and cowrie shells. Trade was highly organized and, in the kingdoms such as Dahomey and Ashanti, important sectors of the economy were under State control. Most kinds of economic operation that were found in pre-industrial Europe were also to be found in Africa. In Goody’s view, “except for specialized fields of wine and the wool trade, external exchange in Africa was similar to that of Europe”.

Now turning to the system of production, Goody concedes that Africa is basically a land of extensive agriculture. Although the African mode of agricultural production was extensive, it was not intensive, and this was related to the nature of the soil, the labour force and the terrain. He asserts that one fundamental invention that spread through Euro-Asia but which found limited use in Africa was the plough. The use of the plough in Euro-asia had a number of effects. First, it increased the area of land a man could cultivate and hence made possible a substantial rise in productivity, as least in open country. This, in turn, meant a greater surplus for the maintenance of specialist crafts leading to an increase in wealth differentials and the development of life styles in urban, non-agricultural systems. Secondly the plough stimulated the move to fixed holdings and away from shifting agriculture. Thirdly, it increased the value of arable land. The plough enabled animal power to be harnessed for tillage of the land. This was also of substantial significance. Human resources were greatly increased since, for the first
time, man tapped a source of mechanical energy greater than this own. The use of
animal power also established a more integrated relationship between stock-breeding and
agriculture. Mixed farming, uniting animal husbandry with crop cultivation, was to
become the distinguishing characteristic of agriculture in Western Euro-Asia. It made
possible a higher standard of living or leisure than was attainable by people relying
mainly or entirely upon the strength of mere human muscle.

In the African forest, the plough had many limitations. First, the wheel, was
never extensively adopted in Africa, though it crossed the Sahara (as evidenced by the
two wheeled chariots liberally engraved upon Saharan boulders) and was introduced into
Egypt and Sundan. This was not because of a lack of metal technology, but rather that
the plough did not improve vegetation to the same extent as it did the cultivation of
cereals in Euro-Asia. Secondly, animal disease was a factor which limited the use of the
plough. The limited use of the wheel meant that man was not only unable to make use
of animal power, but also the power of the wind and water. The lack of the wheel also
limited the possibilities of water control. As Goody points out, the wheel played a
dominant part in raising water from wells to irrigate the land in the drier regions of the
Euro-Asia continent. However, simple irrigation was practised in many parts of Africa
and consisted of channeling water from a permanent spring to run among the fields and
thus farmers got two crops a year instead of one. There was also the shaduf, in use in
several areas along the Saharan fringe, which used the lever principle as a device for
drawing water. In Africa, there were also water storage in wells. Clearly while there
was no lack of water in Africa, the problem of distribution was enormous.
Perhaps the most significant technology gap between Africa and Eurasia, according to Goody, was in the military field. He notes that when the Portuguese spearheaded European expansion into other continents, they succeeded largely because of their use of gun-bearing sailing ships. At first they depended on cannon on their floating castles; later upon the hand-gun. By 1489, the armament of the Portuguese ships was something totally unexpected and new in the Indian and China seas and gave an immediate advantage to the Portuguese. Goody, quoting Beachy, asserts that “The Africans never seem to have learnt to make fire-arms as good as those of the Europeans unlike the Sixteenth- and Seventeenth-Century Japanese and Sinhalese, who soon achieved virtually parity with the Portuguese in this respect.” He remarks that the reason for the failure of Africans to take up the manufacture of this powerful new weapon with any success was that they did not possess the requisite level of crafts skill in iron-work. As a result, African were at an enormous disadvantage when the scramble for their continent began, since they had to fight against the very people who were supplying them with arms.

However Goody’s view is to be challenged here. According to Professor Onwuejeogwu of the University of Benin, recent research on the indigenous forms of technology in Africa seem to have shown that amongst the Awka people in eastern Nigeria, local smiths working with iron made sophisticated guns in the nineteenth century; but these guns were prohibited by the British, who saw the potential of these firearms. Thus in order to understand the relationship between culture and technology, one must be aware of the political nature of even the crudest forms of technologies and
also recognize the role of social institutions in fostering technological development and in mediating between technology and its effects.

Thus as Claxton succinctly summarizes it.

“Technology cannot be considered, therefore, to be culturally neutral. All technology incorporates and reflects, the values of the society, that society’s particular creative genius, as well as the specific nature of the socio-cultural environment in which technology is developed. This makes it difficult, therefore, for it to be transplanted successfully to a basically difficult environment. Such transplantation or transfer of technology can only be successful if it can be adapted to the values and social structures of the new environment”²²

Thus our understanding of the nature of culture and technology is further enhanced when we take into consideration the political nature of technology as well as the socio-economic context in which the various forms of technologies have developed.
SECTION II

APPROPRIATE TECHNOLOGY AND THE CULTURE OF MAINTENANCE

INTRODUCTION

In recent years the concept of appropriate technology has gained currency in both developing and developed countries. This concept has emerged in response to a recognition that, in spite of rapid rates of economic growth in the past decades, the objectives of employment creation and elimination of poverty have not been achieved. One of the reasons for this situation has been an over-emphasis in the past on the part of a large number of developing countries on capital-intensive “heavy” industrialisation and the use of technologies that do not necessarily reflect factor endowments and socio-economic conditions prevailing in these countries. Because nations vary in their level of cultural resource endowment, the strategies adopted by each nation in the pursuit of technological development would vary from nation to nation depending on each nation’s particular circumstances.

The purpose of this section is not to outline the details of the scope and contents of strategies in appropriate technology, but rather to explore one of the critical issues in this debate, namely the “appropriateness of technology”.

Appropriate technology is not, and should not be viewed as a second-best solution. Conversely neither should its role be over-estimated; appropriate technology is not a universal substitute for the conventional modern technology. Appropriate and
modern technologies are complementary rather than contradictory, and the emphasis given to the former does not and should not rule out the use of the latter in those cases where they are particularly well adapted to local conditions.

WHAT IS APPROPRIATE TECHNOLOGY?

Appropriate technology is defined as any object, process, ideas or practice which enhances human fulfillment through satisfaction of human needs. A technology is deemed to be appropriate when it is compatible with local, cultural and economic conditions (i.e. the human, material and cultural resources of the economy), and utilizes locally available materials and energy resources, with tools and processes maintained and operationally controlled by the local population.

Thus a technology is considered “appropriate” to the extent that it is consistent with the cultural, social, economic and political institutions of the society in which it is used. The term appropriate technology conjures some benefits. Abdulahi² has suggested that appropriate technology should be self-sustaining, cause little cultural disruption and should ensure the relevance of technology to the welfare of the local population.

The term appropriate technology has thus become a generic concept which subsumes other alternative forms of technologies such as low-cost technology, intermediate technology, zero-cost, small-scale or village technology. As the terminology implies, the notions of cost and scale are important in the conceptualization of appropriate technology. Schumacher, E. F., a pioneer of the concept of intermediate technology has argued that the latter represents the kind of technology which lies between traditional and advanced technologies. For example, a bicycle is an intermediate
technology between walking on foot and driving a motor car. In clarifying the subtle meaning between these alternative forms of the technologies, Jequier states, that “when speaking of low-cost technology, one focuses primarily of the economic dimension of innovation. The concept of intermediate technology on the other hand, belongs more specifically to the field of engineering. Appropriate technology of the other hand represents . . . the social and cultural dimension of innovation”. The essence of appropriate technology, then, is that the usefulness or value of a technology must be consolidated by the social, cultural, economic and political milieu in which it is to be used.

For the most part, the majority of the low-cost, intermediate or appropriate technologies are promoted in these countries for three reasons:

1. The growing awareness in more advanced countries of the negative impacts of large-scale technologies common and on the environment;

2. Their greater inaccessibility of large scale technologies to poorer countries and

3. Their potential and suitability of appropriate technology for solving the problems of developing countries at their present stage of scientific discovery and innovation. What then is the rationale for appropriate technology?

The promotion of appropriate technologies in developing countries stems primarily from the failure of “economic development” or “growth” strategies to provide full employment and solve the problems of the poor countries. The faith in large-scale industrialization as a panacea for rural problems has waned, because jobs created by such industries, have been too costly and have produced very insignificant results that benefit the poorest of the poor countries. Also because large-scale projects were imposed on societies that have poor capital endowments and rich labour resources, the development
and growth of small-scale enterprises have been greatly hampered. As a result, mass unemployment, low income, and sluggish growth rate and sometimes stagnation in the developing countries have been the rule rather than the exception. Unfortunately, this evidence is only being belatedly recognized. Moreover, technology by itself cannot solve basic human needs. While it might offer solutions to problems, it is human beings who must guide technology and put it into useful purpose under appropriate conditions and circumstances.

However the concept of appropriate technology has tended to operate in two different directions in developed countries and under-developed countries and have focussed on different themes.

In the industrialized countries, a sizeable proportion of appropriate technology groups are working on the development of innovations which focus on the better utilization of scarce natural resources, the transition of renewable sources of energy and the minimization of technology’s negative impact on the environment.

By contrast, most of the groups working in the developing countries, as well as those groups in the industrialized countries which have given particular emphasis to the problems of developing countries, tend to view appropriate technology as the main tool in meeting the basic needs of hundreds of millions of poor people who have largely been left out of the development process. In developing countries appropriate technology aims to include: the provision of employment, the production of goods for local markets; the substitution of local goods for those previously imported and which are competitive in quality and cost; the use of local resources of labour, materials and finance, the provision
of community services, including health, water, sanitation housing, roads and education.

Thus, while appropriate technology in “industrialized” societies has focussed largely on environmental questions, natural resources, and the technologies of the post industrialized society, in developing societies, appropriate technology focuses more attention on problems of poverty, social equity employment and basic human needs. However, the needs of both developed and developing societies overlap to some degree. Furthermore appropriate technologies developed by one of these two societies can in many cases be considered as equally appropriate to the concerns of the other: for instance technologies in the field of energy as well as agriculture.

But when looking at the criteria of a technology’s appropriateness, it is important to bear in mind the differences between these two societies and to realise that what is appropriate to one of these societies will not necessarily be considered in the same light by the other.

WHY DO DEVELOPING COUNTRIES NEED APPROPRIATE TECHNOLOGY?

Several reasons have been advanced to explain why Developing countries need appropriate forms of technology.

In his book on Appropriate Technology Dunn lists the aims of appropriate technology as follows:

i) The provision of employment;

ii) The production of goods for local market;

iii) The substitution of local goods for those previously imported and which are competitive in quality and cost;

iv) The use of local resources of labour, materials and finance; and
The provision of community services including health, water, sanitation, housing, roads and education.

Dunn asserts that appropriate technology should be compatible with the wishes, culture and traditions of a particular community and not have a socially disruptive effect. While Dunn gives these broad guidelines, other writers have been rather specific on the issue.

