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THE LONG-RANGE FUTURE OF THE NAVY

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GROUP RESEARCH PROJECT

THE LONG-RANGE FUTURE OF THE NAVY

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357

Abstract of

THE LONG-RANGE FUTURE OF THE NAVY

A forecast of possible environments which the Navy will face in the final quarter of the Twentieth Century. The writings of futurists in both technical fields and the social sciences are examined to determine the range of plausible world conditions which could materialize. In Volume One, three scenarios are developed depicting the world under varying degrees of international involvement and interstate conflict: World-wide Withdrawal, in which the major nations are turning inward under the pressure of internal problems; the Cooperative World, in which cooperative international interaction is intensified; and a Conflictual World, characterized by interstate conflict. In each scenario, implications for the Navy of the postulated international environment are discussed. The authors do not attempt to predict that the world will develop into one of their three scenarios, but suggest either a weaving of threads and themes from all three, or a sequential development of the characteristics of first one and then another of the basic environmental types. The broad range of research underlying the study is summarized in a series of special studies in Volume Two, in which particular

facets of economics, technology, and society are examined in greater depth. The paper concludes that the Navy should conduct long-range studies on a continuing basis and recommends a number of specific areas for more detailed analysis in future work.

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PREFACE

This study deliberately and consciously violates the hallowed principle that research should be narrow in focus in order to develop in adequate depth a manageable subject area. It would be difficult to imagine a subject more broad than attempting to forecast the Navy nearly thirty years in the future. In spite of this inherent difficulty, however, the need for broad, long-range studies is patently clear. The process of research and development of a weapons system requires from five to ten years, and the life expectancies of such systems may range out to twenty or more years. Many of the ships now being retired, for example, were built during the closing years of World War II or soon thereafter. Similarly, concepts currently being developed will produce weapons systems which will be with us through the end of the century. The Chief of Naval Operations has recognized the need for futuristic studies of the Navy and recently established a study group for this purpose within OPNAV; his interest subsequently led to this effort at the Naval War College. The authors of the present study felt that the resources of the Naval War College were best suited for an examination of sources external to the Navy, and that a study of these materials might well complement the efforts of the OPNAV study group, which enjoys ready access to the current Navy and military sources. In attempting to forecast the possible environments which the Navy may face by the end of the century, this study has therefore concentrated upon the works of futurists in the civilian academic and scientific communities.

The authors wish to gratefully acknowledge the guidance of the co-directors for the project, Professor Vincent Davis, occupant of the Chester W. Nimitz Chair of Social and Political Philosophy, and CDR James A. Barber, Jr., USN, of the Naval War College staff. Considerable recognition is also due LCOL John B. Keeley, USA, for his cogent criticism of the early drafts and excellent advice throughout the project. Similarly, the editorial contributions of CDR Robert M. Laske, USN, and ENS John D. Caswell, USNR, of the Naval War College <u>Review</u> are greatly appreciated.

It is the sincere wish of all concerned that this paper may serve as a useful initial attempt at long-range forecasting for the Navy and provide the foundation for more rigorous research efforts, leading to improved and continuous extended range forecasting.

TABLE OF CONTENTS

LIST OF TABLES

LIST OF ILLUSTRATIONS

THE LONG-RANGE FUTURE OF THE NAVY

CHAPTER I

THE IMMEDIATE SHORT-RANGE FUTURE

Revolutionary changes are taking place within many nations and in the world at large, and these changes may have a variety of dramatic consequences for the long-range future of the global society in general, the United States within that society, and the U.S. Navy in particular. But, before those longer-range considerations come fully into play, the Navy must confront a stark and potentially very dangerous immediate short-range future.

Two facts are central to the short-range problem. First, the Government of the United States, under severe domestic pressures for a variety of reasons and from a range of internal sources, has initiated a process of withdrawal and retreat from international involvement. It remains to be seen precisely how far this trend of withdrawal and retreat will go, but the basic fact is that it has started. For approximately 30 years, from 1940 until 1970, the United States was heavily and continuously involved in many international endeavors including military actions and commitments of varying levels, durations and intensities. But that thirty-year period of involvement appears to have ended.

The second central fact is that the Soviet Union, while occasionally showing an interest in accommodation and negotiation on certain issues, steadily continues to build new military strength and to involve itself actively in many parts of the world where neither the U.S.S.R. nor earlier Czarist Russia were ever before engaged. The Soviet Union has been extremely cautious since World War II in deploying and using its own military forces, but there is little or no evidence to suppose that Soviet leaders have lost their enthusiasm for extending Russian hegemony and influence if not outright control into many areas of the world.

In short, the fundamental rivalry between the two superpowers, the United States and the Soviet Union, which began during World War II has not ended, but is now entering a new phase in which the Soviet Union continues to thrust outward in a variety of sophisticated ways while the United States is backing away.

President Nixon's personal history would suggest that he is presumably not happy about this development, but any president would have to react in much the same way to the extremely severe domestic restraints which have confronted Mr. Nixon. The Nixon Doctrine has bravely asserted that no American commitments will be defaulted, but adversaries may well question first whether the United States can implement this determination in the face of sharply reduced military forces, and second whether the American allies are ready and willing to take up significant parts of the slack.

The policies of withdrawal, reduction and retreat have by now gained sufficient momentum that nothing short of some cataclysmic international provocation could begin to produce a new reversal of this course for the United States over the next three years. Adversaries have generally been cautious in avoiding any such massive provocation to the United States since World War II, and it can be assumed that those adversaries will want to do nothing now to alter the current policies of reduction and withdrawal in the United States. Therefore it can be assumed that these policies will remain in effect at least until approximately 1974. Whether Mr. Nixon is re-elected in 1972, or some new President is elected, neither man could initiate new policies which would significantly reverse or alter the current withdrawal and reduction policies until approximately 1974.

A period of maximum danger may therefore occur sometime during late 1973 or in 1974, after the United States has significantly weakened itself internationally and after the Soviet Union has gained substantial additional strength and international penetrations. The Soviet Union has never failed to probe apparent weaknesses in American will and capabilities. It will probably initiate no major probes until about 1973 or 1974, because it will not want to give the United States an excuse to reverse present policies of withdrawal and reduction. But, if by 1973-74 there is a substantial discrepancy between U.S. will and capabilities on the one hand, and Soviet opportunities and capabilities on the other, it should be expected that the Soviet Union at that time would be tempted to undertake some form of major <u>fait accompli</u> on the assumption that the risk to the USSR by then would be negligible. This, again, would be the period of maximum danger and threat to the United States.

The implications for the U.S. Navy are fairly clear. First, the top priority should be to maximize ready force in being. This means that R&D and many other important activities should receive distinctly lower priorities. The great problem facing the Navy will possibly be that day in 1973 or 1974 when the U.S.S.R. makes its move, and when the President of the United States thus feels compelled to respond. The President would undoubtedly call on the Navy at that moment, and no kind of excuse--not even the excuse that the Navy had merely been trying to follow Administration guidelines in cutting back forces--will be valid if the Navy is unable to respond.

Let us suppose, then, that the Navy does manage to maintain sufficient force in being, along with the other armed services of the United States, and the Soviet Union remains generally deterred from making a major move during the period of maximum danger as suggested here. If that period can be successfully weathered and if the international system can survive relatively intact and unchanged from the general cold war situation at work in the late 1960's and early 1970's, then an entire new spectrum of longer-range considerations must be studied.

The study of these longer-range considerations constitutes the remainder of this paper. If the current international system can be successfully maintained without violent upheavals by the mid-1970's, then a complex variety of trends will begin having a substantial impact.

The authors of this paper have tried to pick up the story beginning in the mid-1970's and look ahead as far as possible--even for a quarter of a century with respect to some factors, out to the year 2000 and the new millenium. Instead of attempting to develop a single clear-cut vision of the future world, an all but impossible task, the authors have elected to develop three scenarios depicting the range of alternative futures which might occur, based on certain plausible evidence. Each of these scenarios is a hypothetical construct. The authors suggest that the future which actually occurs is likely to be some mixture of elements from all of the three scenarios, or perhaps a sequential development of the characteristics of first one scenario and then another. Although it is not possible to determine the precise course which future world development will take, the three hypothetical scenarios are nevertheless very useful as devices to highlight particular kinds of problems which could occur under foreseeable if not predictable contingencies.

Chapter II outlines a number of basic trends which the authors expect to continue in varying degrees regardless of which of the three scenarios most nearly describes the future.

Chapters III, IV, and V are devoted to the three scenarios, weaving in the continuing trends noted in Chapter II as these trends may be specifically relevant to each scenario. The scenario chapters are each organized in three parts: first, a view of the world; next, a view of the United States within that kind of world; and finally, a view of the implications for the Navy within that kind of world and nation. Chapter VI draws together the impacts on the Navy described in the three scenarios and discusses conclusions.

In attempting to forecast the future environments which may fact the Navy by the end of this century, the authors have drawn freely upon the futuristic literature in a wide range of technical and non-technical fields. Selected results of the research underlying the study are summarized in a series of special studies in Volume Two, Chapters VII through XIX, in which particular factors bearing upon the study are examined in greater detail. Principal sources are indicated within each special study and are also listed in the bibliography in the back of Volume Two.

This then concludes Chapter I of this paper, outlining the immediate dangers of the short-range future from now until the mid-1970's, and introducing the chapters to follow which will deal with the possible consequences and implications of the longer-range future stretching out to the end of the Twentieth Century.

CHAPTER II

TRENDS COMMON TO THE THREE ALTERNATIVE SCENARIOS

Continuing on from the short-range projections of the previous chapter, this chapter identifies trends in world society which are expected to continue to the end of the century and outlines three scenarios which will be developed in Chapters III through V.

In order to prepare scenarios depicting the plausible range of alternatives facing man and his world by the end of the century, the study group investigated the major fields of the social sciences and technology. In examining these areas of human endeavor and their possible implications for the three scenarios, the research covered areas as diverse as demography and space technology, identifying a number of significant trends which have a high probability of occurrence or continuation. These trends, which represent the considered opinions of experts in their fields, provide the foundation for the scenarios developed in the next three chapters.

To examine the trends in detail, we will group and consider them under three categories: society and politics; economics, population, and resources; and technology. These trends have been drawn from the special studies in Volume Two, in which the basic sources from the bibliography are identified. The varying implications of these trends under the three postulated world conditions are discussed in each scenario and summarized in Chapter VI.

a. Society and Politics: The trends listed below relate to society and politics in the developed world unless otherwise stated.

1. Accelerating pace of change in society.

2. Diminishing influence of the family.

3. Increasing egalitarianism.

4. Increasing availability of leisure.

5. Increasing appearance of hedonistic, this-worldly, secular, humanistic trends.

6. Increasingly transient nature of property.

7. Increasing degree of social regulation.

8. Increasing potential for encroachment on individual privacy.

9. Development of techniques for altering and controlling human behavior and personality.

10. Increasing ability of man to change or affect his environment.

11. Growing concern in the developed nations and eventually in the developing nations for environmental quality.

12. Increasing role for education.

13. Declining importance of primary occupations (fishing, forestry, agriculture, hunting and mining) and secondary occupations (processing of products of primary occupations) in the developed world. Growing importance of service industries.

14. Increasing phenomenon of serial careers. Increasing importance of re-education for subsequent careers.

15. Better educated electorate and increased popular political participation in both developed and developing countries.

16. Increasing presence of action and protest groups in developed and developing countries.

17. Increasing popular demands on government in developed and developing countries to produce goods and to provide services.

18. Increasing trends toward new power centers (education, armed services, science) in the United States rivaling traditional power centers.

19. Increasing Black domination of the major U.S. cities.

20. Increasing urbanization and population density. Growth of megalopolises in the United States as a result of increased urbanization.

21. Gradual rise in median age in U.S. population.

22. Moderate increase in life span in the developed countries. Significant increase of life span in the developing countries whose average life expectancy is considerably below the average for the developed countries.

23. Increasing potential for better health through control of disease, repair and replacement of organs, correction of genetic defects and chemotherapy.

24. Increasing potential for international destabilization resulting from turmoil among developing nations caught between the rising demands of their populations and their own inability to increase GNP and income significantly.

25. Further emergence of mass consumption societies in the Soviet Union and Eastern Europe.

b. Economics, Population and Resources

26. Increasing economic growth in the United States and other developed countries. (See Chapter XIII for GNP projections).

27. Accelerating economic growth in the developing countries.

28. Economic gap between the United States and the developing countries will not significantly close.

29. Increasing economic interdependence of most countries.

30. Continuing economic competition between East and West over trading partners and raw materials.

31. World-wide trend toward increased government ownership of the means of production and distribution in most countries.

32. Increasing appearance of transnational companies performing tasks on a global basis.

33. Increasing impact on national economies of non-governmental organizations such as international banks, transnational corporations, and international money markets.

34. Continuation of high population growth rates in most of Asia, Africa, and South America. (See Chapter XI for population projections).

35. Continuing ability of world-wide food resource production to keep pace with population growth to the end of the century.

36. Although domestic sources for a sizable number of minerals will be exhausted before 2000, the situation is not considered critical because of increasing ability to generate or obtain substitutes.

c. Technology

37. Increasing general application of space technology: biomedical and life-support developments, space materials and structures, space-related electronic developments, and systems management skills.

38. Increasing capabilities in satellite and communications technology will make possible: direct satellite television broadcasting; possibility of international time-sharing of computer complexes over high-density data networks; advances in weather forecasting and control, oceanography, navigation and world-wide resource surveys; and increased potential for highly sophisticated surveillance systems.