One reason why developing countries need appropriate technology is the poor state of socio-economic development of these countries. As Nji explains it, developing countries are characterized by a predominantly agrarian and hence rural population. These countries account for 70% of the total world population and of this number 75 to 80% of them live in rural areas. Adams and Bjork also note that apart from this structural distribution of the population in the developing countries, these countries have low incomes, low literacy rates, poor or inadequate infrastructure (e.g. roads, buildings, equipment, etc.,) insufficient health and sanitary facilities and a chronic shortage of fiscal resources. Yet as Nji point out, these countries have plenty of labour supply, vast natural resources, and a pool of latent untapped agricultural and mining resources. Kenkare notes that the transfer of technology to the so-called underdeveloped countries must take into account the predominant characteristics of these countries. namely:

The prevalence of a dual economy (urban and rural) with different and often conflicting life styles, unequal resource distribution and a highly intersectional migration propensity; general unemployment and underemployment and consequently, inequalities in income distribution; the relative lack of fixed and circulating capital in terms of machines, tools, and money; and, a larger population growth rate as compared to the developed countries.
An awareness of these inequalities (social and economic injustices) and the fact that they can indeed be removed is a good reason to design and implement strategies that can solve or reasonably alleviate these problems.¹³ It is to this end that appropriate technology can be used as a means to achieve balanced development in poor countries.¹⁴ The ultimate question then becomes how this can be done.

One fruitful way is first to identify the problems. Usually common-sense knowledge tells us that these problems are obvious. Some writers have emphasised the importance of applied research and the use of social indicators to “assess” the ability of a gee-political unit to provide for the continued enhancement of the human condition in those social domain areas consensually-defined as important for social well-being. Thus, applied research is seen as vital component not only in the implementation of rural development projects but also as a desirable and indispensable prelude to the identification, selection, and development of appropriate technologies to combat destitution and misery in the rural areas.¹⁵

Such societal and technological development can be attained by a number of methods:

“Identifying existing technologies in the developing countries to select those that are useful from those that are not.

Improving the quality and performance of human resources in developing countries and those technologies considered to be useful in eradicating rural poverty. This procedure, if it is to be successful, must rely on indigenous knowledge (Brokensha et al. 1980).

Recycling used technology.

Adapting imported technology to local needs, materials, and resources
Research and development of appropriate technologies to solve basic human needs.

These five technological alternatives Nji suggests provide the core for an aggressive conscious course of action to alleviate rural poverty and inequalities in developing countries using appropriate technology as a common denominator. But before such a methodology is used, it is important that the technological analysts, development scientists, and policy-makers all share a common definition of the nature and purpose of appropriate technology in rural development.

The inference from the appropriate technology argument is that the major criteria for the selection of appropriate forms of technologies are a country’s factor endowment: the proportional distribution of labour in the country, land, capital, skills, and natural resources. In the developing countries, where labour is plentiful and capital and skills are scarce, the choice of technology for societal development must strongly support the judicious development and equitable development of human and natural resources. Appropriate technologies in the form of small-scale enterprises will be ideal since they create more work places at lower costs especially in the rural areas.

In the light of the present experience in world development, advocates of appropriate technology unequivocally stress that the current thrust in development must espouse an appropriate technology and basic human needs strategy if elimination of poverty, unemployment, and an increased quality of life are to be achieved. As Nji summarizes his argument:

Thus, the technology required for a basic-needs strategy in a developing country must concentrate more than in the past on meeting the requirements of the small farmer,
small-scale rural industry and the informal sector producer. Such a strategy calls for, and in turn supported by a special kind of appropriate technology: a technology which differs from that development in the industrialized countries by the industrialized countries and for the industrialized countries even more than the difference factor proportions would require.  

MAINTENANCE TECHNOLOGY AS APPROPRIATE TECHNOLOGY

The general lack of a “culture of maintenance” in developing countries, particularly in African countries has been attested to by scholars. The question now arises; what forms of technology is appropriate for developing countries?

In his analysis of culture of Maintenance in Africa, Woherem describes the state of maintenance of various technological artifacts in use in Africa today, especially information Technology and convincingly states that most African countries today have largely developed a culture that ignores the maintenance of their existing systems or that sees maintenance as the least in their scheme of essentials. He points out that the lack of a culture of maintenance is due to both technical and socio-cultural problems (i.e, misplaced priorities, callousness or ignorance on the part of management). He puts it this way:

“The problem of lack of maintenance of systems in Africa is both a socio-cultural and technical problem . . . a callous and irresponsible attitude towards any work that belongs to someone else and what could be simply described as an unexplainable mentality of going for a new one instead of repairing the old one. Sometimes, it is due to unethical behaviour. On the other hand it is also a problem of lack of knowledge of the technical artifacts and how to repair them”.

Woherem draws from recent studies and declares that:
“The problem of lack of maintenance of technology systems is not a new phenomenon in Africa. It stems from a long (post-colonial) history of lack of a culture of maintenance” i.e. culture that sees positive benefits from the maintenance of what they already have. 

Woheren cites two excellent examples to illustrate his point. First he describes from his personal visit to eight large scale organization in Nigeria between 1992 and 1993 and found out how many technical systems that were used for as little as six months that needed only some minor corrective, perfective and/or adaptive maintenance had been abandoned altogether without any consideration of costs to the organization. Thus a personal management and stock control system of a palm kernel processing company in Port Harcourt, Nigeria, which was custom-made for the company and running on a mini-computer platform, was abandoned because the number and ratio of the company’s daily and monthly paid workers have been changed, and therefore the system needed a reclassification of some workers and a new formula for calculating wages for some of the new category of workers, All the system needed was thus a minor enhancement or perfective maintenance, instead of being abandoned altogether. The management was later persuaded to acknowledge that the cost of carrying out the maintenance would have been less than the cost of abandoning the system altogether.

The second example Woherem cites is the once spectacular Nigeria’s Murtala Mohammed International Airport in Lagos which now looks like a faded image of its past. As he describes it, the Murtala Mohammed Airport “is now basically a concrete jungle without air-conditioners, workable conveyor belts, clean and workable toilets and the once functioning computerized information notice boards it had.”
This general lack of a culture of maintenance in Africa’s technical systems can also be witnessed (to an extent in most homes today.²² Many residential homes in the cities of Africa show that most of them are left unpainted for many years, parts of buildings are left to rot away or to wear out for a very long time; many damaged parts of building are not replaced for a long time, grass lawns are left uncut for a long time and gardens/trees are not always looked after properly.²³ The above situation Woherem describes is manifest in all spheres of life in African countries.²⁴ The apparent lack of maintenance of machineries and other kinds of technological system all over sub-saharan African countries has also be attested m by the notable African Scholar Ali Mazrui, As Mazurui points out,. African countries have been modernizing by building new schools, roads, railway systems, production systems etc. But only to allow them to be overtaken by dust and decay. So in most parts of Africa today one can see:

Once useable roads deteriorate into a state of un-usability, through ignorance and lack of maintenance;

Once beautiful buildings and technical constructions, which were once perceived as artifacts, of national pride, allowed to fall apart as a result of the non-replacement of their worn out parts, or their being allowed to be conquered by dirt and the elements:

Once splendid looking airports with working conveyor belts and computerized information notice boards that made them to look like their counterparts in other parts of the world, descend into an unedifying state of disrepair.²⁵

Perhaps the most appropriate form of technology that African countries could acquire today is through the maintenance of various technological artifacts currently in use, especially at the Organizational level. Woherem thus notes that;
“although this general lack of a culture of maintenance is manifest at the Organizational level and at the private level (i.e. in people’s homes), the problem is more acute at the Organizational level. This is due to the technical nature of most of the systems in those organizations, and because Africans have not acquired the knowledge of most modern technologies/systems which they now use, nor how to maintain/repair them. Thus what is needed is both a socio/cultural and technical understanding of systems functionality and their maintenance.”

Woherem suggests that those in-charge of or responsible for the requirements of technological analysis specification and final design of content/functionality of systems should realize that there are items or objects that need to be continually repaired, cleaned and brought up to date. “He emphasizes that “maintenance has to be continual and taken as if it is one of the major objectives of the organization”. Institutions and managers of organizations should not allow things to descend into a state of disrepair, and wasteful abandonment. One of the aims of the management in organization, Woherem points out clearly “should be to ensure that things improve or at least stay functionally the same i.e. at a how-it-was’ level, instead of being allowed to deteriorate. However, Woherem acknowledges that maintainability of machineries, roads, buildings and systems requires a certain amount of investment or money to always be made available in order to keep them operational. Appropriate technology clearly calls for a consideration of whether the budget would be available in the future to keep the systems continuously functioning despite the paucity of financial capital in the country or organization. An appropriate technology also calls for the realization that once operational even before, a maintenance strategy has to be in place, that (1) there has to be a manager responsible for this and (2) the strategy should inform the design given, what could be realistically anticipated and
what the organization or the country can afford.

Woherem outlines the following socio-cultural suggestions that need to be considered in the maintenance and management of any forms of appropriate technology (and software systems).

- There should be a general cultural awareness in the whole society of the need for maintenance, so that awareness can permeate the minds of all individuals and organisations.

- There should be a country-wide ethical training of managers and workers on responsibility and accountability. Workers at every level should be made to realise the importance of not using what belongs to the country or organisation for their own private purposes. They should be made to also identify with the needs and business aspirations of the organisation, and therefore, not to do anything that would retard the progress of the organisation.

- There should be effective training provided to those that will actually carry out the technical maintenance of the systems. Some personnel can initially be sent abroad or to local training institutes to understand how to maintain the systems. who can in turn train others in the organisation.

- There should be an effective formal procedure in place in all organisations for ensuring that all their managers/workers take their responsibilities seriously and desist from sabotaging the interests of their organisation through unethical practices. It should be a process that should always appraise the activities/performance of each of the staff members in order to make them accountable for all their actions, work tasks and financial dealings, to a very fine detail.

- Managers should be trained to be aware of the importance of systems maintenance and how to go about setting up a maintenance strategy and group in their organisation. They should also understand how to go about evolving an explicit maintenance process modes and metrics programme and to ensure that systems maintenance takes place within an appropriate/acceptable procedural framework and that the maintenance strategy conforms with the wider organisational objectives of their organisation.”
Woherem argues that “there will be no meaningful technological acquisition... of any type of technology by African countries, without the ability to repair, enhance and adapt that technology when necessary.

In making a comparison with other advanced countries, Woherem notes that in the United States alone, about $30 billion (thirty billion dollars) is spent annually on software maintenance and in 1995 the process of fixing and upgrading arguing software will employ about 90% of all resources made available for software development and use, Woherem’s provocatively concludes that:

“if this is the case in a rich country such as the United States, it calls for African countries to invest more in the maintenance of their existing systems, instead of dumping what they have to acquire more technically powerful and edifying new arrivals. African countries should realise that to always throw away old software/system for new ones is not always a good strategy, especially for a cash strapped developing country.”

IMPLICATIONS: LEVELS OF TECHNOLOGICAL CHOICE

While criticisms of Africa’s lack of maintenance technology is well noted, this is not to imply that what developing countries of the world need is only the maintenance of old technologies, with no option to choose from available technologies. Technological systems do change over time of course.

Today developing countries, particularly African countries are aware of various forms of technologies, and as a consequence would need to make a choice in technologies at three levels. At the first is simple village level technology which uses local materials, lowly-skilled manpower and natural energy sources such as windmills and solar-powered devices. This technology produces rural self-sufficiency, and puts people to work in rural areas. Julius
Nyerere, former President of Tanzania, seemed to have affirmed his faith in this level of technology when he said:

Our future lies in the development of our agriculture and in the development of our rural areas. But because we are seeking to grow from our own roots and to preserve that which is valuable in our traditional past, we have also to stop thinking in terms of massive agricultural mechanization and the proletarianization of our rural population. We have, instead, to think in terms of development through the improvement of the tools we now use, and through the growth of cooperative systems of production. Instead of aiming at large farms, using tractors and other modern equipment and employing agricultural labourers, we should be aiming at having ox-ploughs all over the country. The jembe (hoe) will have to be eliminated by the ox-plough before the latter can be eliminated by the tractor. We cannot hope to eliminate the jembe by the tractor.

A second level is ‘intermediate” baseline or infrastructural technology. This is the technology that is needed to improve water supply, public housing waste disposal, power distribution, transportation networks, telephone systems, hospitals and training and educational systems, etc. This type of baseline technology requires widely available equipment and techniques such as pumps and valves, piping, electrical transformers and controls. Unfortunately, these items are currently being imported at very high costs by all African countries. It should be possible for African countries to acquire enough technical knowledge to learn how to manufacture many of these items locally. There are thousands of African students at colleges and universities in Africa, Europe, Canada and the United States and several other countries in Western world who are receiving highly specialized training in order to be capable of manning Africa’s ‘baseline’ technological needs through a laboratory-tensive and capital-intensive approach and of producing the machines and know-how needed.

At the third level is advanced technology, needed to process goods which can be profitably exported or substituted for other forms of imports.
There are some African countries where technology has produced some outstanding results. For example, Nigeria has done a good deal in developing its own technology, including petroleum refining, steel production, vehicle assembly and the canning industries. In Kenya, there are factories which process coffee and tea; in Zimbabwe, there are industrial zones with large factories; while in Senegal there are industries for the dressing and packaging of fish. However, some very difficult choices still have to be made on the type of technology that is most suited for developing countries.
SECTION III

CULTURE AND TECHNOLOGY IN SELECTED COUNTRIES OF THE WORLD

In what ways have various countries of the world, and their various cultures responded to the problems of modern technology in their everyday life?

It is generally assumed that all nations need to develop technological capabilities. The extent to which such capabilities exist and are employed in a country have become a yardstick for assessing the degree of development of a nation. Even more, the state of development a nation has almost become synonymous with its technological capability. Thus it is conventional to refer to those nations that have advanced technological capabilities and use them extensively, such as Japan, the Western European countries USA and USSR as developed countries. Those countries that have limited or are just beginning to acquire such capabilities such as countries in Africa, South East Asia, South America and the Caribbean are referred to as developing nations.

The best prescription for making a developing (or underdeveloped) nation to become developed has not yet evolved. although there are numerous scientific and technological information for such a metamorphosis. The process of using that information is very complicated. Undoubtedly, there must be decisions about what information will be used and how: numerous factors such as the culture and geography of a nation must be incorporated into the decision: and institutions such as the educational system, economic and political systems must be designed and implemented.

However, far more than the information base would be required. For a nation to develop technologically, it must have scientific and technological manpower, access to capital, equipment and raw materials and education extending over generations.
The process of technological development is one that would produce many cultural stresses. The question now arising is: How have the developed countries of the world coped with these cultural stresses? Are the cultures of developing countries to be changed. Are customs and indigenous methods in third world countries to be abandoned and new practices adopted in order to achieve technological development?

These questions will be examined in the context of selected countries of the world.
SECTION 3.1

CULTURE AND TECHNOLOGY IN JAPAN

Although Japan’s culture was much influenced by China and later the West, its technology like its art and literature, has reached a height among world civilization. As some scholars have argued, these outside influence may have “corrupted” Japanese traditions, yet once absorbed they also enriched and strengthened the nation, forming part of a vibrant and unique culture.

Our central question for our study of Japan is: what has been the role of culture in the Technological Development of Japan? What aspects of Japanese cultural values have profoundly affected the development of Technology

THE ORIGIN OF JAPANESE TECHNOLOGICAL DEVELOPMENT

In her recent study of 'Sericulture and the Origins of Japanese Industrialization' Tessa Morris-Suzuki¹ identified the opening of the silk trade with the West as one of the best known episodes in Japanese economic history. The story as told in countless school histories and academic texts, goes something like this.² At the very time when Matthew Perry and his black ships were breaching Japan’s isolation from the rest of the world, the European silk industry was falling victim to a devastating silkworm plague - the perbrine. During the 1850s and early 1860s this disease reduced Italian silk production to little more than half its previous level and French production to mere one-fifth of the peak attained in the early 1850s. As a result, Japan was fortuitously presented with ideal conditions for its entry into world trade. Exports of silk and silkworm eggs grew rapidly and provided Japan with its principal source of foreign exchange earnings during the final decades of the Tokugawa period and early part of the Meiji era. This

36
“accident of nature” as one historian has called it, therefore played a vital role in helping Japan to take its first faltering steps on the road to technological development. However as Tessa Morris-Suzuki notes, historical accidents are rarely as accidental as they seem, for it is the best-prepared individuals or societies that are best able to take advantage of chance. According to Claudio Zanier⁹, there are several reasons why European silk producers looked to Japan as their salvation from the consequences of the pebrine. For one thing, there was a long-standing attitude of respect for East Asian agricultural and silk-raising techniques, which can traced back to the 18th century. As China itself was caught up in the political turmoil of the Taiping Rebellion, so European merchants in the 1850s tended to turn instead to the newly accessible and more politically stable trade ports of Japan. Thus it was the improvement in Japanese silk farming techniques and not the vagaries of nature that provided Japan with its opening to the world of technological development.

Tessa Morris-Suzuki raised two points about these developments that were particularly interesting. The first is that, even though Europe and Japan both imported the basic techniques of sericulture from China, and even though both embarked almost simultaneously on the process of improving and refining those techniques, the ways in which they refined them were distinctly different. The second is that, even before the opening of the Japanese ports, some European observers had begun to recognize the value of Japanese sericultural techniques and to seek in them lessons for the West. Sericulture thus became the source of Japan’s first export of technology.

CULTURE AND INDIGENOUS TECHNOLOGY IN JAPAN

In the past few years historians of Japan have begun to pay increasing attention to the role of indigenous (zairai) as opposed to imported (gairai) technology in the process of Japan’s industrialization. The trend perhaps tells us as much about contemporary Japan as about the
country’s technological history. Interest in zairai technology reflects, on the one hand, a nostalgia for craft techniques that are rapidly disappearing and, on the other, the new perspective of a Japan that has begun to be recognized abroad as a technological innovator as well as a technological imitator. Whatever its motives, however, research into indigenous technology has produced fresh insights into the process of technological change.

During the 17th and 18th centuries some Japanese handicrafts such as ceramics had influenced European techniques and designs. But silk production was the first example of an industry in which European producers deliberately sought out Japanese know how and studied traditions of Japanese texts. What is particularly impressive about this transfer of technology from Japan to the West is that it began before the arrival of Perry in Uraga Bay and before the pebrine had inflicted serious damage on the European silk industry, at a time when the communication of ideas between Japan and the outside world was fraught with tremendous difficulties. As Tersa Morris Suzuki explains its

In 1830 the German scientist Philipp Franz von Siebold, who served as physician to the Dutch trading post in Nagasaki, was expelled from Japan by the shogunate. He returned to Europe with a substantial library of books collected during his seven years in Japan, among which was a manual on silk production entitled Yosan Hiroku (The secrets of sericulture). This book, written by Uekaki Morikutmi, a villager from the Tamba region near Kyoto, had been published in Japan in 1803. Its influence on silk production in western Japan was considerable, for Uekaki not only summarized many of the most advanced techniques in use throughout the country but also presented his information in a succinct and straightforward style with charming illustrations that made it readily comprehensible to ordinary farmers.

By the 1840s there was sufficient interest in Japanese silk production for the Dutch government’s interpreter, Johann Hoffmann, to undertake the fairly demanding task of translating Uekaki’s manual into French. Hoffmann was "the only orientalist with a complete knowledge of the Japanese language." The translation was published in Paris and Turin in 1848, with an introduction and commentary by the French sericultural
expert Matthieu Bonafous, and was reissued several times as the pebrine tightened its grip on the European silk regions. Yosa Hiroku therefore became not only Japan’s first technology export to the West but also one of the first Japanese works of any sort to be translated into a European language.

Many notable scholars appreciated the importance of learning more about Japanese crafts and techniques and were even willing to recommend some rather dubious methods of obtaining this knowledge, Tersa Morris Suzuki declares:

that the only way to pierce the obscurity that still envelops this inaccessible country is to steal from the Japanese without scruple and, with the assistance of the trade between Japan and Holland, the special texts that the people possess on the many branches of their knowledge. These genuine texts which will give us reliable information to be preferred . . . to the incomplete images provided by intermediaries of a suspect veracity or by travelers who have not had free access to the interior of a country in which so many obstacles confuse and hinder the best conducted research.

CULTURAL VALUES AND TECHNOLOGICAL DEVELOPMENT

The strengths of Japanese technology lay precisely in her unique cultural values: her wealth of empirical know-how and in a seemingly endless attention to detail.

These were the areas in which developing countries could learn from Japan.

For example, Japan’s labour-intensive techniques in sericulture resulted from its heritage of borrowings from China. Japan had imported from China the technique of carefully preparing the mulberry leaves that were fed to the growing worms: cutting up leaf into very small pieces before feeding them to newly hatched worms and then gradually increasing the size of the fragments until in the final stage of their existence. When we remember that silk worms might need to be fed as many as eight times a day, and that the worms hatched from a single egg, it becomes obvious that feeding alone was a formidable task.

Gradual, painstaking experimentation also led to improved methods of feeding, hygiene,
and temperature control. Here again, however, the trend was not toward standardization but
toward diversity, as trial and error identified the methods of production best adapted to a variety
of local climates and conditions. Interest in the crucial issue of temperature was to lead to one
of the most remarkable developments of the late Tokugawa period: the introduction of
thermometers into Japanese sericulture. Thermometers had been brought to Japan by the Dutch
in the 18th century, but it was not until the first half of the 19th century that an enterprising silk
farmer, Nakamura Zen’emon, recognized their potential importance to the silk industry, where
the precise regulation of temperature was such a crucial factor. European thermometer were
expensive and difficult to obtain, so Nakamura had to begin by making his own thermometers.
He then undertook a complex series of tests, during which he established that slightly higher
temperatures were suitable for some purposes such as silkworm egg production while lower
temperatures suited others such as the production of fine silk. These findings were set out in a
clear and simple manual for producers that was published in 1849.