39. Improvement in computer-assisted information handling capabilities will continue to increase the rate of person-to-person information flow faster than growth in GNP, population, or any other leading indicators.

40. An increasing number of nations will have the capability to participate in the exploration and industrial exploitation of the sea.

41. Gradually increasing capabilities for sub-bottom mining, open sea aquaculture, and deep-water mining toward the end of the century.

42. Increasing world-wide harvest from the sea, although this contribution will not significantly increase world food production by 2000.

43. Increasing capabilities to manage and utilize the ocean depths.

44. Increasing capabilities for self-contained habitat stations under the sea, independent of surface support.

45. Increasing appearance of surface effect vehicles and hydrofoils as ships of the future.

46. Considerable possibility of using laser weapons by the end of the century.

47. Increasing number of nations with the capability of manufacturing nuclear weapons.

In order to obtain a spectrum of scenarios which would be sufficiently divergent to permit development of contrasting implications, the research group assumed world conditions of withdrawal, cooperative interaction, and conflict. The three scenarios are:

a. World-wide Withdrawal: A general world situation in which most countries and particularly the major powers turn attention inward. The withdrawal could result from domestic preoccupations, political disappointments, or ideological decline. Although not necessarily lacking in potential for international conflict, withdrawal will be characterized by a low conflict level as nations turn inward.

b. Cooperative World: A general world situation in which most countries and particularly the major powers increase their interactions in a cooperative manner. The international community will exhibit a considerable degree of consultation and political cooperation, especially among the major powers.

c. <u>Conflictual World</u>: A general world situation in which most countries, the United States included, move toward greater interaction of a competitive nature. The world will be a troubled and perhaps violent place, in great disarray, with conflicts of varying size and style probable. Although no large central war will take place, the specter of one will always loom near at hand.

The scenario spectrum does not include cataclysmic events such as general nuclear war or extraordinary natural disasters since such events cannot be predicted. Barring such disasters, the range of scenarios is sufficiently broad that the real world, as it unfolds, should illustrate a mix of the characteristics of the models, or perhaps a sequential development of approximations of first one and then another of the models.

Each of the scenarios which follows includes a discussion of the evidence which supports the predicated world condition under study and the impacts of the trends of this chapter under those conditions. An examination of the implications of each scenario for the United States and the United States Navy should contribute to a better understanding of the considerations which the Navy must take into account in shaping its course for the long-range future.

CHAPTER III

WORLD-WIDE WITHDRAWAL

This first scenario postulates an international climate in which most nations and particularly the major powers turn their attention inward as a result of preoccupation with growing domestic problems and disappointments with international political involvement. In the United States this is not unusual, for throughout history there has been a tendency toward isolationism following peaks of foreign involvement. As pointed out in Chapter I, current events suggest the plausibility of decreased international involvement.

Before exploring those factors which would support an intensification of withdrawal in the more distant future, there are some preconditions for development of world-wide withdrawal which should be mentioned. Both superpowers and the major powers must all focus their attention inward, withdrawing more or less simultaneously. The United States, for example, could hardly pursue a policy of withdrawal while the Soviet Union followed an expansionist policy, threatening to create a major shift in the power balance. Unless another counterbalancing force were available to fill the void created by a U.S. withdrawal, Soviet expansion would cause a shift to the Conflictual World described in Chapter.V. A relatively stable world for at least the major powers is therefore a precondition for development and continuation of World-wide Withdrawal. With reasonable international stability, a number of factors present in the world today lend support to multinational withdrawal from involvement with other sovereign states.

Many nations currently face domestic problems of increasing severity and complexity. Aided by global communications, a wave of social change is sweeping the world, leading to increased popular demand for participation in the decision-making process, particularly among the young. Among the developed nations, striking success with technological problems of great complexity, such as the moon landings, has led to heightened aspirations for similar progress in the social and political spheres. Decaying central cities, inadequate education and transportation, persistent poverty, rising unemployment with simultaneous inflation, racial inequities, and a troubled youth illustrate the problems which many nations have in common. In the developed nations concern with preserving the environment is calling into question the fundamental, long-standing objective of continued economic growth.

Among the developing nations, internal instability continues to plague governments unable to meet the rising demands of their people for economic progress. As these problems intensify, a concerned public is demanding of its political leaders a reordering of priorities which will divert funds, technology, and national skills and energy away from international involvement in order to concentrate these resources on domestic ills. And yet there are indications that because of resource limitations and the internal inefficiencies of government, even a concentrated effort may not be able to satisfactorily cope with such a wide variety of complex problems, leading to a downward spiral of decline, stagnation, and further withdrawal from international involvement. In recent times we have seen in Great Britain one such example of a great power toppled from the front ranks of the international community by complex internal economic problems stemming from two world wars. Should internal problems of this scope become general among major powers, the diversion of tremendous resources, both human and material, toward their solution would reduce the amount of resources available for military or other expansionist activity, thereby tending to limit interstate conflict.

There are a number of external factors which also would contribute toward a withdrawal from international involvement. Chapter I provided an illustration of withdrawal by the United States under the impetus of disillusionment with international involvement in Vietnam and complex internal factors at home. Similarly disillusioned by their experience in Indochina and Algeria, the French have likewise reassessed their national interests and reduced foreign involvements. Following their recent thrusts into Cuba and the Middle East, the Soviets may also find the long-term economic drain and the increased risk of direct, great-power confrontation to be too costly. Such a reevaluation could conceivably lead to decreased Soviet expansionism in the future. Should the present expressions of political dissatisfaction and the demand for improved standard of living among Soviet citizens intensify, it would complement any disillusionment with international involvement and further reduce the tendency toward foreign adventurousness.

In the developing nations of the world, population growth continues to outdistance economic progress. Present foreign aid programs are minuscule in comparison to the need, and the limited aid made available is often ineffectively administered.

Increased use of synthetics, substitution, and recycling in the future will undoubtedly affect adversely the markets for the raw materials located in the developing nations. These nations lack the capital, technology, and management skills to develop their own raw materials or industry and earn insufficient foreign exchange to create the large markets needed to attract the mass production industries of the developed nations. Having recently thrown off the ties of colonialism, the governments of the Third World frequently resort to intense nationalism as the best available means to offset their inability to meet the rising demands of their people. This nationalism exacerbates their already difficult relations with the developed nations, lending encouragement to mutual disengagement. Popular frustration with lack of progress in the developing nations leads to internal instability which further discourages vitally needed foreign investment.

These economic factors, combined with the problems of continued population growth, could well lead to increasing divergence of interest between the developed and underdeveloped nations and accelerate mutual withdrawal. Although there is potential for conflict in such a situation, it can be argued that the nations of the Third World have so little strength that even in concert they would not pose a significant military threat to world stability beyond that which could be resisted by further withdrawal.

The technological trends outlined in Chapter II indicate that the capability for self-destruction will continue to grow, and as the century wears on, will become more widely distributed. Certainly at the nuclear level of conflict, the cost of war and the risks of destruction have become unacceptable. Although negotiations to reduce these risks are extremely difficult, we have already seen some positive results in the Nuclear Test Ban Treaty and the Treaty Banning Nuclear Weapons from the Seabed. Further progress may be achieved through the Strategic Arms Limitation Talks. There are some indications that the stalemate is gradually extending to lower levels of conventional war as well, even without the benefit of formalized agreement. War as an instrument of national policy is being called into serious question among the community of nations. As this attitude achieves increasing acceptance with the passage of time, unilateral intervention may no longer be considered a viable national option in a crisis.

In international economics, under the pressure of the types of external and internal problems sketched in this scenario, some tendency toward decreased foreign trade would be inevitable. As isolationism grows, protectionism is likely to follow, particularly in the event of serious world or national economic problems, such as an unchecked inflation. As individual nations draw back and continue to pursue economic activities in which they have less comparative advantage, the resulting inefficiencies will cause further economic decline, accelerating the tendency toward further withdrawal and protectionism.

Let us consider some of the possibilities for specific international actors in a scenario of World-wide Withdrawal. The United States and later the Soviet Union, stung by setbacks in their foreign involvements and beset by major domestic problems, will consolidate their interests and turn inward, while attempting to maintain sufficient world stability to permit their withdrawal to continue. Europe will continue its internal economic integration, but external trade relations will become increasingly difficult. Complete political integration of Europe seems less likely in this scenario than in either of the others. China will feel less threatened once the United States and the Soviet Union begin to turn inward, and will feel free to concentrate upon her own severe domestic problems, created primarily by the burgeoning Chinese population. China's contacts with the world community will probably increase, particularly with Japan, as the Chinese try to industrialize their agrarian economy. Japan will continue her economic growth, but at a slower rate as a result of popular demand for greater consumption and environmental problems caused by the density of industry and population. As the United States and the Soviet Union withdraw, Japan will inherit increased influence in the Far East and the burdens of economic and political leadership. The Third World will remain largely unchanged, making slow progress economically while undergoing continual internal turmoil and minor regional instability.

In summary, a World-wide Withdrawal will bring a decided decrease in interaction as nations become preoccupied with domestic problems and disillusioned with international political involvement. There will be a high threshold for conflict. Withdrawal will diminish the occasions of interstate conflict, while the severe internal competition for limited funds will diminish national military capabilities. As a result, the threat of a war which would reverse the course of withdrawal will decrease. The economic and technological gap separating the developed and underdeveloped nations will remain wide. As the superpowers withdraw and their relative political influence declines, a greater degree of polycentrism will emerge to replace the bipolar balance of power. What these developments may mean to the United States will be considered in the next section.

THE UNITED STATES IN WORLD-WIDE WITHDRAWAL

The trends outlined in Chapter II will create some profound impacts on society in the United States over the next thirty years, particularly as the pace of change continues to accelerate. Full development of U.S. society in its economic, political, technological and sociological ramifications, including those forces underlying all three scenarios, will be found in the special studies in Volume Two of this report. In this section we will concentrate on those trends which have particular significance for the United States in World-wide Withdrawal, emphasizing those factors which either contribute to the development of withdrawal or those which are substantially modified in a climate of withdrawal.

The economic prospects of the United States are perhaps altered more drastically in this scenario than in either of the others. One of the possible root causes for development of World-wide Withdrawal is unchecked inflation either for the world or within the United States, which would greatly reduce the rate of real economic growth. As the nation's resources are diverted into efforts to alleviate the social problems foreseen in this scenario, one of the first efforts to be reduced will be advanced technology supported by the government, such as space exploration or deep ocean developments. As government support of basic science and research and development declines, the flow of technology into other areas will be reduced. More than half of the productivity increase which has contributed to the steady growth of the GNP in the United States over the years is attributed to innovation and technical change. This implies reduced economic growth as technological advance slows in this scenario. Several other factors likewise will contribute to a reduced rate of economic growth. Environmental damage and many social ills have been attributed to an undue importance being accorded to the goal of economic growth, an attitude which is likely to enjoy greatest support in this scenario. The trend toward increased governmental control or even ownership of the means of production and distribution is also likely to be greatest under the problem-charged atmosphere of this scenario, which may have implications for the efficiency of the economy. The trend toward service industries, which are labor intensive and therefore are less amenable to sustained productivity increase, will further slow economic growth. If one of the internal problems contributing to the U.S. withdrawal is widespread unemployment, this trend could be accelerated by expansion of the services provided by the public sector, primarily for the purpose of increasing employment. Under the influence of these factors, acting in various possible combinations, there is a real prospect of a reduced rate of economic growth for the United States in World-wide Withdrawal.

With the economy growing at a slower rate in real dollars, or perhaps even in a state of decline, the government will find itself with reduced resources as it faces the myriad social and political problems which have contributed toward its withdrawal from the international arena. Certainly urban problems will head the list. Without massive efforts, which in this scenario may prove impossible, the cities will continue as repositories for the bulk of the nation's social ills. Politically, the cities will be more important than ever; by the year 2000, urban areas will represent 80% to 90% of the population and will generate most of the nation's wealth. Race problems and poverty will still be upon us and may be inflamed by the economic conditions of this scenario. New political coalitions of the poor, the Blacks, and other minorities will emerge to elect their own representatives and demand their rights with greater effectiveness. The trend toward action and protest groups will be accelerated by the internal problems of this scenario and growing popular dissatisfaction. The long-term increase in demand for more and more governmental services will hamper the effectiveness of the government in dealing with the basic internal problems which caused withdrawal; resources will simply be inadequate to meet social demands, even those of universally accepted legitimacy. In the early stages of withdrawal, some decentralization of government will probably be tried in an attempt to improve responsiveness and effectiveness. If the problems underlying withdrawal continue unchecked, however, an eventual return to the traditional strong centralized government seen in past times of crisis is likely. The demands placed upon government by the combination of serious problems and reduced resources could prove to be unprecedented in any peaceful period in previous U.S. history.

The social implications of this scenario are many and varied. Although the pace of technological change and attendant social impacts will be slower in World-wide Withdrawal than in either of the others, social impacts of the underlying internal problems will probably more than make up the difference. The social problems created by the long-term trend toward a decline in the work ethic, for example, may be exacerbated by the massive social disruption of widespread unemployment. Although the trend toward rapid job obsolescence will be slowed by the decreased pace of technological change, the reorientation of national effort toward social problems will create a somewhat similar problem for those educated and experienced in basic science, research and development, and advanced technologies as these fall into disfavor. The long-term trend toward increased individuality will also be slowed in this scenario.

The problems facing the nation will undoubtedly give rise in this scenario to larger numbers of divergent, vocal interest groups of greater political strength than will be found in either the Cooperative or Conflictual Worlds. Aided by modern communications, this cacophony of voices making demands of a government hampered by inadequate resources may create serious political and social unrest; the priorities set by the government cannot begin to satisfy all demands in this climate. Popular support for government may suffer initially, although prolonged and deepening crisis would eventually cause the people to turn to stronger government to solve their problems.