Most mid-century Europeans held the view that the process of technological change
were unilinear. They tended to assume that technological progress culminated in railways and
highly mechanized factories since Tokugawa Japan lacked these. It was taken for granted by
many foreign observers that Japan was technologically backward and that its success on world
markets could only be the result of good fortune.

But, as historians like Francesca Bray⁴, have recently observed, technological change can
follow many paths. The peculiar political and economic structures of Tokugawa Japan created
necessities that encouraged invention. Domestic policies to develop local cash crops and
industries encouraged the nationwide spread of technological know-how and created an economy
where craft production was not concentrated in a few urban centers but was remarkable evenly
dispersed throughout the country. At the same time, Japan’s limited contact with the outside

world, its restricted and segmented markets, its abundant labour supply, and its shortage of raw materials fostered a type of technological development profoundly different from that of Europe. Instead of increasing the input of inanimate energy and the output of standardized products, Japan’s technological development tended to increase the input of human labour and the output of variable, differentiated products.

Francesca Bray argues that, this was not, in any moral sense, a “better” or “worse” path of technical change: both European and Japanese technological developments imposed great costs on the human work force (although costs of a rather different kind). The two paths of technological development were simply better suited to different types of industry. The labor-saving, energy-intensive techniques of the European Industrial Revolution were best adapted to the large and growing number of industries that produced standardized goods for a mass market; the labor-intensive, resource-enhancing techniques encouraged by the Tokugawa system were best adapted to those few branches of production where standardization was impossible and where methods had constantly to respond to natural conditions over which humans could exert little control. Of these, sericulture was the outstanding example.

It was therefore the nature of Tokugawa technological change, rather than some happy accident, that enable Japan to obtain a foothold in the world silk market of the mid-19th century. Technological success in sericulture provided a basis on which Japanese industries could build, reinvesting foreign earnings in the import of the more capital-intensive techniques they lacked. One of the first areas to be affected was, of course, silk reeling, where the existing labor-intensive Japanese methods could not produce the standardized quality demanded in foreign markets.

But sericulture not only provided an economic basis for technological development, it also helped to provide an intellectual framework. During the Tokugawa period, leading silk farmers
came to appreciate the importance of the deliberate improvement of techniques and developed a practical, empirical approach toward technological experimentation. These attitudes were to be carried on into the Meiji period and put to use in the import and application of technology, not only in the silk industry but also in a wide range of other areas of production. Interest in improved techniques permeated the consciousness of the ruling classes too. Sericulture proved a successful testing ground for schemes of “developing industry and promoting enterprises” that in turn were to become models for the technology policies of the Meiji regime. In this way, the distinctive pattern of Tokugawa technological development laid the foundations for the import of those science-based, mechanized technologies that were, in their turn, to transform the nature of Japanese society.

CONTEMPORARY CHANGE IN CULTURE AND TECHNOLOGY

Since the mid-nineteenth century, when the Tokugawa government first opened the country to Western commerce and influence, Japan has gone through two periods of economic development. The first began in 1854 and extended through World War II; the second began in 1945 and continued into the early 1990s, in both periods, the Japanese opened themselves to Western ideas and influence; experienced revolutionary social, political, and economic changes; and became a world power with carefully developed spheres of influence. During both periods, the Japanese government encouraged economic change by fostering a national revolution from above, planning and advising in every aspect of society. The national goal each time was to make Japan a powerful and wealthy nation that its independence would never again be threatened.

In the Meiji period (1868-1912), leaders inaugurated a new Western-based education system for all young people, sent thousands of students to the United States and Europe, and hired more than 3,000 Westerners to teach modern science, mathematics, technology, and foreign
languages in Japan. The government also built railroads, improved roads, and inaugurated a land reform program to prepare the country for further development.⁹

To promote industrialization, government decided that, while it should help private business to allocate resources and to plan, the private sector was best equipped to stimulate economic growth. The greatest role of government was to help provide the economic conditions in which business could flourish. In the early Meiji period, the government built factories and shipyards that were sold to entrepreneurs at a fraction of their value. Many of these businesses grew rapidly into the larger conglomerates that still dominated much of the business world in the early 1990s. Government emerged as chief promoter of private enterprise, enacting a series of business policies, including low corporate taxes.¹⁰

Rapid growth and structural change have characterized Japan’s two period of economic development since 1868. In the first period, the economy grew only moderately at first and relied heavily on traditional agriculture to finance modern industrial infrastructure. By the time the Russo-Japanese War (1904-5) began, 65 percent of employment and 38 percent of gross domestic product was still based on agriculture, but modern industry had begun to expand substantially. By the late 1920s, manufacturing and mining contributed 23 percent of GDP, compared to 21 percent for all of agriculture. Transportation and communications had developed to sustain heavy industrial development.¹¹

World War II wiped out many of Japan’s gains since 1868. About 40 percent of the nation’s industrial plants and infrastructure was destroyed, and production reveried to levels of about fifteen years earlier. The people were shocked by the devastation and swung into action. New factories were equipped with the best modern machines, giving Japan an initial competitive advantage over the victor states, who now had older factories. As, Japan’s second period of economic development began, millions of former soldiers joined a well-disciplined and highly
educated work force to rebuild Japan.

Japan’s highly acclaimed postwar education system contributed strongly to the modernizing process. The World’s highest literacy rate and high education standards were major reasons for Japan’s success in achieving a technologically advanced economy. Japanese schools also encouraged discipline, another benefit in forming an effective work force.¹³

PRIVATE ENTERPRISE AND CULTURE OF JAPANESE MANAGEMENT

The engine of Japanese technological growth has been private entrepreneurship, together with strong support and guidance from the government and from labour. As Shoshido¹² points out, the most numerous enterprises were single proprietorships of which there were over 4 million in the late 1980’s. The dominant form of organization, however were the corporation. In 1988 some 2 million cooperation employed more than 30 million workers or nearly half of the total labour force in Japan,

The culture of Japanese management so famous in the West was generally limited to Japan’s large corporations. These corporations provided their workers with excellent salaries and working conditions and secure employment. These companies and their employees were the business elite of Japan. A career with such a company was the dream of many young people in Japan, but only a select few attained the jobs. Qualification for employment was limited to the men and the few women who graduated from the top thirty colleges and universities in Japan.

In the late twentieth century, placement and advancement of Japanese workers was heavily based on educational background. Students who did not gain admission to the most highly rated colleges only did not have the chance to work for a large company. Instead, they had to seek positions in small and medium-sized firms that could not offer comparable benefits and prestige. The quality of one’s education and, more importantly the college attended, played decisive roles in a person’s career.¹³
Technological companies provided their own training and showed a strong preference for young men who could be trained in the company way.

One of the prominent features of Japanese management was the practice of permanent employment (Shushin Koyo). Permanent employment covered the minority of the work force that worked for the major companies. Management trainees, traditionally nearly all of whom were men, were recruited directly from colleges when they graduate and, if they survived a six-month probationary period with the company, were expected to stay with the companies for their entire working careers. Employees were not dismissed thereafter on any grounds, except for serious breaches of ethics.

Permanent employees were hired as generalists, not as specialists for a specific positions. A new worker was not hired because of any special skill or experience: rather the individual’s intelligence, educational background, and personal attitudes and attributes were closely examined. On entering a Japanese corporation, the new employee would train from six to twelve months in each of the firm’s major offices or divisions, Thus, within a few years a young employee would know every facet of company operations, knowledge which allowed companies to be more productive. 

Another unique aspect of Japanese management in the late twentieth century was the system of promotion and reward. An important criterion was seniority. Seniority was determined by the year an employee enters the company. Career progression was highly predictable, regulated, and automatic. Compensation for young workers was quite low, but they accepted low pay with the understating that their pay would increase in regular increments and be quite high by retirement. Compensation consisted of a wide range of tangible and intangible benefits, including housing assistance, inexpensive vacations, good recreational facilities, and most importantly, the availability of low-cost loans for such things as housing and a new car.
Regular pay was often augmented by generous semiannual bonuses. Members of the same graduating class usually started with similar salaries, and salary increases and promotions each year were generally uniform. The purpose was to maintain harmony and avoid stress and jealousy within the group.

All these features have become part of the Japanese culture that has helped to enhance her technological development.
SECTION 3.2

CULTURE AND TECHNOLOGY IN WESTERN EUROPE

Since the 17th Century Industrial Revolution, Technological Development in Western Europe has remained strong. This is because of close relations in trade and industry, common external problems like oil supply and commodity prices, and the commitments made to international corporation in science and technology. It makes most sense, therefore, in discussing culture and technology to consider Western European countries together, especially since most of the problems they face are common ones and hence there may be common lessons to be learnt.

There are three main problems Western European countries have had to face with regard to technology since the Second World War. Firstly, the fact that no nation in the world is technologically preponderant and that all countries depend to a greater or lesser extent on international flows in technology. In this situation countries have had to decide what technologies to import and what to develop themselves, and how to achieve the former through licensing, trade and foreign investment. The second problem stems from the first and is that most countries have been faced with the problem of priorities. No country can do everything or lead the field in every sphere, thus they have had to ‘specialise’. The decision to specialise and the determination of what fields to specialise in, has not necessarily been made centrally or even explicit by countries. Rather it has emerged from an awareness of their own and competitors’ strengths and weaknesses. Thirdly, all countries have had to decide on a policy towards big technology. Those that have embarked on such projects have had problems in maintaining viable programmes, especially in aircraft, nuclear energy, advanced electronics and space exploration. The problems they have faced are those of increasingly large scale, large R and D costs, technical and
commercial risks. the influence of strategic interests and interrelationship between the military and civil industry, and the U.S. lead in most of these fields stemming from the 1950’s, the ‘technology gap’ and the American challenge. The main question arising therefrom are: How has culture influenced technological developments in Western Europe. What cultural developments and policies will shape the future of Western European technology? Let us first examine the experience of the three largest countries: Western Germany, Britain and France.
In his recent study on “Technology in Western Germany”, Raymond Stokes\(^1\) examined the role of technology in what now constitutes Western Germany’s superior performance in the face of seemingly insurmountable odds, or the so-called Wirtschaftswunder or economic miracle.

Beginning in the mid-1950’s the origins and unfolding of the “miracle” captured the attention of scholars.\(^2\) As Stokes has pointed out, the post-war years in Western Germany were marked by enormous obstacles. The bombing destruction was extensive and the dismantling of factories continued into the 1950’s. Furthermore, and the division of Germany destroyed various cultural and traditional supply networks. Under this circumstance, what role did culture play in the technological development of Western Germany? Stokes had argued that the way Western Germans (workers as well as managers) approached technological change bound economic miracle both German past and to the country’s present-day industrial structure. The Western German approach, in other words, has drawn upon a set of German technological traditions that emerged in the late 19th and early 20th centuries, major characteristics of which include a drive for technical excellence tempered by gradual implementation of new technologies.\(^3\)

### CULTURE AND THE GERMAN TECHNOLOGICAL TRADITION

According to Stokes’, Germany’s technological tradition includes for instance, industrial relations, scientific and technical education, organization of research and the role of the state. Key technologies that helped define the German technological tradition include chemical technology, machine tools, specialty steels and automobiles technologies. These technologies
grew enormously in terms of production value and significance beginning in the late 19th century. They also demanded precision manufacturing and deliberate application of scientific knowledge to technology through research and development. Such characteristics distinguished them both from less sophisticated large-scale industries (such as textiles or iron manufacturing) that developed earlier and from those developing later (that are much more research-intensive such as micro-electronics). The historian, Wolfram Fischer called these “sophisticated traditional investment goods.”

TWO VIEWS ABOUT CULTURE AND GERMANY’S TECHNOLOGICAL AND ECONOMIC MIRACLE

One view advanced by scholars about culture and Germany’s technological and economic miracle is that the experience of skilled workers and the persistence of socio-economic relationships were important factors in permitting an economy to reconstruct itself after a disaster. For instance, the Hungarian economist Franz Janossy argued in The End of the Economic Miracle: Appearance and Reality in Economic Development that, when a disaster befalls an industrialized economy and when it causes the destruction of a significant part of a country’s means of production, the economy will eventually return to the level it would have reached had the disaster not occurred. Janossy assumed that there was heavy war damage to German and Japanese industry during World War II. In simplified form his idea that extensive war damage paved the way for technological renewal in Wester Germany has persisted in popular conceptions of post war German (and Japanese) technological performance.

A second, and a more recent view is that the most important cultural factor that was responsible for Germany’s technological and economic miracle was the ability of western German technologists and industrialists to embrace technological alternatives (alternative technology). Raymond Stokes used the post war technological transformation of the German
organic chemicals industry from coal-based to petroleum-based chemistry to provide a case study in this context, while addressing issues such as research management, introduction to new products and processes, technology transfer and international competition.

As Raymond Stokes points out, immediately after the end of world war II, chemists in German firms identified petrochemicals—especially as developed in the United States—as the wave of the future. While the Germans did not at first expect petroleum-based chemistry fully to replace coal-based chemistry, they recognized that petrochemical processes (although chemically more complicated than those using coal-based feedstocks) were less cumbersome from an engineering standpoint. Companies could thus realize economies of scale in petrochemicals manufacture undreamt of in coal chemistry. Only by producing chemical products such as polyethylene in high volume and at low cost in large-scale petrochemical plants could German firms hope ultimately to compete with their American and British rivals. By the mid-1950s, Shell and BASF jointly produced polyethylene in West Germany’s first petrochemicals plant.

Thus before they implemented new technologies, many West German firms began to make significant inroads into key foreign markets. Volkswagen’s managers for the most part used existing technology and some prewar machinery to rebuild, and their best-selling product, the Beetle, was of little-changed prewar design. They were thus able to take advantage of the explosion in demand at home and abroad during the 1950s.

To summarize, then, recent studies evaluating the role of technology in the Western German economic miracle indicate surprisingly slight bombing damage to industrial plant. What is more, dismantling and reparations often had little effect on the West German economic base. Some technological systems in place at the end of the world war II especially in chemicals and some other industries important to the war effort, were relatively new, but often the actual machinery was worn out. Most firms were unable to invest in new technologies for some time.
because of restrictions and/or limited availability of capital in the postwar years. Nonetheless, many companies used older technologies to produce goods to capture export markets while at the same time identifying targets for technological improvement and using the proceeds from domestic and export sales to invest gradually in new technologies.
SECTION 3.2.2

CULTURE AND TECHNOLOGY IN BRITAIN

Britain’s technology since 1945 reflects a reluctant but steady retreat from the position of a world-wide imperial power to that of a medium-sized European power. At the end of the Second World War, although having suffered some destruction. British industry was fairly strong in advanced technology.¹ There was a big aircraft industry, an advanced nuclear capability and close technological links with the U.S.A. through war time arrangements and subsequent defence agreements. This, together with worldwide political activities and commitments made Britain a first rank world technological power. In the 1950’s Britain attempted to continue this role. It developed its own independent nuclear weapons and undertook ambitious programmes in civilian nuclear and aircraft technology, while spending on education and R and D increased rapidly. especially in industrial and military R and D. 2 Nevertheless, consumer prosperity marked real problem in Britain’s industry. In the late 50’s two factors emerged which revealed the underlying weakness of the British economy. This first was the realisation that British industry had not been particularly innovative, nor had it really taken advantage of modern technological developments. The second factor was the realisation of the growing economic status of the rest of Europe, particularly those countries that formed the ‘Common Market’ in 1960. It was also realised that the resource and market base of Britain was so small in comparison to the U. S. that Britain could not hope to compete in the modern period. At this time too, British political commitments diminished with the end of the Empire whilst the costs of technological development increased with growing scale, complexity and risks.²
The 1950’s were characterised, therefore, by a mismatch between culture (political and economic ambition) and technological reality. The result was a series of expensive and costly failures in advanced technology. In civil nuclear technology the initial euphoria of building the first commercial productive reactor in 1956 at Calder Hall was not sustained in subsequent development nor were sufficient reactors sold abroad to offset development costs. In civilian aircraft the British record was equally bad: neither the Comet, Britannia, Vanguard nor DC10 were commercial success, the one success of the decade being the turbo-prop Viscount. Later the TSR2, Concorde and Rolls Royce continued the sorry story. The saga was more or less repeated in Britain’s abortive rocket programme... Blue Steak, Black Knight, etc.³

TECHNOLOGY AND PARTY POLITICS

In the early 1960’s British R and D expenditures were still rising and the newly established Ministry of Science made the first steps towards establishing a policy for science and technology. However, science and technology were still an essentially non-party issue and there was little public debate about policy. After 1963 all this changed and technology became one of the major issues in the 1964 election. In 1963, with a view to the impending election, the Labour Party sought to be identified as the party of ‘change’ or in Harold Wilson’s phrase “the White Hot Technological Revolution”. The Labour Party became committed to a platform of “socialism and technology”, with the objectives of making British industry more technologically competitive, spending more on science and technology’, halting the brain-drain and developing economic and industrial planning.⁴

Despite these changes there remained and indeed still remain a number of continuing problems. The problems of rationalizing British commitments to aircraft and nuclear energy had perished. Although outbacks have occurred over the past ten years, these programmes are still very big and involve politically powerful vested interests. Control of these projects is difficult
due to the secrecy and uncertainty that surround them: there is an obvious need for more open politics in relation to these projects: why for example is the British Government spending so much on the development of fast breeder reactors? A second problem concerns fundamental research, higher education and scientific manpower. In retrospect it can be seen that the British position has been fairly stable and successful. However, the impact of the Rothschild report has raised questions, as have the cut backs in higher education and the continuing shortfall in science and technology applicants in higher education. The final, most important and most enduring problem has been the poor growth and trade performance generally, stemming from long-term weaknesses in the British economy (particularly the nature of the industrial base), under investment and poor export performance.¹

In spite of all the rhetoric about cutting government expenditure, the 1970 Tory government, in essence, continued Labour politics. Commitments to Concorde and nuclear reactors were maintained despite rapidly rising costs and deteriorating commercial prospects: also the Government took on new responsibilities with regard to Rolls Royce. Furthermore, recent evidence suggests that a new long-term problem is emerging for the British economy, in that there has been, since the late 60’s serious under-investment in both production and industrial R and D.²
SECTION 3.2.3

CULTURE AND TECHNOLOGY IN FRANCE

France has had the same experience as Britain with big technology. Before the Second World War French industry was weak, it was not competitive in international markets due to the protectionist policies operated by the government, and it suffered from the high military budgets arising out of French colonial interests. After the War, France unlike Britain, had virtually no advanced technological effort and no special technological links with the U.S.A. However, in the 1950’s it did begin a small nuclear programme in both military and civil spheres, and the small aircraft industry made cheap, simple and successful military planes, as well as the Caravelle. Immediately after the Second World War the Centre National de la Recherche Scientifique (CNRS) was set up to coordinate the national scientific effort. However, it had little power and did not seem to have played a major part in policy direction.¹

SOCIO-CULTURAL FACTORS AND TECHNOLOGICAL DEVELOPMENT

This somewhat backward position in technology persisted until 1958, but with the coming to power of Charles de Gaulle and the foundation of the 5th Republic, French industrial, technological and scientific policy was given a major stimulus. With de Gaulle, came the notions of political grandeur and the drive for economic independence. De Gaulle saw clearly that science and technology were closely bound up with these objectives. The Delegation Generale a la Recherche Scientifique et Technique (DGRST) was set up to provide direct advice to both the Prime Minister and the Interministerial Commission responsible for R and D policy. From this one commentator has said: “On paper France has the most logical and clear-cut machinery for science policy of any major West European country”. However, the important defence, space

56
and nuclear sectors remained outside of this machinery and under direct Presidential control. This emphasizes once again the importance of socio-cultural, economic and strategic factors in policy for technology development. In this case, French concern over the challenge of American technology to the power base of European countries was all important. After the settlement of the Algerian war de Gaulle accelerated France’s nuclear weapons programme and gave it top priority, such that in 1967 France became the fourth thermonuclear power. The associated development of delivery systems through the super-sonic, Mirage bomber to nuclear-powered missile firing submarines had spin-offs for both the aerospace industry and satellite technology. The French aircraft industry though small, had a number of successes, particularly with Caravelle and Mirage fighters, but because of the small home market increasingly sought to undertake projects on a cooperative basis e.g. Concorde. The French independent space programme was very modest but did succeed in getting four satellites into orbit. The French civil nuclear programme developed similar technology to the first generation of British reactors. However it was some years behind Britain and was never commercially adopted. Lastly, French initiatives in developing a colour television system and in establishing a competitive French computer industry while politically attractive in the short-term have had technical and economic difficulties.

The politically prestigious commitments have proved to be too big and too expensive for France’s limited resources, especially after May 1968 and the departure of de Gaulle in 1969. Since then the civilian nuclear programme has had abandoned and it has been decided to buy U.S. technology. The independent nuclear deterrent remains, but with a much lower priority. France remains the only country in Europe with its own space programme and the expense of this had caused considerable concern in France. The SECAM colour television system has proved very costly and difficult to operate, and has only been sold to the Russians and a number of Arab...
countries. Finally the problems with Concorde and the changing policies on the European Airbus are well known.¹

French problems with big technology programmes have been compounded by the actions of lobbies and vested socio-political and economic interests. This commitment has been common to both the political left and the right. Unlike Britain, however, France’s economy and private industry have been successful in terms of growth and international markets. This has stimulated industrial R and D in general. Thus France’s technological development has been stimulated by its socio-economic and political interests more than any other factor.
SECTION 3.3

CULTURE AND TECHNOLOGY IN THE USA

DEMOCRATIC AND UTILITARIAN VALUES

Writing in 1835 de Tocqueville made the following observation about Technology in the U.S.A.