In this section we have depicted a United States withdrawn from active international involvement and beset with serious internal problems. Less rapid growth or decline in the economy will decrease the resources at the disposal of government, and the pace of technological change will slow. Domestic concerns will monopolize politics, in response to increased political activism of interest groups. In such a climate, defense interests run counter to the basic internal orientation of the nation and likely will find decreased support. Some of the implications this may have for the Navy are explored in the discussion which follows.

THE U.S. NAVY IN WORLD-WIDE WITHDRAWAL

As the United States turns inward and withdraws from international involvement, ties with NATO and other alliances will be loosened and commitments reduced. Forward deployments and overseas bases will gradually decline in an effort to reduce costs and improve the balance of payments. U.S. allies, feeling less certain of their protection under the U.S. nuclear unbrella, will insist on developing their own nuclear arsenals. The Department of Defense will face great challenges and many hard decisions in such a climate. The nation will look to its military forces to help maintain the world stability necessary to permit continued withdrawal, while the resources provided for this purpose will dwindle under the pressure of economic decline and escalating internal problems. The delicate balance of World-wide Withdrawal can be overturned with little warning by the sudden expansionist tendency of some major power, plunging the United States into a Conflictual World for which its military forces may be ill prepared, following a period of prolonged cutbacks.

In common with the other two scenarios, in World-wide Withdrawal the strategic importance of the sea will increase. Even though some slackening of growth in world trade is envisioned, ships plying critical trade routes will continue to carry large volumes of raw materials and manufactured goods to and from U.S. ports. Routes to Hawaii and Alaska, for example, have assumed even greater importance since these territories achieved statehood.

Because of their relative invulnerability, submarines will provide a much greater share of the national nuclear deterrence in all three scenarios for the future. The enemy submarine likewise will pose the most severe strategic threat; no breakthrough in long-range detection of quiet submarines operating at depth is foreseen. As U.S. forces are returned from overseas in favor of the "Fortress America" concept envisioned for this scenario, the Navy will also provide the first line of defense against potential aggressors. The Navy will thus continue its traditional roles of strategic deterrence, protection of vital sea communications, and interests abroad, and contributing to the flexible response required by the nation in preserving world stability. In this scenario, however, there will be some important differences. Instead of the world-ranging, long-endurance Navy of prior years, revised priorities and reduced resources will force the Navy into a regional orientation, operating primarily from ports in the United States, and relying on speed and mobility for response in crisis. The stability of the Western Hemisphere will have first priority over more remote areas. Foreign internal conflicts will tend to be ignored by a United States burdened with its own problems. Only those conflicts which threaten vital U.S. interests, narrowly defined, or which threaten to spread to several nations and upset world stability will goad the United States into taking action. In many cases, other major nations, similarly burdened and primarily concerned with maintaining the stability essential to continued withdrawal, will cooperate in quelling conflict, or will at minimum not be inclined to interfere with a short-term intervention by others. Small, mobile, high-speed forces will be required for quick insertion and immediate redeployment as soon as stability is restored. The Navy will provide some of this response capability, along with the Air Force, and also will be utilized to mount a "show of force" off troubled coastal states. Requirements for massive troop lifts will be substantially reduced in this scenario. In a troubled world of reduced international contact, surveillance and intelligence will be of great importance, exceeded perhaps only in the Conflictual World. With reduced overseas basing in this scenario, the Navy will probably bear a larger share of this requirement than in the past.

As previously mentioned, resources for defense and the Navy will be greatly reduced, forcing sizable cutbacks in ships, personnel, research and development, and the shore establishment. In a climate of severe internal problems, defense spending will likely be regarded as a drag on the economy and support for the defense establishment will decline, a tendency which will be abetted as the major nations withdraw, decreasing the immediately apparent threat. Of the three worlds developed in this paper, the resources devoted to the national defense and the Navy will probably be least in World-wide Withdrawal. In accommodating to this level of support, the Navy will have to pursue every conceivable economy. The organization of the Navy will have to be streamlined, perhaps by integration of operational and administrative command lines. Unnecessary organizational layers will have to be eliminated. Every self-imposed barrier to use of the diminished force with maximum flexibility will be reevaluated. Forces will of necessity have multiple missions, and hardware must be developed accordingly. Much of the uncertainty will have to be eliminated before commitments to new weapons systems can be made; introduction of new ships and weapons systems into the fleet will take longer as a result, requiring continuation of overage assets. Tight, centralized direction will characterize both management and operational control as the Navy tries to squeeze the maximum from every dollar. Research and development will be reduced in favor of continued operation of existing forces.

Support for the defense establishment may be quite low, especially if defense comes to be popularly regarded as a drain on the economy and an unnecessary one at that, in an atmosphere of low apparent threat. Recruiting and retention of the highly qualified, technically skilled personnel required by the modern Navy are expected to be difficult in all three scenarios, a subject to be explored further in Chapter VI. In World-wide Withdrawal, however, there is some possibility that widespread unemployment in the civilian economy could increase the relative attractiveness of military service. The total numbers required will also be least in this scenario, which would further ease the situation. In view of the long-term trend toward political activism, collective bargaining and unionization of military personnel is a distinct possibility in all three scenarios. The possibility that the nation would call upon the military services and the Navy for an increased social action role, perhaps by training numbers of young men who might otherwise find themselves unemployed and unemployable, is very real under the circumstances of stark need which could materialize in this scenario.

The Navy in World-wide Withdrawal is thus envisioned as continuing its traditional role, but with increased responsibility for strategic nuclear deterrence, great reduction in overall size, and with short-legged, CONUS-based forces, which will rely on speed and mobility to help the United States preserve the world stability required to allow continued concentration on internal problems and reduction of international involvements. This smaller Navy, with aging hardware, would eventually find itself inadequately prepared for rapid transition to the Conflictual World of Chapter V, a not unlikely contingency over which the United States would not have much control.

CHAPTER IV

THE COOPERATIVE WORLD

In marked contrast to the previous scenario, the Cooperative World is characterized by an intensified cooperative interaction among the major states and a gradual lessening of conflict. Although it is doubtful that a global utopia will emerge during this last third of the Twentieth Century, there are a number of powerful forces already in evidence which are likely to help fashion a world which is more interdependent and integrated than at present. This chapter will highlight some of these forces, discuss a number of global problems which impel cooperation, and develop an alternative future in which the center of gravity of human affairs has shifted in the direction of cooperative action among major states and away from the exclusive pursuit of national interests.

The impetus toward global cooperation will be provided by a number of congruent forces. High on the list of global problems which will occupy mankind is the environmental crisis. McHale tells us, for example, that "passage of an air parcel around the earth in mid-latitude requires about one month;

a complete interchange of all circulating air masses between latitudes and hemispheres is calculated to take about two years." (McHale, 1969) Atmospheric pollution by one nation will thus create detrimental effects for many nations widely scattered around the globe. Ocean circulation patterns create similar results from water pollution. Motivated by self-preservation, the common interest in restoration and maintenance of the delicate balance of our earthly biosphere will therefore create an imperative for global cooperation. We have seen in the Nuclear Test Ban Treaty an early example of international statutory recognition of the fact that there is but one ecology.

Similarly, in discussing resources management for the future, another author observed that "the great phenomenon of the Twentieth Century . . . is closure." (Boulding, 1970) Modern technological society exists on a limited base of geological capital which is rapidly being depleted. In order to husband, develop, and equitably distribute what remains, a high order of international cooperation will be required. Since many of the unexploited natural resources lie in the underdeveloped countries, an expanded and smoothly functioning system of world trade, unimpeded by trade barriers, will be a necessity. As trade increases national economies will become increasingly interlocked, causing nations to place a higher and higher premium on continuation of the world stability necessary for continued access to world markets and resources. This economic interdependence will become institutionalized through powerful international financial organizations and transnational corporations, which will be beyond the control of single nations. Flourishing in the cooperative atmosphere, world trade and economic interdependence will become more highly developed in this scenario than in either of the others.

Growth in world trade and the interdependence of economies will gradually help to bridge the gap separating East and West, a process abetted by the tendency toward convergence which characterizes the socio-economic systems of both sides. Western capitalism is already marked by increasing governmental regulation and control of the means of production and distribution and other socialistic trends. Nationalized industry has been common in Europe and Great Britain for years, and is becoming more common in the United States in the form of public corporations, such as the TVA, COMSAT, and now AMTRAK. The Soviets in turn are experimenting with

"Libermanism," greater decentralization of control, and market mechanism ideas in order to improve efficiency and remove some rigidity from the planned economy. Although total convergence is unlikely, narrowing differences in economic philosophy will contribute toward an amelioration of tensions and decreased ideological conflict. In addition to trade and economic matters, the United States and the Soviet Union will find a growing mutuality of other interests: both are high-technology societies, both are maritime powers, both face rising internal and external demands, and both recognize benefits from improved world stability.

Another trend contributing toward international cooperation is the increasing scale of the undertakings required for development of much of our future technology. Even the most powerful nations will find that these developments exceed their individual financial and technical resources. A truly planetary effort will be required to efficiently explore and develop the resources of outer space or the earth's ocean deeps, for example. In this scenario, international cooperation will lead to the successful establishment of an international regime under the United Nations for the exploration and exploitation of the deep seabed, an achievement which is unlikely in the other scenarios. The funds which flow into the United Nations from large-scale development of offshore oil and gas, and ultimately from hard minerals, will provide the means for greater independence of U.N. action. In a similar vein, cooperative development of space and international regulation of communications, transportation, and weather technologies will expand rapidly as these areas develop in importance and complexity. Free exchange of scientific and technological information will develop, contributing to more rapid diffusion of technology. With elimination of duplicative effort and the synergistic effects of rapid exchange of discoveries, the pace of technological change will accelerate, and technology will reach a higher state of development than in either of the other scenarios.

The population problem, which is discussed in detail in Chapter XI, may emerge as the most serious one facing mankind. Unchecked population growth would exacerbate most of the other global problems and could well create famine of unprecedented magnitude. The Cooperative World, however, probably would provide the best prospects for bringing this problem under control. Food distribution problems would be least severe in this scenario, and the Cooperative World also offers the greatest promise of improved food production, development and sharing of improved birth control techniques, and improvements in economic conditions and education. The tools of communications, cybernetics, and modern technology in this scenario will be used to begin the conversion of some of the underdeveloped nations directly into modern industrial states, capitalizing on the knowledge accumulated at great expense in time and resources by the developed nations during the successive stages of the Industrial Revolution. With the benefit of large-scale foreign aid, technical and management assistance, and corporate investment, all motivated as much by an intense interest in developing the natural resources and markets of the Third World as by altruism, the gap between the developed and underdeveloped nations may begin to close in the later stages of the Cooperative World. Even here, however, the most which can be hoped for by the end of the century is a well-established trend toward closure; the gap will still be quite wide. This progress toward closure is peculiar to the Cooperative World. No closure is anticipated in the Conflictual World, and some widening of the gap is likely in World-wide Withdrawal.

Economic progress will contribute toward improved internal stability in the Third World, enabling governments to lay aside their intense nationalism. Some regional federation will take place, further enhancing the economic viability of the Third World and its bargaining power vis-a-vis the developed nations.

One of the most powerful forces impelling us toward a more cooperative world is the continuing increase in the destructiveness of military weapons. There is a growing realization among nations that because of the devastation which can now be wrought, war as we have known it may no longer be considered a rational alternative in the resolution of problems between states. In the future, the nuclear stalemate will gradually extend to lower and lower levels of conventional and limited war, a development which will be particularly encouraged by the conditions of this scenario. Increased destructiveness, improved surveillance capabilities, and the speed of response made possible by advanced technologies will increasingly inhibit covert intervention by the major powers. War will not become obsolete, for even in the Cooperative World internal rebellion will be a continuing problem among developing nations, and occasional regional conflicts are likely. The nature of conflict since World War

II, however, has clearly tended to become more closely controlled and limited in scope. As this trend continues, unilateral intervention will decline in favor among the major nations and diminish in practice under the pressure of strong world opinion. In this scenario, multi-lateral peacekeeping forces will develop under the auspices of regional organizations and the United Nations to replace unilateral intervention by the major powers.

Some limited form of nuclear arms agreement is also likely in the Cooperative World, perhaps more so than in either of the others. The United States and the Soviet Union will achieve the initial agreement, which will probably limit the size and number of delivery vehicles. The authors have concluded that even in the stable atmosphere of the Cooperative World, total nuclear disarmament will not prove possible. So long as the nation-state system with its competing interests persists, nations will feel compelled to protect themselves with an adequate strategic deterrence, either one of their own or through alliances. In later stages of the Cooperative World, the other nuclear powers will join with the United States and the Soviet Union in arms limitation agreements. Within the agreed limitations, periodic qualitative improvements will continue. In the face of these continuing improvements in offensive missiles, anti-ballistic missile systems may well prove unable to achieve significant effectiveness, in which case their deployment will be limited to "thin" systems primarily for the purpose of improving the protection of command and control systems. Nations below the status of super-power will find it too expensive and impractical, in light of the continuing improvements in technology, to develop and maintain a credible nuclear deterrent and will rely instead on the major powers to keep each other in check. In this scenario therefore, the spread of nuclear weapons will be inhibited, not only by technical and cost factors, but also by the co-operative, stable world situation.

The world developed in this scenario implies integration, close coordination, and effective management of human activity on a larger scale than at any time in history. There are two related technologies which are capable of providing the mechanisms needed to make such a development feasible: communications and cybernetics. The explosive growth of these two emerging sciences has already wrought revolutionary changes in society.