“In America the purely practical part of science is admirably understood ... But scarcely anyone devotes himself to the essentially theoretical and abstract portion of human knowledge.”¹

This emphasis on utility was part of a more general cultural attitude that favoured technology, stemming from the importance in American history of taming the wilderness’, ‘developing the frontier’ and puritanism. De Tocqueville himself tended to the view that the emphasis on technology was the direct consequence of ‘democracy’. This explanation is rather too simple as indeed de Tocqueville himself points out.² However, the notions of ‘democracy’, ‘individual freedom’ and especially ‘laissez faire’ were crucial in shaping the development of the U. S. A. American society developed without a feudal heritage, this favoured entrepreneurial attitudes and a much greater emphasis on ‘business’. In 1926 President Coolidge remarked “The business of the U.S. is business”.³ Due to its special labour conditions American industry has always been capital intensive and innovative: similarly American agriculture has been very dynamic. The size of the U.S. market allowed for specialisation of industry, also the absence of trade barriers and excellent transportation system favoured competition, and hence capitalist development. The American economy has also benefited from mass education, enormously rich natural resources and the pluralism of U.S. political institutions. It can be seen, therefore, that American culture
has been particularly favourable for the application of science and technology.\(^7\)

**GOVERNMENT SUPPORT FOR TECHNOLOGY**

From the end of the second World War until the mid-1960’s there was a prolonged ‘honeymoon’ in the U.S.A. between scientists and technologists on the one hand and the Government, industry and public on the other. This was against the background of a massive growth in the resources devoted to science and technology. At the highest level of American Government, the Executive Office of the President, technology did not have an official voice until 1957 when the shock of the launching of the first Russian Sputnik led to a proliferation of institutions. The Science Advisory Committee of the Office of Defense Mobilisation was promoted to the President’s Science Advisory Committee (PSAC) and the office of Special Assistant to the President for Science and Technology (SAPST) created. The American Congress did not respond to these executive initiatives immediately, but since the early 60’s a number of powerful and influential ‘watch-dog’ committee emerged to deal with various aspects of science and technology, e.g. Joint Committee on Atomic Energy and House Committee for Science and Astronautics.\(^5\)

The Federal Government’s policies for science and technology have been mediated in two ways; firstly, by the creation of ‘operating agencies’ and secondly, by the use and placing of ‘contracts’ with private firms. The most important agencies for Federal R and D have been the National Science Foundation (NSF), Atomic Energy Commission (AEC), National Aeronautics and Space Administration (NASA), Department of Health, Education and Welfare (HEW) and of course, the Department of Defence (D D). Although all of these have been subject to changes in public policy and priorities, they have nonetheless become politically powerful as has been the NSF. These agencies have ‘contracted out’ R and D and production to private industry.\(^6\) This massive commitment of resources to science and technology was made in response to four...
factors. Firstly, the Post-War emergence of the U.S. as the major world political power, and the
subsequent Cold War with the U.S.S.R. Secondly, the technological predominance of U.S.
industry in post-war period stemming from the supremacy developed during and immediately
after the second World War. Thirdly, and resulting from the first two points, overall U.S. pre-
eminence in science and technology in terms of facilities, manpower, important breakthroughs,
technological capabilities, etc. All these led to a tremendous optimism on the part of scientists
and the public that science and technology could and would solve all the world’s problems.3

DISENCHANTMENT WITH TECHNOLOGY

Since the mid 1960s, however, there has been a fundamental change. U.S. predominance
in both civil and military technology has been challenged. In the military field increased costs,
decreasing security and Russian military advances have led to attempt by both the U.S.A. and
U.S.SR. to reach some agreement on the stabilisation of the arms race. In civil technology the
U.S. lead has been successfully challenged by Japan and West Germany. to the extent that
America has had a substantial trade deficit. had to control imports and devalue the dollar. There
has also emerged a general disenchantment with science and technology. This questioning of
technology as being necessarily progressive and beneficial has been in response to a number of
factors; particularly important have been the uses made of science and technology in South East
Asia, environmental problems, the emergent futility of putting men on the moon. the use of
science to ‘legitimate’ various policies e.g. urban dynamics.4

These changes have had a number of effects. the most striking of which is decrease in
the funding of R and D. Since the mid 60’s defence R and D expenditures have been more
heavily cut back. These deductions have caused financial problems for the development of new
technologies especially defence and aerospace technology and the unemployment of scientists and
technologists. However, unemployment rates for scientists and technologists have ‘only’ been
in the order of 3 per cent, compared to 6 per cent for the U.S. as a whole and 10 per cent for the black population. The ‘problem’ has been overplayed because the unemployed have been concentrated in politically sensitive States like California and because scientists and technologists are, after all, mainly articulate, middle-class whites who know how to defend their interests.  

A second major change has been in the type and degree of the Federal Government’s commitment to university research, with the latter becoming less dependent on military and space agencies for research grants. Various moves to completely cut out military funding of university research while individually of limited success, have had a cumulative impact in scaling down the reliance of universities on the military. Pressures from students and University academics themselves have accelerated moves in this direction. Funds available for university research have, as a consequence, levelled out. This has created certain problems, but has meant that research projects can no longer be justified purely on the grounds that “the Russians are doing it”. The fact that other countries were able to import and utilize the results of U.S. R and D made the point that the U.S. could import science and technology from countries such as Japan, Western Europe and the U.S.S.R.  

Thirdly, in the face of this scientific, technological and industrial challenge there has been increasing pressure from both private industry and from within government for federal support of the commercial development of civilian technology, on a scale similar to that previously given to military technology. This was a new departure for the U.S. Government and one that has not been a success. It has revealed the problems of cost, control and accountability that were a suspected feature of defence projects, but that were cloaked by the Department of Defence security. The best example of unsuccessful Federal support of civilian technology has been the supersonic transport, which was eventually cancelled due to problems of commercial viability and environmental considerations. However the other main field of Federal support, nuclear
technology remains an important area of ‘public’ investment, especially since the “energy crisis” following the Middle East War of 1973.”

The final important change has been that scientists and technologists have increasingly turned their attention directly towards ‘social problems’, arguing that they can help with their solution. Clearly, in the face of reduced expenditures and growing public hostility both scientists and technologists have attempted to make their science and technology more ‘relevant’.
SECTION 3.4

CULTURE AND TECHNOLOGY IN THE U.S.S.R.

Our discussion of the interaction between culture and technology, in advanced industrialized societies, so far, has been in relation to Western capitalist mixed economies. Now let us examine this interaction in a different society: that of a centrally planned communist society, the USSR. The areas of focus are two-fold,

1. What have been the major cultural objectives of the USSR with regard to technology?

2. What problems have been encountered meeting these objectives?

Before the Revolution in 1917, Russia still had many of the features of a feudal society, with very little industry and a large military force. It was a poor country with a large uneducated peasant class and with great majority working in agriculture. In such circumstances Russia was very dependent upon foreign technology and R and D especially that from Germany,

TECHNOLOGY AND THE BOLSHEVIK REVOLUTION

With the Revolution came a major attempt to change this situation. After the upheavals of the First World War, the Revolution itself and the ensuing Civil War, the Bolsheviks were faced with the problems of reconstruction and modernisation in a devastated and disintegrated country. The main problem was agriculture, where small holdings, backward methods and conservative farmers made improvements very difficult. However, the main thrust of Bolshevik policy was the drive for industrialisation and modernisation. The key to the success of the Revolution in overtaking capitalism in production and welfare was seen to lie in planning and science and technology. In 1918 Lenin drew up a draft plan for technological work, the objective
being to transform society very quickly. It was assumed technology could refute traditional
Russian mysticism and develop the country’s wealth. In the twenties and early thirties there was
a tremendous growth in the number of scientific and technology institutes in both pure and
applied fields. This early growth was much admired by many British scientists. For example.
in 1939 J.D. Bernal wrote:

“(Soviet technology) has done enough to show that in this
new way of organizing (technology) in the service of humanity
lie possibilities for both altogether beyond those which the
present indefensible and chaotic system of science and industry
in the West can offer.”¹

This expansion of technological capabilities slowed down after 1929, as Stalin’s crash programme
of industrialisation in heavy industry and capital goods took precedence. The main objective of
this programme was ‘technological independence’ for Soviet society. Immediately after the
Revolution, Soviet industry was so underdeveloped that there was no alternative but to import
technology from the West, particularly from Germany and the USA.² However, this was
regarded as a temporary measure, it being hoped that Soviet science and technology would
rapidly develop an independent technological capacity. Science and technology, therefore, were
still afforded generous support, but by the mid 1930s, policies and organisations were set. The
dominant pattern was the centralisation of R and D in independent institutes, unlike in the West
where research developed along with teaching in the universities and with production in industry.
Higher education in the USSR was concerned mainly with teaching: whilst fundamental research
was carried on in Academies and institutes. In Soviet industry, industrial R and D was carried
out in institutes, production in the factories. The goals of the policy of ‘technological
independence’ was not technological autonomy, but simply the development of the ability to use
anybody’s technology (foreign or home-based) effectively.:
TECHNOLOGICAL INDEPENDENCE AND SOVIET VALUES

The reason for the adoption of the policies of ‘technological independence’ and ‘centralised research’ derived from ideology and from the particular historical circumstances of Soviet society. Centralised research was part of a more general policy of centralisation due to the importance given to planning; in research, at least, it was supposed to avoid unnecessary duplication in many enterprises. Generally, the circumstances of Soviet society and industry favoured centralisation. Industry and society were essentially conservative, thus it was thought to make most sense to concentrate force for change and innovation rather than to dilute them. Furthermore, scientific and technological resources were scarce, thus there were obvious advantages in concentrating efforts. The final factor favouring centralisation of R and D related directly to the objective of ‘technological independence’. The main role of industrial R and D at that time was, the adaptation of imported technology to Soviet needs, this was easier controlled and done by central government institutes than by individual factories.

The main difference between Soviet and Western capitalist policies for technology was that in Russia the objectives of R and D were determined by central planning, rather than in response to decentralised decisions and the market mechanism. However, even in the 1930s central planning was not the whole story. Politicians were often able to cut through the bureaucracy to allow the importation of strategically important technologies or provide resources for innovators from outside of regular channels.

This basic structure of central planning was maintained after the Second World War. There was, however, a big increase in R and D expenditures related to defence, to continue moves to technological independence and to catch up and overtake capitalist countries in production. For many years it was difficult to know or compare Soviet R and D expenditures with those of the West, especially because of secrecy surrounding military R and D.
In high priority fields like weapons technology and space there has been a very strong performance and visible success. However, in other fields, such as civil technology and agriculture, performances in technical innovation has been poor and the USSR has remained behind the West. For example, priority in the 1960s was still given to steel, while plastics and other modern materials lagged behind. Similarly, for various ideological and economic reasons, the Soviet computer industry made a very late start, such that in 1970 the USSR had fewer computers than a small country like Japan and less than a tenth the number in the US. This last point is particularly significant because it illustrates the compartmentalized nature of the Soviet system, in that there has been little technological ‘spin-off’ from defence and space programmes in computer technology.

Despite its phenomenal progress in industrialisation, Russia has failed to meet certain scientific and technological objectives: the question to ask is why? One suggestion is that it may be due to insufficient science and technology. While this may be true of certain fields like genetics and cybernetics (neglected for ideological reasons) it is unlikely to be true for the effort as a whole. It has also been stated that absence of contacts with foreigners and Russia’s pathological secrecy have not helped technology transfer. However, when a piece of technology was needed it was usually acquired by some means or other.

More generally, it has been argued that Soviet society and industry have suffered from the overriding priority given to defence in the 1950s and 60s. The result of this, and other policies, has been the division of Russia into three sectors: - the defence sector as advanced as anything in the world and equal to the USA: the industrial sector equivalent to that of a moderately industrialised country like Argentina: and an agricultural sector, fairly backward and not too dissimilar to Russia before the Revolution.

It would therefore take some time and new socio-economic, and cultural policies before technological development would reach the level achieved in western industrialized societies.
SECTION 3.5

CULTURE AND TECHNOLOGY IN AFRICAN SOCIETIES

INDIGENOUS TECHNOLOGY

There is a view that indigenous technological development was either non-existent or irrelevant in traditional African societies according to the myth of ‘primitive Africa’. However, this view is now being challenged and is not accepted by everyone. Africa possessed a technological base on which a technological revolution and successful industrial development might have been achieved but for the historical disinter of slavery - Africa was thus technologically castrated.¹

Recent studies have documented pre-colonial indigenous technology in Africa with respect to manufacturing and agricultural technology, mining and civil engineering, transport, communication and warfare. In her study ‘The place of indigenous iron technology in the development of Awka economy 1890-1960’, Eunice Nwokike² documents a unique example of how the mode of pre-colonial African development was based on the growth of iron technology. The Awka people in Nigeria (as in most other communities in Africa) manufactured various products which were used in the local community or sold to other African States. The skills displayed in the smelting of iron ore surprised the Europeans when they arrived in the 1800s. They could not believe that they would meet a community with such technological knowledge and ingenuity.

The technique of iron smelting was well known and indigenous furnaces were also widely used. Nwokike mentions various types of furnaces that were used in prehistoric Africa. These included the pit furnace, the Nupe forge, the Taruga furnace and the shaft furnace. Blacksmiths
in Awka produced cutlasses, hoes, knives, guns, spearheads and swords using local kilns and furnaces. These iron workers were organized into guilds; and there were also brass-bronze-and goldsmiths.

Everyday life in pre-colonial Africa also thrived on indigenous industrial technology such as the manufacturing of clothing, soap, leather, food and drinks, as well as industrial fuels. Weaving with the hand-loom still persists in Africa. It was this development that turned Kano City into the ‘Manchester of West Africa’ by the 1850s. The processing of staple foods and drinks such as Pete, Ogogoro, palm-wine etc. are still widespread.

Agricultural techniques in Africa consisted of shifting cultivation land clearing using the cutlass, and land tillage using the hoe, both of which were produced locally by blacksmiths out of wrought iron and shaped wood. In the savannah regions, simple ox-drawn ploughs were also used.

Mining technology has also been developed in any parts of Africa in the mining of gold and rock salt. In civil engineering, the construction of houses, palaces, roads and simple bridges was widespread. Transport in the pre-1860 era seems to have restricted to camels and horses and to dug-out canoes. The canoes were usually made out of wood and, in the early 19th century, probably used with sails. Military technology consisted of the manufacture of bows and arrows, spears, cutlasses, swords, knives and later guns, produced locally by blacksmiths.

THE DECLINE OF INDIGENOUS TECHNOLOGY

With the imposition of colonial rule, indigenous technology declined in most parts of Africa. For example the Europeans banned the manufacture of local products (e.g. guns) and made them illegal. The Europeans, partly by establishing a stronghold on the distribution of African products and partly by swamping them by importing European goods, eventually succeeded in putting an end to the expansion of indigenous technology. Furthermore, the factors which had
sustained indigenous technology (i.e. the demands of traditional societies) were gradually being eroded.

In his study of 'Culture Food and Agriculture, Claxton documented how during the colonial period, peasants were forced to produce raw materials for European industries under conditions dictated by Western agricultural technology developed largely in the temperate zone. Using the examples of sugar, cotton and coffee, Claxton showed how these crops stimulated and helped perpetuate slavery with all the dire social economic and cultural consequences that ensured for the victims of that pernicious system.

The Agricultural practices developed in many traditional societies over the centuries to preserve soil fertility were discouraged. Traditional societies under colonial role were ‘taught’ to adopt monoculture instead of intercropping, and intensive agriculture with fertilizers instead of allowing cultivation of rotate and some land to remain fallow.

Now that soils in most of these areas have degenerated to the point where it is difficult to produce enough food to sustain the increasing populations scientists and technologists are beginning to draw attention to the rationality and wisdom of many traditional agricultural practices.

Many African peoples had detailed knowledge of the weather and soil properties and varieties of tropical plants and trees in their neighborhood. Even shrubs in the Sahara were carefully studied by the Berber and Arab nomads and cultivators. Elsewhere there were elaborate classifications of plants into families and sub-groups according to cultural and ritual properties which do not tally with modern botanical classification but were so detailed and complex that modern botanists have a lot to learn from the basis of comparison and classification. Knowledge of the pharmaceutical properties utilized in healing systems is now beginning to be investigated by Western-trained pharmacologists.
Among cultivators, there were specialist groups, particularly hunters as individuals and guilds, who acquired and classified knowledge of tropical animals in cultural terms. As Claxton was pointed out some of this knowledge was applied in healing systems largely on the basis of analogy: that bits of an animal prepared with herbs of known therapeutic values can pass on their characteristics to heal a person suffering from lack of those characteristics for which the animal was best known. Pastoralists such as the Fulbe and the Maasai, and some Somali, acquired extensive knowledge of their animals and their biological needs, and detailed knowledge of the animal world generally. From this, many developed impressive veterinary knowledge and expertise, including noteworthy techniques of animal surgery. Some of this knowledge has been extended to surgical treatments of humans, and it is now believed that modern medicine has something to learn from such transitional methods of bone-setting. Broken legs and sprained ankles are treated much faster among traditional healers than in modern hospitals. The reputation of some African bonesetters spread so widely that medical researchers in distant lands like the Federal Republic of Germany, Scotland and Poland started focusing special investigative attention of African techniques.

Indeed African technology in the pre-colonial period were adequate to sustain life, especially in the areas of health care, agriculture, veterinary medicine and industrial processes such as food preservation, metallurgy, fermentation, the making of dyes, soaps, cosmetics and other toiletries. How then has Africa become so backward and technologically underdeveloped?

EMERGENCE OF A TECHNO-CULTURAL GAP

In recent years the impact of culture on technology in most traditional societies has tended to bear on two opposing directions at once.

On the one hand western technology is being sought virtually without limits, on the other hand, there is opposition to certain aspects of western life styles, attitudes and values. This
phenomenon has been termed as the techno-cultural gap between traditional values and western technology.

Thus inspite of their potential, indigenous technologies have all along been neglected in most of the Third World. This is because, in their effort to develop, developing countries have come to rely on the importation of Western technologies to achieve results. This marked the beginning of the transfer of technology which has become widespread in contemporary times.

TECHNOLOGICAL INFRASTRUCTURE VERSUS THE CULTURE OF SELF - RELIANCE

What is the technological situation in most third world countries today?

T.T. Isoun in his editorial analysis which appeared in the Journal Discovery and Innovation, portrays the reality of the third world very aptly when he wrote.

“The ability of African (and most third World) nations to design, innovate, fabricate, manage, and mass produce (manufacture) the essential consumer goods, and strategic machinery for industrialisation and defence has not improved significantly over the past 35 years (the period since just before the independence of most African (third world) countries to the present)” So what went wrong?

Immediately after their independence, many African countries adopted the flawed policy of import substitution. This policy was fed handsome amounts of hard currency which African countries got from the sale of agricultural cash crop commodities, and, in the early seventies, on the windfall of hard currency from the sale of crude oil and other mineral raw materials. At the same time, many African countries maintained over-valued exchange rates which encouraged imports and discouraged capital goods production. Then, in the early eighties, came the crash of crude oil and cash crop commodity prices. Thus the policy of import substitution has gone into inevitable collapse. In its place, the new policy emphasis on self-reliant development has emerged.
The successful outcome of this strategy will mean that African countries would be able to produce sufficient food and consumer goods for their populations, and create an industrialisation process, strong enough to product goods for local consumption and export, as well as sophisticated weapons for defence to ensure peace security for development.

Although existing policies on industrialisation have included establishment of plants for the manufacture of textiles, beverages, and cement, there is clearly inadequate (near absence of) development of capital goods (heavy) industries."

Isoun identifies the lack of development in industries and technology due to the absence of technological infrastructure. He defines technological infrastructure as the technical, engineering, and management human resources, raw material and fundamental facilities which make it possible to make products and machines which can be further used to establish other industries or manufacturing plants. Some of the most basic physical technological infrastructural facilities include iron and steel plants; machine tools plants; power generation, transmission and distribution; natural and liquified natural gas plants; and fertilizer and petrochemical plants.

Although reliable data on the technological infrastructure in third world countries are difficult to come by, some countries like Algeria, Egypt, South Africa, Zimbabwe and Nigeria appear to have the beginnings of what could be termed as a viable technological infrastructure, while Zaira, Kenya and Ivory Coast appear to have the potential for capital goods industrialization.

According to Isoun the main constraints to development of technological infrastructural and capital goods industries in Africa are:

* Very few African countries (with the exception perhaps of Egypt, Nigeria, Zaire, Ethiopia) have big enough internal markets for capital goods arising from engineering infrastructure. Some scholars may argue that big internal markets are not absolutely required for successful capital goods industries especially when we record the success story of Taiwan.
* Multinational companies are not interested in investing in engineering infrastructure and capital goods industries (they would rather export capital goods to these consumer countries).

African indigenous private capital is weak.

IMPLICATIONS

Now, if we take these issues into full consideration, we are left to conclude that what is needed at this moment is not just an increase of international technology transfer nor even the setting up of a screening mechanism permitting only appropriate technologies to be transferred, but rather a major re-orientating and restructuring of technology at two levels: the domestic and the international.

At the domestic level, it is important to build a popular technological awareness crossing the borderline between the so-called indigenous and modern technology. People should become aware of the issues in culture and technology and that they can improve their livelihood by modifying and improving indigenous and modern technologies. R & D should not be an activity left to scientists and technologists in laboratories but rather it should be built by making improvements on existing technology indigenous evolved in the village communities.