In the near future, communications networks employing advanced satellites will be global in scope and real time in responsiveness. These communications systems will provide the basis for progress in the direction of common language, the application of the most advanced technology anywhere in the world, mass education, greater homogeneity, and surely less fighting and more arguing. (Asimov, 1970) Such a system will vastly increase the interactions between people around the globe, knitting them together on a personal rather than national basis, which will help to sustain the integrated Cooperative World.

Cybernetics will provide the means for effective management of the Cooperative World. The potential for both simulation and regulation of complex systems through the use of modern, high speed, large-capacity computer complexes is just beginning to be realized. Central planning and management of economic, ecological, transportation, communications, and meteorological systems, plus many others, will become feasible on a global basis in the near future. Cybernetics will harmonize these increasingly complicated networks of the cooperative global society.

Having examined some of the factors contributing toward cooperative integration of the world and two technological mechanisms which will make such a development possible, we turn to a consideration of the process by which political integration of the world might take place. The nature of man and the nationalistic traditions of governments strongly suggest that the process will be very gradual. Given an extended period of reasonable world stability and diminishing armed conflict, however, the factors enumerated above could lead to the gradual type of integration advocated by the "functionalists." By concentrating on technical and noncontroversial aspects of intergovernmental relations, a growing web of institutional relationships could be created to meet common needs, much in the manner of the specialized agencies of the United Nations. The new international organizations mentioned above in world trade, development of the ocean resources and space, and the regulation of global technologies all illustrate this type of activity. Task-oriented experts and technical specialists in such organizations, with their strong bonds of mutual technical and professional interests, may be able to surmount their national diversities and reach agreements where statesmen would fail. A kind of "federalism by installments," in the words of David Mitrany, then becomes possible. (Haas, 1964)

Herman Kahn, among others, has forecast the development of an extended period of the precise international climate which would permit such a development:

> We feel that the next thirty years will not be marked by as many politically and economically surprising and cataclysmic events . . . . There is a growing consensus that we are entering a period of general political and economic stability as far as the frontiers and economics of most of the old nations are concerned. (Kahn and Weiner, 1967)

Having developed a world of relaxed tensions, diminished armed conflicts between states, and a high degree of cooperative interaction and economic interdependence, we next examine the position of the United States in such a Cooperative World.

THE UNITED STATES IN A COOPERATIVE WORLD

The affluence, individualism, and educational and technological advances forecast for American society in the next several decades are quite consistent with U.S. participation in the Cooperative World. Drawing upon the special studies of Volume Two, this section will highlight implications of a cooperative world for the United States and those aspects of U.S. society which support such a scenario.

As one of the most highly industrialized nations, the United States will find itself heavily involved in the development of the interlocking world economy forecast in the previous section. U.S. industry will compete actively in the international quest for raw material sources, markets for industrial products, and investment opportunities, and many of the transnational corporations which emerge will spring from roots in U.S. firms. Participation in the international consortiums which will be created for exploitation of the ocean's resources, exploration of space, and the development of global technologies will involve the United States both as a nation and as a source of advanced technology and industrial power. The United States will continue as the world leader in large computers, automation, aircraft, ocean and space technology, and other highly advanced technologies.

A cooperative world and an increasingly affluent United States should reinforce one another. The diminished threat to national security and the enhanced international economic opportunities should increase the general affluence of the United States, including the diffusion of goods and services among its citizens. Less money will be spent on defense and more on solving national and international economic and social problems. As the general public enjoys the fruits of affluence and reduced international tensions, public support for international cooperation should increase.

The federal government has successfully obtained public support for the increasing U.S. foreign involvement in the Twentieth Century, especially over the last twenty-five years, because of the increasing awareness by a more educated public of the responsibilities of a world power. Public opinion polls have consistently demonstrated that support for an active U.S. foreign policy is a function of education; the more educated the voter, the greater the probability that he will support an active foreign policy. The level of education within the American populace will continue to rise in the future. The goal of universal post-high school educational opportunities for every able high school graduate will approach full realization. Future administrations will thus be addressing a more knowledgeable and better educated electorate which will be generally willing to support active U.S. involvement in the intensified cooperative international activities of this scenario. On the other hand, such electorates will at the same time be more discriminating and less tolerant of unacknowledged mistakes.

The American public will also become more internationally oriented because of the transportation and communications revolution. Affluence will enable greater numbers of Americans to travel abroad, and satellite communications will expand the capability of television to bring global news into every American living room as it occurs. The public's perception and understanding of problems abroad will therefore be improved.

Other factors impelling the American populace toward support for an active, cooperative foreign policy include the following: the national shift toward broad social goals directed at solving the internal problems of the United States; world economic interdependence; recognition of the universal indivisibility of such problems as pollution, ecology, food production and population control; the increasing destructive potential of war; and increasingly active participation of citizen pressure groups.

The general climate of the Cooperative World will facilitate the ability of the United States to solve its internal problems. The present problems of air pollution, water pollution, radioactivity, urban sprawl, and social tensions can be traced in large measure to the past failures of decision-makers to perceive social costs and take them into account. By the year 2000 a better informed, better educated public will demand that public and private decision-makers examine these "negative externalities" in the course of their economic decisions. Peter Drucker's caveat provides the framework for this force:

> The need is no longer so urgent as to make the gains to be expected from economic advance outweigh every other social consideration. We have already learned to raise the question whether the social price to be paid for the economic achievement is reasonable and justified. (Drucker, 1969)

To some extent recognition of social costs and attacks on social problems will characterize all three scenarios, but the potential for success in this endeavor is greatest in the cooperative scenario. Facing a reduced external threat, the United States can apply a greater share of its resources to such problems, and the cooperative environment will facilitate international solutions to many of the problems which are just as rampant in other countries as they are in the United States.

In a Cooperative World, the United States will be an international activist, providing initiative and leadership in the world community to sustain stability, improve the conditions in the underdeveloped countries, and promote the betterment of mankind. Toward this objective the United States will increase its foreign aid, primarily through multilateral channels such as the United Nations, the World Bank, and other development agencies. In addition to financial assistance, the United States will expand technical assistance programs, providing technical experts in agriculture and industry, management consultants, and educators. Young people from the United States will be offered the opportunity for service abroad under new programs of national service. The popularity of the Peace Corps in its early years illustrates the results which can be obtained.

In the military sphere, thoughtful analysis of the Vietnam experience will result in improved understanding of the limitations of technological superiority in limited war and the employment of presently constituted military force for the solution of socio-political problems. A more realistic assessment of U.S. capabilities will emerge from this process. At the same time, public support for the military establishment will diminish and Congress will slash military force levels, as indicated in Chapter I. The President's ability to employ military forces will also be subject to new Congressional restraints. Following withdrawal from Vietnam, the need for strategic mobility will increase in order to provide a credible U.S. capability to meet its commitments, express and implied, as forward deployments and overseas bases begin to decline. Gradually the basis for this strategic mobility requirement will shift to U.S. support of the multilateral peacekeeping forces. The United States will continue to find it necessary to maintain and periodically upgrade a nuclear strategic deterrence capability, which will gradually come to rely almost exclusively on missiles for delivery. As a percentage of GNP, the defense budget will remain at about current levels for several years, declining toward the end of the century as international stability continues.

This chapter has thus far highlighted briefly some facets of the international scene and the United States which are expected to develop in the Cooperative World. The final section will consider some of the implications which these developments may hold for the U.S. Navy.

THE U.S. NAVY IN A COOPERATIVE WORLD

In the Cooperative World the apparent threat facing the United States will decline considerably. As regional and international peacekeeping forces become effective, strong moral sanctions against unilateral intervention will emerge. The rise of new powers will create popular pressure within the United States for more equitable sharing of the burdens of world security. Within such a climate, reductions in defense spending will appear attractive and the overall U.S. forces will be cut back.

In an expanding United States, thrusting out in many new and sophisticated ways, the role of the Navy within the U.S. military establishment is likely to be of increased importance. Overseas bases will decline to very low levels as a result of the reduced threat and domestic pressures within both the United States and the host nations overseas. In such an environment, the sea will assume increased strategic importance. The Navy will perform its traditional roles--strategic deterrence, power projection, and sea control--albeit with some important differences, and a number of new Navy roles will be added. The Navy envisioned in this scenario will range in size from small to medium-sized;

as such it falls between the very small Navy of the Withdrawal World and the large Navy of the Conflictual World.

Despite the growing international stability and cooperation, total nuclear disarmament will not prove possible, although limited nuclear arms agreements will be achieved and nuclear proliferation will be inhibited. In this scenario, the U.S. nuclear deterrent will shift primarily to submarine launched ballistic missiles for a number of reasons: the advantages of mobility; relative invulnerability to detection and destruction; and remoteness from population centers. In the Cooperative World, it is possible that all nuclear weapons except an agreed number of missiles of specified maximum outer dimensions would be banned under an international agreement verified by an inspection system. In the United States, the agreed number of missiles would be those aboard the Navy's ballistic missile submarines.

The power projection role of the future Navy in this scenario will gradually shift from unilateral to multilateral control. Naval units are ideal national contributions to regional and international peacekeeping forces; as self-contained, reasonably long-endurance units, they simplify the interface problem. The U.S. contribution toward such forces may consist primarily of high-speed naval units, while the less technologically advanced nations, which have abundant manpower, contribute ground forces. International naval peacekeeping forces will be able to respond rapidly to the typical small conflict, put ashore ground forces if necessary, and provide supporting naval gunfire, tactical air strikes, and logistic support. A significant portion of the future Navy in this scenario will thus be under the operational control of regional and international organizations.

In the Cooperative World, the United States will have national and commercial interests in every corner of the world. International trade will be at record levels, U.S. firms will be involved in development of commercial interests in every nation, and U.S. citizens will be abroad in unprecedented numbers as tourists, students, businessmen, and government representatives. Offshore and deep ocean development will actively involve U.S. corporations, reaching a higher level of activity in this scenario than in either of the others. The degree of protection which the United States will provide these far-flung interests will depend on a number of factors: the declining threat and an assessment of the chances of shifting to the Conflictual World; the effectiveness of the multilateral peacekeeping forces in this role; and the degree to which other states cut back their national forces in favor of reliance on multilateral protection. With few overseas bases, the U.S. protection which is provided would undoubtedly be the task of the Navy. The enormity of this task for the small to medium Navy envisioned in this scenario would dictate world-ranging, highly mobile units, and would probably require introduction of large surface effect ships of 50 to 100 knot capability.

A number of new roles for the Navy might emerge in support of U.S. involvement in the Cooperative World: policing and enforcement of licenses issued by the international regime for deep ocean development; enforcement of international agreements in such fields as transportation, fisheries conservation, and control of ocean pollution; deep ocean search and rescue; and the placement and maintenance of underwater navigation aids in the deep ocean. In the stable international environment, it seems highly probable that between periods of conflict increasing nonmilitary use would be made of the large pool of technically skilled manpower represented by the Navy. For a variety of political and humanitarian reasons, an increased role might be assigned to the Navy in disaster relief, rescue, civic action, and medical assistance, both within the United States and in foreign countries. Since most of the international conflicts which would arise will involve the developing countries, this skill in civic action and nation-building would contribute toward effective performance in crisis, while also contributing to the positive image of the United States and the Navy.

In facing these traditional and new requirements, there are a number of factors which will be significant to the future Navy in the Cooperative World. The combination of limited resources and far-flung commitments will make speed and mobility a prime concern in ship design. The general level of conflict will be low, which will encourage development of hardware, doctrine, and tactics for the small local conflict to the exclusion of the capability to deal effectively with a more serious international conflict. The possibility of some catastrophe which would cause a major conflict and a shift to the Conflictual World must not be neglected. Surveillance to support a close and continuous evaluation of the capabilities of other powers would be essential to warn of shifts toward conflict. As overseas bases decline, the Navy role in surveillance is likely to increase to supplement satellites and other means. The future Navy is likely to place greater reliance on submarines, not just for strategic deterrence forces, but also for general purpose forces in order to take advantage of the difficulty in detecting submarines. Satellite surveillance will increase the vulnerability of surface units to detection. In the low-threat environment of this scenario, with movements for the most part unopposed, such monitoring might not pose serious problems, but in the event of shift to the Conflictual World, surface forces could prove unacceptably vulnerable.

Personnel recruitment and retention are likely to be a primary factor in all three of the scenarios. In the Cooperative World, discontinuation of the draft is quite probable, and young men might regard the Navy and military service as "irrelevant" in an atmosphere of low threat, expanding cooperation between nations, and many competing opportunities for humanitarian service. Under such circumstances and with an expanding U.S. economy, the poor and less well educated, for whom the Navy represents opportunities for self-improvement and social mobility, may well constitute the most fertile manpower pool for Navy recruitment.

Certainly the Navy must provide every Navyman with challenging, satisfying assignments; only effective appeal to higher-level individual needs will be successful in competing with the many attractive alternatives in the civilian economy.

A significant portion of deployed naval units in this scenario will be under the operational control of international organizations, which will pose new problems in command and control, logistic support, and administrative organization. Major reorganization will be required to reduce and realign the organizational structure to the new realities. The pace of technological change will be greatest in this scenario, resulting in many more potential weapons systems developments than can possibly be exploited within the limited Navy budget. Reorganization must therefore provide for improved means for technology assessment to insure that those systems selected for development are those which will contribute the most to the Navy and the nation.

The Navy in this scenario will thus be small to medium in size, with increased responsibilities for strategic deterrence, surveillance, and protection of the growing U.S. interests on the seas and around the globe. The Navy will be reasonably modern, world-ranging, and operating much of the time under international control. As the threat decreases, there will be great pressures to reduce the Navy; such reductions must be carefully balanced with the reductions of other nations to avoid being caught ill-prepared by a sudden shift to the Conflictual World, described in the next chapter.

CHAPTER V

THE CONFLICTUAL WORLD

The conflictual model of this chapter reflects a world in which nations and peoples will be interacting and communicating across every institutional and cultural spectrum. In contrast to the cooperative model of Chapter IV, this high level of interaction results in conflict due to the great diversity in levels of economic, political, and sociological development. A root cause of the conflict will be the inability of individual powers to subordinate their national interests to the common good.

The Conflictual World will become increasingly unstable as it transforms into a polycentric model. Instead of two principal nuclear superpowers of the bipolar era, three and perhaps as many as five major powers will assert themselves. Japan, China, and a combination of European powers will develop independent bases of power and independent policies. The polycentric system will enable the developing countries of the Third World to enjoy greater flexibility and independence of action, including the freedom of defying the major powers and playing one off against another.

Conceptually, one can view the polycentric world as sets of major power national interests, which overlap and thereby create possibilities for cooperation or conflict. It is envisioned that the increased frequency with which conflicts occur in this scenario will result primarily from the increased diversity of potential conflicts rather than an overall increase in animosity. Within the polycentric model, the United States and the Soviet Union will wield significantly less influence than at present. Their ability to contain conflict through political influence alone will diminish considerably.

While vestiges of the East-West ideological conflict will linger, the principal thrust of the times will be the strident demands of people everywhere for the benefits and affluence of the modern industrialized state. These demands could increase economic competition among the major powers and among developing countries. Such competition will be a frequent cause of conflict. Among major powers the largest international economic problems will include: the securing of sufficient raw materials to sustain their industries; the race to develop and expand international markets for manufactured goods; and the difficulty associated with protecting their domestic enterprises from the increasingly stiff competition of other industrial states. These problems will increase in scope as the world economy becomes more integrated. Under the influence of the tendency noted above for nations to attach undue importance to their own immediate interests, they may often be unwilling to make the compromises necessary to reach international economic agreements, however mutually beneficial over the longer range. Considerable expansion of world trade will develop in the conflictual environment, but this nationalistic attitude will prevent international trade and the world economy from achieving the same high degree of expansion forecast for the cooperative environment of Chapter IV.

Among the developing countries, major sources of conflict will stem from ethnic and economic nationalism. Plagued by unchecked population growth, the massive social disruption created by the urbanization accompanying industrialization, and the rising expectations of their populations, developing nations will find themselves caught in a crisis of modernization. In a developing country riven by modernizing groups intent on reform and industrialization and the traditionalist groups demanding preservation of their cultural and ethnic heritage, nationalism becomes the only available unifying factor. National leaders will be forced to assert themselves against the major powers in order to avoid being overthrown by their restive populations.

Competition and self-interest will be keen in the relations between the industrialized powers and the developing countries. The major powers will compete among themselves for economic advantages in the Third World. The enlightened developing countries will form regional economic organizations to enhance their bargaining position, playing the major powers against one another. The recent success of the Persian Gulf states vis-à-vis the western oil companies illustrates how future groups of developing countries will drive the hardest bargain possible in an attempt to improve their economic strength and enhance their prestige. Some intensely nationalistic developing countries, however, will not be able to submerge their differences long enough to unite economically with their neighbors.

In the conflictual environment of this scenario, it may very well prove impossible to reach a generally acceptable agreement for the development of the ocean's resources. The prolonged, unsuccessful effort to establish a uniform width for the territorial seas of all nations provides an instructive example of the difficulty of such negotiations and also illustrates how failure to reach agreement may lead to widely varying claims and eventual conflict. Should no agreement be reached on the seabed, the rush to carve up this last unclaimed area of the globe could easily result in serious conflict and perhaps even armed struggles on the pattern of the Colonial Wars. Without cooperative development under international auspices, only a few technologically advanced nations would be in a position to develop their claims, which would contribute to the already strained relations between the developed and underdeveloped nations. Other problems which are likely to contribute to conflict in an environment in which international agreement is difficult or impossible include the following: pollution control, the regulation of transnational corporations, the competition for highly educated and talented individuals (the so-called "brain drain"), food production and distribution problems, and development of the global technologies, such as those discussed in Chapter IV.

The shifting, polycentric balance of power will create some feelings of insecurity among nations in the Conflictual

World, causing more nations to insist on their own nuclear deterrent. Not only will major powers possess substantial nuclear deterrent forces, but small industrialized countries and some of the larger developing nations will obtain limited nuclear arsenals. This nuclear proliferation will substantially alter, if not erode, the major power nuclear balance. Despite some increased uncertainty and the more widespread availability of nuclear weapons, the authors have concluded that nuclear deterrence will successfully inhibit general war between the major powers in the Conflictual World. The polycentric model will, however, reduce some of the constraints against limited war between such countries, particularly as the years continue to pass without a nuclear detonation. The increasing activity and potential for conflict will cause the major powers to build and maintain sizable conventional forces, both as a deterrent vis-à-vis each other and as a credible instrument of power in their relations with the rest of the world. At least three of the major powers--the United States, the Soviet Union, and Japan--will be first-rate maritime powers.

Among the major powers, conventional conflict will be limited generally by objective or by size and type of force.

Two of the major powers, by virtue of unique circumstances, will be able to use their conventional forces in a somewhat more dominating fashion than the others. The central geographical position and the traditionally large land army of the Soviet Union will enable it to dominate the land balance of power between Europe, China and itself. The geographical position, industrial capacity, and ocean tradition of the United States will enable it to dominate the maritime balance between the Soviet Union, Japan, and itself. The interplay between these two triangular power balances will represent the main possibility for escalation from limited conflict to general war.

The potential for conflict in the polycentric world may be illustrated by a hypothetical dispute which breaks out between two developing countries. In this example, Pakistan, using new deep water drilling and production techniques, explores for and discovers oil in the sedimentary basins off her coasts in the Arabian Sea and the Bay of Bengal. Having found oil, she unilaterally proclaims exclusive jurisdiction over the seabed in an area extending 150 miles from her coasts. India, lacking sedimentary basins off her coasts, protests vigorously and insists that all nations have a right to the exploitation of oil in water depths beyond 200 meters. Pakistan is unmoved. India attempts to move a drilling rig into the disputed area in the Arabian Sea, but Pakistan promptly sinks the rig. Feeding on the long-standing ethnic and religious animosity between the two states, the conflict rapidly degenerates into armed clashes. The major powers, greatly alarmed, bring pressure on the two countries, and a thirty-day cease fire is arranged through the United Nations. The cease fire is quickly violated by the Pakistanis within the disputed area in the Arabian Sea. Japan, fearing disruption of her supplies of oil from the Middle East, ninety percent of which comes from the Persian Gulf, moves her fleet into the area in an attempt to intimidate the two belligerents. The Pakistanis perceive the Japanese move as an attempt to protect the investments of Japanese-based transnational corporations in India and the large India-Southeast Asia foodstuff trade carried by the Japanese merchant marine. The Pakistanis' resentment of the Japanese is inflamed by the disclosure of previous negotiations between Japanese oil firms and the Indian government regarding development of offshore oil. Iran supports Pakistan, her Regional Cooperation and

Development partner, by threatening to close the Persian Gulf to Japan until the Japanese fleet is withdrawn. Western Europe and the United States, already deeply concerned, are greatly disturbed by this latest development, since Europe receives fifty percent of its oil from the Persian Gulf and U.S. firms have substantial oil interests in the area. The United States is also concerned that the Soviet Union will try to further its long-standing interest in the Persian Gulf and the Indian Ocean by coming to the aid of Iran. With vital interests such as oil flow and major investment at stake, there is considerable potential in this highly charged atmosphere for an outbreak of armed conflict involving various combinations of the United States, the Soviet Union, Japan, and Western Europe, plus a number of smaller local powers. The possible outcomes of such a confrontation might include successful negotiated settlement; withdrawal by some of the powers; a continuing armed stalemate; or outbreak of hostilities.

The important lesson of this scenario is that because of the polycentric system the emergence of conflict does not automatically divide the world into two conflicting groups. Each major power, possessing its own nuclear deterrent capability, will have considerable flexibility in protecting or even advancing its interests through the use of force. Alignments will shift in each new conflict, as each state evaluates the particular interests which it has at stake.

Conflict between the major powers could just as easily develop as a result of a small power nationalizing the assets of a corporation from one of the major powers. The United States and Japan, for example, acting in concert to compel Iran to release nationalized oil properties, could come into conflict with the Soviet Union if the Soviets perceived an advantage to be gained from supporting Iran. The potential for conflict between the major powers will be greatest in countries such as Iran where the interests of several principal powers interact.

An important contributing factor to maritime conflicts will be the increased mobility and flexibility of naval units. In the Conflictual World, maritime powers will maintain considerable strength deployed in forward areas. When conflict develops, these forces will be rapidly reinforced by units capable of transiting at 100 knots. The breakthrough in mobility could create such severe time compression for decision-making during a crisis that maritime confrontations might escalate beyond the intent of national authorities.

THE UNITED STATES IN A CONFLICTUAL WORLD

Futurists generally agree that the United States in the year 2000 will be more like today than different. The research developed in Volume Two, particularly Chapters VII, VIII, and IX, outlines the directions of U.S. society over the next several decades. Our primary concern in this section is to note those forces and trends which either support or constrain U.S. participation in the Conflictual World.

Chapter IV developed the idea that a better educated U.S. populace in the future would be more willing to support an active foreign policy, a concept equally applicable here despite the shift from the cooperative to the conflictual international environment. Improved communications and increased travel will also make the future citizen better informed on the international issues, which in the Conflictual World will be numerous and complex.

These liberalizing trends could be countered by forces which, while subjectively less desirable, would strengthen the capability of the government to participate actively in a conflictual world. The increasing governmental controls requisite to a post-industrial service state and the increasing potential for governmental encroachment on individual privacy will enhance the capability of the national administration to ignore or even control public opinion. Instant nation-wide visual communications increase the potential effectiveness of governmental efforts to control the news by "interpreting" events so that they contribute toward a particular governmental objective. Increasing numbers of individuals dependent on some form of government largesse in the modern service state could find it more difficult to dissent. Although these observations fly in the face of present trends, such as the increasing activism of highly critical interest groups, the potential for governmental control or influence of public opinion is increasing, a development which is likely to be exploited in the Conflictual World. If the foreign threats of the Conflictual World become sufficiently naked, the American public would not rebel against such increased governmental controls, as was demonstrated in World War II and other times of crisis in the past.

The exponential advance in technology will continue to increase American affluence and advance the capabilities of American industry. Although the disruption and factionalism of the conflictual international climate will restrain technological progress and economic growth from reaching the levels achieved in the Cooperative World, U.S. industry in this scenario will still be operating at high levels and continuing to grow. Without the cooperative development of the previous scenario, however, the Third World will not make as much economic progress and the gap between the industrialized nations such as the United States and the developing nations will remain wide, with progress toward closure improbable. The United States will be actively engaged in foreign trade to provide its growing industry with the raw materials of manufacture and outlets for its finished products. Considerable interlocking of economies will result, and in order to protect its economic interests, the United States will increasingly find itself drawn into the shifting conflicts described in the previous section.

The affluence of Americans, increased travel abroad, and the continuing economic difficulties of the developing countries could well interact in ways inimical to the interests of the United States. It is not difficult to visualize attacks on U.S. embassies and missions, diplomats, various types of government representatives, or servicemen by the inhabitants of some developing country suffering from rising expectations and declining living standards. U.S. citizens could find themselves being used as ploys by insurgents in one of the continual internal rebellions mounted by frustrated radicals attempting to achieve social change by force. The larger numbers of Americans living and travelling abroad and their increasing affluence may contain the seeds of trouble. Increased tension could result in unilateral U.S. interventions to rescue its citizens. Although the United States will continue to exercise restraint when Americans are seized, injured, or killed by powers geographically or politically close to the Soviet Union or China, it will employ unilateral force to rescue Americans from the developing countries. Whereas the United States has been reluctant to act against North Korea or China, it has shown itself to be less inhibited about acting in the Congo, Jordan, or the Dominican Republic.

In the event conflicts arise over the exploration and exploitation of the seabed, the United States is certain to have at minimum an indirect interest. Although the Japanese, the Soviets, the French, and several other nations are showing increased interest, the United States is presently the world leader in ocean technology. U.S. firms are certain to play an active role in any deep ocean development, whether undertaken for the United States or other nations. Diminishing reserves of certain minerals, primarily oil, in economically exploitable deposits on land increase the potential for conflict over the resources of the sea. As conflicts and disputes arise, the United States will inevitably be drawn in; if U.S. national interests are not directly involved, U.S. industrial interests will be, or the conflict may threaten to establish a precedent in international practice which the United States must challenge to protect its own long-range interests.

Although there are forces and trends in American society which enhance the potential for U.S. involvement in the Conflictual World or which may even generate some of the conflict situations, we must acknowledge problems which could divert the American will from an active foreign policy. The nation at present confronts massive problems in the urban crisis, racism, ecology and pollution, poverty, and minority group activism. No guarantee exists that these problems will be solved by the end of the century. More than a few experts predict the presence of urban problems through the year 2000. Large resources will undoubtedly be devoted to attacking these difficulties, which will reduce the funds available for international involvement. What is important for this scenario is to recognize that the nation's internal problems could dwarf foreign policy imperatives, undermine support for active foreign involvement, and drive the nation toward the World-wide Withdrawal of Chapter III. The more successfully the society addresses domestic problems, the easier it will be for the government to generate confidence and support for an active foreign policy in a conflictual world.