At the international level, the re-orientation and restructuring of science and technology must touch on two areas:

1. On the study of science and technology in schools, scientists, technologists and science educationists of different cultures, languages and social systems must build new paradigms for science and technology education from a multi-cultural perspective. Science and technology must be seen as existing in all cultures, the issues must be taught and the potentials of these must be explored in situations of everyday life.

2. An acceptance of the restructuring of R & D systems could permit the developing and the industrialized countries to engage in a dialogue on alternative R & D, assessment of
technology for development, concrete measures to redirect government R & D from technocratic to need-oriented technology development, etc. and joint R & D for alternative technologies.
CULTURE AND TECHNOLOGY IN CHINA

The art of printing was invented in China prior to the nineteenth century, more than 600 years before it was known in the West. The discovery served commendably to print Chinese literature, including the classics, and government documents. However, it failed completely to support a growth of technology it did in the West. The failure cannot be attributed to a lack of interest in technology in China. More probably it was due to cultural values in China, specifically the pre-eminence of those values over technology. The earliest patterns of Chinese culture were evident in the Shang (also called the Yin) dynasty, usually dated 1766-1122 B.C. It was in that period that the deep respect for knowledge and intellectual values that have characterized the Chinese down through the ages developed. A strong emphasis on government also developed. Presumably, the need for written documents in government brought the intellectual into government, thereby initiating in China an identification of learned people with government that prevailed into the twentieth century.¹

Certain forms of technology were also apparent under the Shang dynasty, particularly. There was evidence that knowledge of metallurgy and the agriculture existed; engineering principles were applied in the building of large structures, such as temples and palaces. Thus a form of technology began in China at a very early date.²

The Shari: dynasty was followed by the Chou dynasty (1122 -403 B.C.). The pattern of thought that was crystallized during that period, as to the twentieth century was crystallized during that period, as were the factors that were to affect the development of technology in China. In terms of influence of the future history of China, the dominant figure during the Chou
The dynasty was Confucius (551–479 B.C.). Confucius emphasized human conduct, the social and philosophical aspects of man. Knowledge was to be developed by abstract thought. When the landlord-scholar-official class replaced the old feudal system under the Han dynasty (206 B.C.-A.D. 22), Confucius's thinking was wholly adopted by this class. It flourished, became a kind of official state religion, and exerted a greater influence on Chinese thought. That influence, although undergoing variations in certain periods of Chinese history, has prevailed to the present.

It cannot be said that Confucianism opposed the development of technology, but, in its preoccupation with other intellectual pursuits, it did nothing to promote technological development.³

Lao Tzu (60–531 B.C.), founder of Taoism, also lived during the Chou dynasty. Taoism treats the relationship of the individual to his natural surroundings and up-holds a state of nature where the free expression of the individual is the end and justification for everything. It seeks to teach man how to live in harmony with the controller of the universe and advocates living in harmony with nature, shunning the seeking of wealth and social rank. Unlike Confucianism, Taoism stressed that man should immerse himself in nature and thereby directed the attention of the Chinese to their natural environment. It is thus logical that this philosophy would encourage the development of science and technology. Indeed, when Taoism flourished in early Chinese history, advances in medicine and botany took place.³

TECHNOLOGY AND CLASS FORMATION

By the time of the Han dynasty (206 B.C.-A.D. 220), scholarship in China was identified with the study of the Chinese classics. The scholars were the highest class in China, and their work was held in high esteem. It became traditional for them to do no work with their hands; their long fingernails and characteristics of their dress proclaimed their status of physical inactivity. The scientists and technologists of traditional China belonged to the scholarly class.
In keeping with the privileges of their class, they did no work with their hands—hence no experimental sciences in China.  

Below the scholar in the class system of traditional China was the peasant farmer, followed by the artisan and, last, the merchant. It was from the artisan class that Chinese technological devices came into being. Unfortunately, the class distinction meant that there was little interchange between the scientist and the artisan engineer. Furthermore, the class separation led to downgrading of the artisans’ accomplishments, for the artisans could not embellish them with words of explanation adequate to satisfy the sophistication of the scientist-scholar. Nevertheless, over the centuries the artisan class produced numerous noteworthy devices, such as elaborate clocks. Many of the artisans devices had ended up as mental exercises, toys, or amusements for an emperor or a high official. At no time in Chinese history were the efforts of the artisan class and the merchant class combined to expand production. Therefore, no social revolution of the kind that occurred in England in the nineteenth century ever came about in China.

**ORGANIZATION OF TECHNOLOGY**

China’s intellectual progress since 1949 has been due in large measure to the extensive planning of the central government, aided, prior to 1960, by Russian officials. Those responsible for planning and policy-making, despite the fact that many of them had little scientific education and knew virtually nothing about science and technology, appreciated the value of education and science and technology to the future of China and acted accordingly. Educational institutions and curriculums were reorganized, and higher education enrollments were increased immediately. Enrollments in science and, especially, engineering were increased more rapidly than in any other field.

In 1949, after the P.R.C. was founded, the support of science was confirmed with the
establishment of the Chinese Academy of Sciences through a merger of the Peking Academy of Science with the existing Academia Silica and some lesser institutions. The new organization, which started with sixteen research institutes, was, commissioned to plan, direct, and promote science and technology. It was also intended from the beginning that it would aid in the education of research personnel.

Since that first official act, which signified the importance of science to the P. R. C., the organizational structure for the planning, support, and development of science and technology has been in a state of flux. Today, the state Scientific and Technological Commission, founded in 1958 and under the jurisdiction of the State Council, has become the organization in which the Chinese Communist Party has vested the most authority for the planning and direction of scientific and technological activities in China.

Current with the evolution of the State Scientific and Technological Commission and the development of the Academy of Sciences, several ministries were formed and given responsibility of scientific and technological activities. Among them are the ministries of Education, Agriculture, Geology, and Defence. In addition to the Academy of Sciences, separate academies were formed under the Agriculture, Public Health, Geology, and Defence ministries. Most of the research and development institutes are administered by the ministries.

TECHNOLOGY AND THE CULTURAL REVOLUTION

In the planning for the Cultural Revolution there was concern that there would be gross interference with scientific and technological activities in China. To ensure that such interference would be minimal, an aspect of the charter for the Cultural Revolution was drafted to state as follows:

Policy toward scientists, technical personnel and working people in general: In the course of this movement, the policy of unity-criticism-unity should not be continued toward those scientists, technical personnel, and working people so
long as they are patriotic and work actively without opposing the party and socialism, and so long as they have no improper association with foreign countries. Those scientists and technical personnel who have made contributions should be protected. Assistance may be rendered in the gradual transformation of their world outlook and work methods.¹¹

The extent to which this policy was applied and research and development activities proceeded without interference is not known. There was some conflict in the institutes of the Academy of Sciences between the pro-Maos revolutionaries and the pragmatist followers of Liu Sha-ch’i. The revolutionary action, with the support of the army, took control of the academy, which has undergone few or no personnel changes at the highest administrative levels. Although there have been exceptions, it is believed that research and development personnel and programs were subjected to comparatively few direct abuses. However, it appears quite probable that staff personnel were disturbed emotionally by the disruptions associated with the Cultural Revolution, and the progress of their research and development programs may have suffered as a result. ¹²

The most conspicuous harm produced by the Cultural Revolution in the technological sectors will be that resulting from the closing of schools in China. The extent to which school were closed, and what schools are now back operating is not fully known. However, the general impression is that most schools were shut down for two or three years. The closure of education produced a gap in the manpower supply, and the gap eventually reduced the acceleration of Chinese research, development, and production programs.¹³

It is apparent that the education of peasant youth was stressed in the secondary schools and at the higher education level. Many of those admitted to these institutions did not have adequate preparation, and therefore the cause of education was further retarded. Here again, the Cultural Revolution was detrimental to China’s scientific and technological progress, at least in the immediate future.
SOME CONCLUDING REMARKS

Expressions of pessimism about China’s technological progress often appear in the Western press. They may be in part an exhibition of a dangerous tendency among many Western observers to correlate all progress in China with the reported disruptions resulting from the Cultural Revolution. It must be recalled that China’s technological accomplishment since 1950 have generally exceeded the estimates of Western observers, and these have been attained against a host of adversities. It would thus appear that if China remedies and expands its educational system, it may well become quite strong technically and in time become a centre of science and learning in the world. As an example of what can happen in a relatively short period, in the 1930’s U.S. science was behind European science. In the 1950’s it had forged ahead of European science. Through the 1960’s and up to the present, there has been great concern over the status of technology in Europe because it is so far behind that of the United States.

Although China will progress in the sciences and technologies, it seems quite unlikely that it will have a scientific and technological capability to that of the United States or the Soviet Union in one or even two decades. On the other hand, even though it is not obvious that the Chinese will someday be successful in their efforts to achieve technological parity with leading nations of the world, it is also not obvious that they will fail.

In the last third of the nineteenth century, the West employed physical force in the treatment of China. Marshall McLuhan, a controversial figure in Western education today, has pointed out: ‘Today’s war is an information war’. Now, in the last third of the twentieth century, it is the information from the West - especially the vast amount of scientific and technological information - that is being assimilated on the Chinese mainland. The entire scientific and technological structure in the P.R.C. has been designed not only to assimilate from the West but also to develop and apply more information of the same type. Basic questions arise.
as to what will be the impact of this information on Chinese culture, what changes will result therefrom, and what implications the changes will have for the rest of the world.
NOTES AND REFERENCES TO SECTION I


5. Ibid


10. Mervyn Claxton, opcit, p.23


12. Ibid.


14. Ibid.

15. Nji (1992) opcit


17. Ajaga Nji opcit.

18. Ibid.
19. ibid.


22. Mervyn Claxton opcit.

NOTES AND REFERENCES TO SECTION II


4. N. Jequier. (1979) ibid

5. ibid.

6. ibid.


12. ibid.

13. ibid.
NOTES AND REFERENCES TO SECTION 3.1


5. ibid.


8. C.G. Allen *opcit*.

9. *ibid*.

10. *ibid*.

11. *ibid*.

12. Shoshido *opcit*.

13. *ibid*.

14. *ibid*.

**NOTES AND REFERENCES TO SECTION 3.2.1**


4. Stokes *opcit*.

5. Franz Janossy cited in Raymond Stokes *opcit*.

6. Raymond Stokes *opcit*.

**NOTES AND REFERENCES TO SECTION 3.2.2.**


2. *ibid*.
3. ibid.


5. ibid.

6. ibid.

NOTES REFERENCES TO SECTION 3.2.3


2. ibid.

3. ibid.


NOTES AND REFERENCES TO SECTION 3.3


2. ibid.

3. ibid.

4. ibid.


6. ibid.


87
NOTES AND REFERENCES TO SECTION 3.4


2. ibid.


6. ibid.

NOTES AND REFERENCES TO SECTION 3.5


NOTES AND REFERENCES TO SECTION 3.6


3. ibid.

4. ibid.


6. ibid.

7. ibid.

8. ibid.

9. ibid.

10. ibid.


12. ibid.

13. ibid.