This brief discussion has highlighted certain aspects of future U.S. society as they may affect this scenario. The implications for the U.S. Navy of the Conflictual World developed thus far in this chapter will be explored in the section to follow.

THE U.S. NAVY IN A CONFLICTUAL WORLD

The Navy will assume increased importance among the future military services in a conflictual world. The international polycentricity and continuation of some of the trends noted in Chapter I will lead to a loosening of alliances and a decrease in the overseas facilities available to the United States. Since the U.S. will be intimately involved in the conflicts and politics of an interactive conflictual world, it must be prepared to project power in this new environment. Forward deployment will more often be accomplished by deployed units of the Navy rather than by the Army or Air Force. The Navy will project power with its ships, its Navy-Marine team, and its organic aviation. The concern of the national administration will be to deter nuclear war while simultaneously deploying sufficient conventional forces to protect U.S. interests. The validity of the strategic deterrent and the mobility of the conventional forces will be major imperatives of the U.S. defense posture.

Unlike the other scenarios, defense expenditures in the conflict model will steadily increase in the years ahead. As much as 15 percent of the Gross National Product will be appropriated for military use by 2000 without straining the U.S. economy.

In a conflictual world, the Navy will continue three of its present roles--strategic deterrence, projection of power ashore, and sea control--and will assign new importance to the protection of off-shore investments. As in the other two scenarios, the Navy will continue to pursue its corollary mission of intelligence gathering. Because of the increased conflict potential and world-wide deployment, the Navy will be considerably larger than in the other scenarios and will require even greater mobility to meet its deployment demands.

First, and of increasing importance, the Navy will provide a sea-based nuclear deterrence with its submarine launched ballistic missiles. The nation's primary nuclear deterrent force will shift from land-based ICBMs to mobile submarine platforms. The shift to an undersea deterrent will take advantage of the expected difficulties in submarine detection, the mobility of the submarines, and the enemy's difficulties in targeting submarines. In a polycentric world where the strategic threat to the United States could shift from one power to another, the sea-based deterrent force will provide the capability to reposition and concentrate strategic forces to counter changing threats.

The second role of the Navy will be to project power ashore to protect U.S. interests or to localize conflicts between other powers. The conflicts inherent in a world of the type described earlier in this chapter, the world-wide economic interests of the United States, the increasing presence of U.S. citizens around the world, and the need to prevent an unfavorable shift in the balance of power will create situations in which the United States must be prepared to employ its military forces. The Navy's role will be quite substantial because of its capabilities to: (1) deploy elements in forward areas with minimum base support; (2) carry and deploy ground combat troops; and (3) employ organic aviation. Its role is enhanced by the number of areas of interest which lie adjacent to oceans.

Third, the large volume of sea commerce resulting from the advanced state of world economic integration, U.S. need for raw materials, and the increasing size of dangerous or potentially dangerous foreign navies will place heavy demands on the U.S. Navy to protect these lines of communication and accomplish its function of maintaining sea control.

The world-wide offshore investment of U.S. corporations will be substantial, reaching levels exceeded only in the more cooperative environment of Chapter IV. With less international cooperation presumed in this scenario, the Navy must anticipate difficulties and be prepared to protect U.S. interests within the U.S. continental shelf, in disputed ocean areas, and in disputed areas adjacent to foreign shores.

With an increased percentage of the GNP assigned to defense, more funds will be made available for research and development in this scenario. Rising costs of weapons systems, lengthening development lead times, and extended life cycles for weapons systems will complicate the dilemma of determining which areas or projects should be allocated R&D funds. Sizable financial resources will be expended on submarine detection and ABM systems. These areas will receive R&D emphasis because major breakthroughs in either by the United States or a foreign power would significantly affect the strategic nuclear balance. The increase in funds available in a conflictual world would enable some effort to be expended on some of the more esoteric projects described in Chapter XIX, such as laser and anti-matter weapons.

Present trends and the shifting political alignments of this scenario will continue to reduce the number of overseas facilities available, even though the need for such facilities will be greater in this scenario than in the other two. Overseas bases will continue to play a major role in the logistical support of deployed elements of the U.S. Navy. The high potential for conflict in any part of the globe and the advantages of short lines of communications will help to justify forward bases in the face of cost and gold-flow considerations. In the Conflictual World, this need will probably be met at least in part by an afloat basing concept, an approach which would minimize overseas fixed assets and enhance base mobility while meeting the primary need of providing overseas operating facilities. This might be the only viable concept in a situation of changing alliance structures.

Command and control of naval forces in this scenario will become increasingly complex with the increased size of the Navy, increased subsurface activities, greater forward deployment of forces, and increased potential for conflicts. The problems will be compounded by the loss of base rights (e.g., communications stations) in some overseas areas. The time compression resulting from surface ship speeds and the likelihood of conflict will create situations in which the on-scene commander will render the critical decision. Although the trend toward greater centralization of command at the national level will continue, national leaders will have to acknowledge the fact that time compression will not permit them to make the crucial decisions in many situations. New guidance must be developed within which the local commander may act with confidence and effectiveness in rapidly developing situations.

As in the other two scenarios, the personnel picture will be bleak. The manpower available for recruitment will be increasingly better educated but will be the product of an affluent, permissive society. In a conflictual world, the Navy will probably be able to take advantage of draft legislation and a better public image of the military services due to the presence of foreign threats. These advantages will be offset, however, by the much larger personnel requirement. Retention and recruitment will be particularly difficult because of the high wages, reduced working hours, and increased benefits in the civilian environment. The state will increasingly guarantee many of the benefits which today are important military fringe benefits. The personnel dilemma for the Navy will be that its efforts to rely primarily on draft inducement by not competing effectively against civilian employment will be counter-productive if the real world moves from conflict to another scenario.

This concludes the development of the three scenarios of World-wide Withdrawal, the Cooperative World, and the Conflictual World, each of which has implications of its own for the future Navy. Some of the more important implications, particularly those which are common to two or even three of the scenarios, will be amplified in the next chapter, which presents the conclusions of the study.

CHAPTER VI

IMPLICATIONS FOR THE NAVY OF THE FUTURE

The basic objective of this project has been to forecast the environment within which the Navy will have to operate to the end of the century. The inherent difficulty of this task was eased somewhat by the natural fascination which the year 2000 holds for the growing number of social and physical scientists who are turning to serious examination of the future. In the preceding chapters we have drawn heavily upon this growing body of research in order to briefly sketch the short-range future and three scenarios which attempt to depict the range of alternative futures which the Navy may face by the year 2000. ... this chapter we will discuss the implications for the Navy of the differing world and national conditions which have been projected.

For the short range, the next three or four years are expected to produce deepening rivalry with the Soviet Union. A period of maximum danger is anticipated in the mid-1970's. As pointed out in Chapter I, our ability to survive this period of danger depends upon our ability to maintain a high state of readiness and to maximize resources devoted to the operating forces. Toward this end research and development must be given a lower priority until the danger point of the mid-seventies is passed. The Soviets are expected to continue their growing expansionist activity in nations around the globe, while continuing their traditional interest in bordering nations. The new dimension of Soviet activity is thus its global maritime character; the U.S. Navy may thus expect increased responsibility in countering the Soviet threat over the next few years. The nature of any conflict or even any serious new threat of conflict during the early seventies could have a fundamental effect upon the character of the U.S. Navy during the last twenty-five years of the century. The Soviet naval build-up in reaction to the Cuban missile crisis and the U.S. reaction to the threat posed by Soviet surface-to-surface and air-to-surface missiles illustrate the point.

In the longer-range future, each of the scenarios has envisioned continuation of the traditional roles of the Navy: strategic deterrence, power projection, and sea control. The discussion which follows will first consider the differing implications for these three traditional roles and then examine some of the potential new roles which the future may bring for the Navy.

All three scenarios forecast a relatively larger role for the Navy in providing strategic nuclear deterrence. Based on the research of the futurists surveyed in this study, the authors have predicated that there will be no general war, either nuclear or conventional, in any of the three scenarios. Some limitation of nuclear arms is likely, although a prolonged Conflictual World could inhibit such agreements, but even under the favorable conditions of the Cooperative World, complete nuclear disarmament is not considered likely by the end of the century. The degree of nuclear proliferation is expected to vary depending on the world conditions which materialize--both World-wide Withdrawal and the Conflictual World would tend to cause nations to develop their own nuclear forces, while proliferation would be somewhat inhibited in the Cooperative World. To counter these nuclear threats the United States will thus find it necessary to maintain strategic deterrent forces through the year 2000. An increased proportion of this deterrent will shift to the Navy and the ballistic missile submarine, regardless of which scenario the future world most closely resembles.

The principal advantages of the mobile undersea platform over other types of nuclear forces stem from the strengths of the submarine: relative invulnerability to detection and destruction, and remoteness from population centers when on station. These advantages are expected to continue during the period under study; indeed, in marked contrast to their general optimism regarding technological possibilities, scientists have suggested that nothing is less probable than a breakthrough in tracking quiet submarines operating at depth. In addition to its strategic role, the importance of the submarine in conventional and limited warfare will also increase, based on these same advantages.

The power projection role of the Navy was found to be subject to more variation under differing world conditions than the strategic deterrent role. In the Conflictual World the shifting alliances and multiple, changing threats will require a large Navy, able to project power at locations around the globe, often on a unilateral basis. In Worldwide Withdrawal and the Cooperative World, the requirements are less stringent. Although power projection in the Cooperative World will be global in range, both the level and frequency of conflict will be low, and the response will be primarily multilateral. These factors will tend to decrease the size of the U.S. naval forces required in the Cooperative World. In World-wide Withdrawal, the nature of U.S. response will be considerably modified from that of the recent past. Only those conflicts which seriously threaten the world stability upon which withdrawal depends will incur a U.S. response. U.S. interests will be centered primarily within the Western Hemisphere; it will require a threat to a truly vital interest to involve the United States further afield. Responses are more likely to be unilateral. In such a climate, the Navy will provide a principal means of power projection. Naval forces available for this purpose, because of severe competition for resources in a United States beset with internal problems, will be limited in number and designed for regional operations primarily from U.S. ports.

Sea control, the third traditional naval role, is perhaps less affected than power projection by variations in world conditions. Although there were differences in degree, world trade was found to increase substantially in all three scenarios. A highly industrialized nation such as the United States will require access to both resources and markets around the world, even under conditions similar to World-wide

Withdrawal, and most of this increased trade will continue to move by sea. Toward the end of the century, there will also be substantially increased U.S. commercial interest in ocean resources. As in the case of world trade, development of ocean resources will be most advanced under the conditions of the Cooperative World, somewhat inhibited by the lack of co-operation in the Conflictual World, and most adversely affected in World-wide Withdrawal. The fundamental long-term trend toward increased world trade and increased commercial development of ocean resources will require sea control forces to insure the integrity of vital sea areas and lines of communication the world over. The foreign threat to these interests will vary with world conditions, being greatest in the Conflictual World, much less in World-wide Withdrawal, and least in the Cooperative World. The exact size and type of forces required for the sea control role will thus be determined by a complex interaction between the development of world trade and deep ocean interests on the one hand and the perceived threat on the other. Because of the critical and direct relationship between overseas lines of communication and the continued economic strength of the nation, however, sea control forces will be of fundamental importance regardless of the world conditions which develop.

Among potential new or newly important roles, Navy responsibility for surveillance and intelligence gathering is expected to increase regardless of the world conditions which develop. Surveillance was found to have increased importance in each of the three scenarios to forewarn of shifts in world conditions and to warn of actual conflict. Intelligence regarding nuclear capabilities of potential enemies will continue to be essential under any foreseeable world conditions to warn of a breakthrough which would significantly alter the nuclear balance of power. The number of overseas bases is expected to decline from present levels regardless of world conditions, a subject to be explored further below. As a result of fewer overseas bases, the Navy will enjoy unique advantages of accessibility to foreign nations from the safety of international waters. The Navy role in intelligence and surveillance is therefore expected to increase relative to the other services. Electronic intelligence gathering of all types, including HFDF, and submarine detection and tracking efforts, will shift increasingly to mobile surface and subsurface platforms. Satellites will play an increasingly important role, augmenting mobile surveillance with long range overhead capabilities.

Other potential new roles for the Navy include service in regional and international peacekeeping forces, enforcement of international agreements for the development and protection of the ocean's resources, deep ocean search and rescue, underwater navigation aids, and policing of international agreements on ocean pollution. Undoubtedly the most challenging of these will be the development of multilateral naval peacekeeping forces, in which the United States would play a critical role. Obviously these new roles would become most significant in a world which most resembles the cooperative scenario, although some would also be found to a lesser extent under other world conditions.

In the Cooperative World and to some extent in World-wide Withdrawal, the Navy will have a larger role in social action. Under the compelling internal problems of World-wide Withdrawal, for example, the Navy might be called upon to conduct training and development programs in the United States to ease civilian unemployment. In the Cooperative World, with its reduced threat and increasing stability, the technological skills of the Navy could be utilized in nation-building and other international developmental and educational programs.

In carrying out its assigned responsibilities, traditional and new, the Navy will face a number of problems in the future. Several of the more important problems will be explored in the discussion which follows, with emphasis on the differing implications of these problems under the range of world and national conditions which has been projected. The difficulties created by shifts in world conditions from one scenario to another will be a recurrent theme throughout this portion of the discussion.

The resources available for national defense will vary widely under different world conditions, perhaps ranging from three percent of GNP in World-wide Withdrawal to a high of fifteen percent in the Conflictual World. In Chapter XIII, it is estimated that by the year 2000, the funds allocated for national defense could range from $50 billion to nearly $500 billion annually. Then as now, however, justifying the funds necessary to meet national defense requirements will present problems. This problem is likely to be most severe in the withdrawal and cooperative worlds. The public and the Congress have a tendency to base defense allocations on an assessment of the intentions of potential or actual enemies, rather than upon an assessment of enemy capabilities. In World-wide Withdrawal, under the pressure of internal problems, this could lead to severe reductions in funds for the Navy, particularly as the withdrawal of other nations made enemy intentions appear increasingly benign. Similarly, the lack of apparent threat in the Cooperative World could lead to drastic cuts. In these circumstances there is real danger that concentration upon an assessment of enemy intent will encourage reductions of U.S. forces to levels at which they are no match for enemy capabilities. This situation could prove highly destabilizing. A sudden shift toward the Conflictual World would then find the United States and the Navy ill-prepared. The Navy must do everything in its power to insure that enemy capabilities are understood and that U.S. naval forces do not get seriously out of balance with potential enemy capabilities. While military manpower can be adjusted rapidly, weapons system development and procurement require such an extended period that any sudden crisis must be met with forces in being. This general problem increases the importance of effective and continuous long-range forecasting. Resources must be programmed on the basis of future rather than present conditions if the Navy is to be effective.

Overseas base rights are expected to decline in the future under any foreseeable world conditions. Under withdrawal, financial problems and the basic internal orientation of the United States would probably eliminate most overseas bases. In the Cooperative World, the low threat would reduce the requirement for overseas bases. In the Conflictual World, although the world-ranging naval operations would greatly increase the requirement for overseas basing, the shifting alliances of the polycentric world would create political pressures for reductions in overseas bases. The trend toward fewer overseas bases will create problems for intelligence gathering, as mentioned above, for communications, and for logistic support. In the face of the greatly increased requirement for overseas support, afloat basing is expected to reach an advanced state of development in the Conflictual World. The lack of overseas bases would pose significant problems in the event of a shift from either World-wide Withdrawal or the Cooperative World to the Conflictual World.

There are several factors which will operate to make changes in the existing Navy organization imperative in the future. Under the current organization, development, procurement, and administration are carried out independently for air, surface, and undersea forces. Organization along the lines of force "types" limits the Navy's effectiveness in a combat environment requiring all three force elements. Communication difficulties among submarines, ships, and aircraft illustrate the point. In a similar manner, the duality of administrative and operational command lines may bear re-examination in the interests of efficiency, economy, and responsiveness.

Future development of technology will present the Navy with a bewildering array of potentially attractive opportunities for research and development. The organizational mechanisms for technology assessment must be improved to insure that projects selected for development will contribute the most to mission performance of the entire Navy. Improved means of technology assessment will become particularly critical in World-wide Withdrawal, in which the severe fund limitations will dictate that much of the uncertainty be eliminated before the decision is made to procure a promising development for fleet use. The future will require a Navy which is highly flexible and responsive; organizational emphasis on mission rather than on type of force will help to achieve those ends.

The command and control of future naval forces will continue to be a significant problem, particularly as time compression becomes more severe with improvements in speed and mobility of forces. The long-term trend toward centralized control will undoubtedly continue regardless of the world conditions which develop. The increased destructiveness of weapons will intensify the desire of those in the highest positions of authority to make sensitive decisions themselves, and improved communications will provide the means of satisfying that desire. Under the predicated condition of no general war, the level of conflict will be sufficiently low even in the Conflictual World that centralized decision-making could be achieved without saturating the decision network.

The one counter-trend is the decrease in time available to render critical decisions. Particularly under the circumstances of the Conflictual World, with its shifting alliances and threats, the on-scene commander may be the only one able to render a decision in time in a rapidly developing situation. This eventuality must be recognized by higher levels of national authority in order that they may provide the commander with advance guidance within which he may effectively act. The tendency for strong central control could create problems in the event of a sudden shift to the Conflictual World after prolonged existence of withdrawal or cooperation; not only would responsibilities have to be realigned, but field commanders would find themselves faced with sensitive political decisions for which they had not been prepared by experience.

Recruitment and retention of naval personnel will continue to present major challenges throughout the entire range of national and world conditions which has been forecast. The smaller navies of the withdrawal and cooperative scenarios would require fewer personnel, but popular support for military service is also likely to be lower in these circumstances because of the reduced threat. Draft legislation would probably be available only to meet the large personnel requirements of the Conflictual World. Although the Navy's manpower will be drawn from a larger pool of eligibles in the future, the trend toward diminishing inclination for military service is expected to continue during the period under study. The political activism characteristic of civilian life will have its military counterpart; demands for impartial adjudication of grievances and collective bargaining will emerge. Whether or not this trend continues to the point of military unions, the attitude that military service to one's country provides its own reward seems destined for further serious decline.

The attractiveness of military service will also be affected by an erosion of relative military benefits. The modern welfare state will provide guaranteed income and subsidize housing and medical care for all its citizens. The security of military service and its traditional fringe benefits will therefore have less appeal. It will be difficult and costly for the Navy to maintain comparability with the increased leisure of civilian employment. This trend could force the Navy to institute the Blue and Gold crew concept for the majority of its vessels. Difficulty in competing with the many attractive opportunities for civilian employment could mean that underprivileged youth, women, and various minority groups seeking upward mobility or opportunities for self-development might become important sources of future Navy manpower. The only counter-trend found throughout the range of conditions examined was the possibility that widespread unemployment in the advanced stages of withdrawal might improve the relative attractiveness of military service.

Earlier retirement in civilian employment and the general youth-orientation of American culture may bring about a younger officer corps and a shorter naval career. By 1990, for example, an officer might achieve flag rank at age 35 and return to civilian life by age 45. Similar acceleration would occur within the enlisted ranks.

. Technical sophistication of the Navy could foster a basic change in the personnel structure. For example, personnel might be classified into the following categories:

a. Officers - highly educated and trained to command and manage naval forces through experience in the development and operation of surface, subsurface, and aviation components of the Navy. Technical complexity will foster a wider variety of career paths and some further specialization among the officer corps.

b. Officer Systems-Engineers - technically trained and frequently retrained to maintain qualifications for supervision of maintenance and operation of complex weapons systems as officer technical specialists.

c. Enlisted Specialists - technically trained to operate or maintain particular equipment within a narrowly defined technical rating. Competition with civilian industry may necessitate payment of these enlisted specialists on the basis of civilian trade scales, abandoning the traditional parity between paygrades in different specialties.

d. Seamen - unskilled personnel moderately paid and volunteering either for a few years or in anticipation of education and training leading to a career as an enlisted specialist or as an officer.

The officer systems-engineers and the enlisted specialists would in many cases have exact civilian counterparts. Since the primary emphasis within these categories is upon technical rather than military skills, the mobility between military and civilian employment for qualified technical personnel is expected to increase. In a military build-up, such as might be required by a shift from withdrawal or co-operative conditions to conflict, skilled experienced personnel could be recruited directly to meet requirements at advanced levels.

This study is regarded as a beginning. In the opinion of the authors, the technique of evaluating the future through a series of scenarios proved useful in assessing the environment within which the future Navy will operate. Through this device the ideas of forward thinking physical and social scientists could be contemplated under varying world and national conditions in order to derive possible implications for the Navy. The deliberately wide focus of this study has precluded in-depth analysis of many important problem areas; a broad study such as this may be used to best advantage to reveal problems which deserve further analysis. From the many possibilities, the authors suggest the following subjects for further investigation:

a. National and Naval Strategy - strategies adapted to the world conditions in the three scenarios, and consistent with the resources which would be available under such circumstances.

b. Personnel Problems - recruitment, retention, increased leisure, the implications of increasing technical complexity, training disadvantaged personnel, personnel motivation and job satisfaction.

c. Naval Organization - simplification to reduce internal rivalry, improve technology assessment, and improve efficiency and responsiveness through mission orientation.

d. Reduced Overseas Bases - afloat command and control, communications, electronic intelligence gathering, and logistic support.

e. Multilateral Naval Peacekeeping Forces - doctrine, hardware, training, and command and control.

f. New or Increased Navy Roles - strategic deterrence, surveillance and intelligence, international operations, social action at home and abroad.

g. Command and Control - increasing centralization, freedom of action by field commanders, time compression for decision-making, organizational implications of tight centralization, and analysis of command and control problems under differing international climates.

h. Hardware - submarine detection, improved surface and subsurface speed, mobility, and flexibility.

There are new research techniques that have evolved in recent years for the purpose of analyzing the future which may prove useful in further studies. These new techniques are included under the general term "forecasting." Since its development during the 1960's, forecasting has grown rapidly and is now approaching the status of a new science. Many forecasting techniques involve manipulation of large amounts of data, sophisticated mathematical procedures, and computer simulation. A brief discussion of some of these new techniques is included in Chapter XIV.

The authors recommend that technological and social forecasting be continued both within the office of the Chief of Naval Operations and at the Naval War College. Within OPNAV, forecasting efforts should concentrate primarily upon technological innovations and developments internal to the national government, the Department of Defense, and the Navy Department. Primary emphasis for the forecasting studies at the Naval War College should be on external societal influences which may precipitate change within the Navy. The Navy is formulated by, drawn from, and reflective of society. It must adjust to the realities of societal change. This objective can be accomplished only through an awareness of trends and continuous adaptation by the Navy. The only alternative is periodic major readjustment, which is inherently more difficult to achieve and also creates unacceptable disruption.

The authors found that participation in this study has produced a basic change in their individual perceptions of the process of societal change and heightened their sensitivity to underlying causal factors. Everyday experiences and events from the daily news are now tested unconsciously by each participant against his personal perception of the long-range future, which is thereby being continuously modified.

This report thus has the disadvantage of being a static representation of what is inherently a dynamic and personal process. The reader of the forecasts in this volume and the supporting studies in Volume Two can, however, bring to bear his own interests and experiences and achieve a unique insight into the Navy's future which is tailored to his own needs. The authors remain firmly convinced of both the need and the usefulness of forecasting studies and will consider themselves amply rewarded if this report makes some small contribution toward stimulation of such efforts within the Navy.

CHAPTER VII

THE INDIVIDUAL AND SOCIETY

by

LCOL Frank A. Hart, U.S.A.

> Within a decade or two it will be generally understood that the main challenge to U.S. society will not turn around the production of goods but around the difficulties and opportunities involved in a world of accelerating changes and ever-widening choices. Change has always been a part of the human condition. What is different now is the pace of change, and the prospect that it will come faster, affecting every part of life, including personal values, morality, and religious, which seem most remote from technology. (Ways, 1964)

1. Introduction

Max Ways' assertion expresses clearly the view of most futurists concerning the challenges which will confront U.S. society. To provide the underlying social basis for the scenarios developed in Volume One, this chapter will explore predicted changes in social forces and institutions. The discussion which follows relates to the American society, but in a more abstract sense it pertains in large measure to any other affluent, post-industrial society of a non-totalitarian nature. The interaction of technology, demography, increasing affluence, and an accelerating rate of societal change drives the forecasts. The analysis in this chapter will indicate how these forces impact on the various aspects of society.

Although the subjects in this chapter will not be drawn together to produce a scenario the reader might well combine them into a more optimistic view of society than is intended. The sum of the predicted forces can appear almost utopian. Actually, several cautions must be advanced. Some of the trends such as increasing individuality and increasing social control are inherently contradictory. It would be foolhardy to predict which would prevail. The social forces leading to a permissive, individualistic society could well generate repressive reactions. Large elements of the U.S. population are uneasy with the present direction of society. They probably will become even more so in the future. This uneasiness with the future and a nostalgia for a perceived past might well combine with some future economic, social, or political crisis to produce a more closely regulated society. Technology will increasingly favor the state's ability to do so. The potential for social controls will be discussed in Section Four of this chapter.

In the arrangement of social forces and phenomena which follows, the reader ought not feel that various subjects are assigned an equality of importance by virtue of their position within the chapter. The organizing arrangement was selected for clarity and is unrelated to any scheme of relative importance of the subjects discussed.

"The Individual and Society" will be covered under the following headings: values and rights; life style of the individual; social regulation; urban problems; and intellectual institutions.

2. Values and Rights

a. Equality. Equality in the United States will become increasingly meaningful as a result of the continued trends toward egalitarianism and meritocracy, the diffusion of goods and services, and the effective democratization of the country. The continued lowering of barriers to educational opportunities and the increasing indifference of business and government to any occupational prerequisites other than education and ability will advance meritocracy and egalitarianism. The New York and California examples of guaranteed college educations for every able high school graduate appear as the wave of the future. The present levels of social services in the fields of medicine, unemployment, minimum income, and retirement are only the forerunner of an increasing diffusion of goods and services throughout society.

Although formal democratization of the United States took place in the last century, it appears that effective democratization is occurring at the present time. The expanding scope and range of education and the wide spectrum of occupational experiences in a technologically sophisticated society are providing the citizenry with a political competence which will manifest itself in increasingly effective challenges to the views and authority of the governing elites. (Knorr, 1970)

The demand of minority groups for equality will escalate. Their sense of being exploited will continue to increase even as the degree of objective exploitation decreases. Racism will remain a major irritant in U.S. society. Increasing black control of major metropolitan areas and the continued presence of the urban problems will fuel black-white antagonisms. (Parsons, 1968)

Tokenism will not satisfy the female demand for equality. The feminist movement will probably gain force as those aspects of the life style of the individual which diminish woman's traditional role gain momentum. (Ginzburg, 1969) Serial careers, temporary marriages, the diminished influence of the family, and population control pressures, will all promote the female cause. (Ehrlich, 1970; Ridley, 1968)

b. Privacy. The degree of privacy available to the individual becomes an increasingly difficult phenomenon to forecast because the impact of the present social forces will be manifested in contradictory ways. Preeminent among the results will be the possibility of major encroachments on individual privacy stemming from increased urban density, technological capabilities, and demands for increased governmental services. In 1967, 70% of the U.S. population lived in urban areas; the percentage is expected to be 85% by 2000. Urban density will increase. The population concentration gains significance when coupled with the technological and information acquisition capabilities of government. Government's capability to monitor the individual will not be inhibited by technological constraints. Surveillance and computer information handling capabilities will continue to expand. Increased urban problems combined with greater demands for governmental services and responsiveness will increase the potential for social regulation. Recent publicity about the government's projected national data bank raised horrified cries from numerous congressmen, but post-industrial service states require such facilities to be responsive. It would be difficult to deny that the rising demand for enlarged and more responsive social services will necessitate more sophisticated statistical and information gathering capabilities. The potential for privacy invasion grows. This privacy invasion is not limited to the actions or files of government alone; numerous non-governmental organizations amass files on large segments of the population. (Bell, 1967)

To some extent the encroachments on individual privacy will be mitigated by the increasingly plural nature of society and by the varieties of choice in career, marriage and leisure. (Toffler, 1970)

c. Individuality. The individual will confront expanding opportunities for individual choice in life-style. A plethora of subcultures will emerge from occupational specializations, recreational opportunities, age differences, and marital status differences. Not only will the spectrum of subcultures be wide but many individuals will probably relate to subcultures in several areas, moving from occupational to recreational to marital ("the world of the formerly married," for example) for their primary societal relationships. Society will continue to breed new specialties of an increasingly refined nature as its technical base increases in complexity. Because of increased leisure, recreational forms will proliferate as well as become increasingly important; subcults will continue to develop around the various recreational activities. (Toffler, 1970)

Individuality will be further enhanced by serial careers, temporary marriages, geographical mobility, and transience of property.

The increasing opportunities for individuality will not be costfree or unimpeded. The costs may be considerable in terms encroachment of individual privacy and in the social controls necessary to implement the services provided the individual. Population increase, knowledge expansion, and technological growth will constrain the individual's ability to exercise free, rational choices concerning his future. Additionally, all but the most exceptional individuals will be constrained by meritocratic trends limiting the range of occupations and degree of affluence available to them. Finally, some individuals will experience psychic difficulties in their efforts to adjust to the increasing changes and choices.

(Bell, 1968)

d. <u>Hedonistic/Sensate Trends</u>. U.S. society will continue to exhibit increasing aspects of a sensate culture comprising broad multifold trends characteristic of the last several centuries of western civilization. The culture exhibits features variously termed secular, humanistic, this-worldly, utilitarian, hedonistic and permissive. Technological advance, affluence, diminished family influence, and increasing individuality will strengthen the hedonistic and permissive aspects of the sensate culture in the next several decades. (Sorokin, 1964; Kahn and Weiner, 1967)

e. <u>Property</u>. Future property will be stamped by the increasing appearance of the economics of impermanence or transience. Durability of goods will diminish. More "buy, use, and throw-away" goods will appear. This phenomenon will result not so much from planned obsolescence as from technological advances. Uncertainty about future needs will result in goods being built for short-term use. All this further increases disposability. (Toffler, 1970)

Man's desire to fulfill temporary needs will lead to another aspect of the economics of transience. Temporary man-thing relationships such as rented cars, rented homes, rented furniture, and rented appliances will spread. Geographical mobility, short-term needs, and modification of man's acquisitive instincts creates this phenomenon. (Hellman, 1970)

3. Life Style of the Individual

a. Serial Careers and Renewed Education. The most significant change in career patterns over the next several decades will probably be a move toward multiple sequential careers for the individual. Specialization will continue to increase the number of occupations as technological innovation reduces the life expectancy of any given job. The result will probably be a tendency in the direction of "serial careers." Rather than programming himself for a career in a particular specialization, man will recognize that he will face a series of careers, perhaps all within the same career trajectory. (Ginzburg, 1969) Career changes will be interspersed with periods of renewed education. This trend will be advanced by the younger generation's diminished concern for security as well as by job specialization and obsolescence. The service state's benefits will continue to erode individual preoccupation with job security. (Bell, 1968; Toffler, 1970)

b. <u>Leisure</u>. Future man will cope with increasing leisure time and facilities. Of course, the U.S. could retain its present work structure and divert its increased productivity to conquer the national social and ecological problems. Such an undertaking appears unlikely; hence the fruits of affluence will probably be spent on leisure.

Leisure opportunities will arise from the interaction of technology and affluence. Automation will continue to replace routine activity in many aspects of business and home life. (Azimov, 1968) More individuals will have larger parts of their time free for non-work activities. The exact work pattern is in doubt but it might follow the present trend of shorter work weeks and longer week-ends. Leisure industries will appear in many forms such as "experiental" industries created to provide pre-programmed experiences. (Bell, 1968; Toffler, 1970)

Increased leisure opportunities will not be an unmixed blessing. Society will be confronted with a crisis in values between the psychic orientation required for work and that required for leisure. The work ethic is oriented to achievement and organization toward some specific end, while leisure becomes increasingly permissive and exploratory. Large segments of the population will probably have some psychological difficulty adjusting themselves to their particular work-leisure balance; some individuals might find it difficult to work. (Mumford, 1968; Chase, 1968)

c. Occupational Aspects of Society. Present evidence strongly suggests continued movement of U.S. society toward a more pure meritocracy. Meritocracy is used in David Reisman's sense as a shorthand definition of an industrial society organized along technocratic lines. A strongly held value of American society has been that positions in society ought to be open to merit and ability without regard to one's social position. Equality of access to educational opportunities will bring this value closer to fruition. The implications of the meritocratic trend, as other aspects of human character are sacrificed to efficiency, are not clear. (Bell, 1968; Parsons, 1968)

American meritocracy will differ from the English and French versions in that it will be diffused by the separate importance of Washington, New York, the several industrial centers, and the geographical separation of the more important universities. This separation will inhibit creation of an all-encompassing national power center in the sense that

London represents England and Paris represents France. (Bell, 1968)

The interplay of technology and automation and a staggering increase in capital equipment will lead to growing demands for service and maintenance personnel. Our present society has been unable to meet such demands. Continued dearths of executives, scientists, and engineers will still exist as science, education and occupations become more specialized. The managerial problems will prove more challenging. (Bell, 1968)

d. Future Role of the Family. The influence of the family will continue to diminish. This result will stem from increasing occupational mobility, crowded living, and reduced parental influence in the socialization of the adolescent. The continued trend toward the nuclear family will be modified by the appearance of a reduced or streamlined form of the nuclear family consisting of only husband and wife. Simultaneously, childbearing will probably be delayed in many families. The streamlined family will result from the impact of increasing numbers of temporary marriages, female commitments to careers, and the impact of population control pressures. Temporary marriage is a term describing the predicted appearance of increased numbers of divorces and separations leading to an initial perception of marriage as a temporary union. This phenomenon will probably become a standard feature of U.S. society. (Cal Tech, 1967)

e. Societal Change. The accelerating rate of societal change will challenge man's capacity for adaptation. This accelerating change is a function of the increase of technology, knowledge, and transience. Technology creates change through its tendency to suggest novel solutions to social, philosophical, and even personal problems. The increasing temporariness or transient nature of man's relationship to other people, things, places, ideas and institutions is derived from the accelerating change. Transience will manifest itself particularly in job, home, and marriage mobility. (Fabun, 1967)

The successful member of future society will be forced to adjust his concept of durational expectancy to the accelerating pace of change. Implicit in this adjustment is a society with severe limitations on individual commitments to values or systems. If one accepts man as a biosystem with a limited capacity for change then an overwhelming of that capacity will probably result in physical or psychological problems. The real unknown concerns the limits of man's ability to adapt and hence the percentage of individuals who will become psychological victims of accelerating change. (Toffler, 1970; Krutch, 1968)

f. Generational Conflict. Society will increasingly contain within itself the seeds for generational conflict. Central to this conflict will be the shift from a gerontocratic-meritocratic society to a more pure meritocracy. The older generations cannot be expected to surrender power willingly. The young will be impatient. It can also be expected that some alienation of the young will take place as they find it difficult to anchor themselves to concepts, ideals or values in such a changing situation. The reduced role of the family and church will remove two factors which have normally constrained alienation. Additionally, parts of the older generations will find it difficult to adjust to the accelerating change. They may resist change, vie for power, or merely cease adapting. (Parsons, 1968)

4. Social Regulation.

Most futurists predict a growing potential for increased social regulation and social controls in the United States. This potential is derived from perceived societal needs, tensions within the society, and the increasing capabilities for social control. Major elements of society will increase their expectations as a result of the impact of continued urbanization, effective democratization, and the communications revolution. Simultaneously, American society will probably become more fragile, with a growing dysjunction between culture and social structure. While society organizes functionally, the culture is becoming more hedonistic, permissive, expressive, and sensate. Possible alienation of the young, generational conflict, and an increasing propensity for ghetto violence will further exacerbate tensions. The increasing demands upon the national society and the rootlessness of so many of its members will add to the need for social controls. (Bell, 1968; Ferkiss, 1969)

The ability of government to create effective social controls will be considerably enhanced by improving technology, especially in the fields of surveillance and information acquisition. More efficient techniques for controlling behavior and modifying personality will be available. New behavior control techniques using pharmacology and neurophysiology add to the potentially dangerous situation. (Cal Tech, 1967) Public acceptance of decreased privacy coupled with the sophisticated information systems available to the centralized governmental bureaucracy further removes barriers to repressive controls. The information needed by even a genuinely democratic government to provide services to a post-industrial population establishes the foundation to support any degree of repression. Restraints on the centralized bureaucracy will continue to decrease. (Bell, 1968)

It must be noted that the predicted society is still an individual society with a wide range of choices available. How meaningful these choices will be becomes a function of the degree and areas of social control.

5. Urban Problems.

The cities will continue to turn into collection points of the nation's social ills while generating a substantial part of the national wealth. Present evidence and trends strongly suggest that the inner cities at the end of the century will continue to be the locus of many of the nation's problems. (Chase, 1968)

The problem is first one of size. Although the national population will increase about 65% by the year 2000, increasing migration and population growth will double the urban population to some 85% of the national total. Present problems in communications, transportation, housing, social services, pollution and minority integration will be magnified by the increased urban density. Solutions will be rendered more difficult by certain results of the urban growth: increasing obsolescence of the metropolitan governmental structure; financial difficulties of the cities; middle class exodus from the cities; and minority control over an increasing number of cities. (Moynihan, 1970; Banfield, 1970)

The race problem will still be present at the end of the century and will be intertwined with the urban problem as more cities come under black control. Increasing ghetto violence and collective action groups will probably be continuing features of inner city life. Drastic changes in the social order and city structure may well be required to check the adverse effect of city life on the black family. Eminent sociologists have reported that it is the social structure of the city and not the act of moving into it that has had such an adverse effect on the black family and hindered its assimilation into society. (Moynihan and Glazer, 1963; Wilson, 1968)

The possibility is quite strong that the inner cities will become more segregated in the next several decades and the affluence gap between them and the suburbs will be greater. Such results will lead to increasing metropolitan dependence on the state and federal governments. The increasing urban ghettoization, financial straits, and ghetto propensity to violence will strain black-white and city-state relationships. (Wilson, 1968)

New concepts will appear to ameliorate aspects of the urban sprawl. The "New Towns" such as Reston, Virginia, are expected to proliferate and offer better ways to organize suburbia. The "New-Town-in-Town," manifested by the rebuilding of downtown Brooklyn, will offer an industrial and service area in the central city surrounded by perimeters of low cost and medium cost housing projects. The housing projects will be within walking distance of the downtown area or extended along mass-transit arteries. Success of this concept in Brooklyn will probably spur its appearance elsewhere. City management will be aided by computer-assisted information systems to enable city leaders to surmount their burgeoning bureaucracies and thus be more responsive to the citizenry. (Wilson, 1968)

The suburban spread will increasingly express itself in the growth of several large megalopolises, e.g., Boston to

Richmond. The solution of problems inherent to any particular megalopolis will challenge existing governmental structures.

Although the national society will possess the skills and resources to revitalize the urban areas, present trends, tensions and efforts offer few grounds for optimism. One has only to look at the lack of success of the urban development schemes of the past decade. Admittedly, some of the more flagrant problems will be recognized, understood and perhaps dealt with, but other aspects of the urban situation will worsen. The cities will be livable but hardly attractive at the end of the century. (Mumford, 1968)

6. Intellectual Institutions.

Intellectual institutions, especially universities and research centers, may well enjoy increasingly important roles as central innovative institutions in the post-industrial society. This development would follow from a continuation of the trend of the past several decades whereby intellectual institutions displaced older industrial organizations as the innovating forces in American society. The unanswered question of most importance concerns the forms such intellectual institutions will assume in the future. It is an open-ended question of utmost importance. There does appear to be an increasing possibility that universities or intellectual research centers will merge with businesses to provide the thrust needed to tackle the problems of the nation. (Bell, 1968; Nation's Business, 1968)

Social demands and technological needs will continue to push increasing percentages of the college-age population into colleges and universities. Increasing percentages of students will move into post-graduate education. The role of the university will assume additional importance as society structures itself to accommodate the increasing phenomenon of serial careers and re-education. The university will prepare itself to handle educated man through the whole of his productive life.

There will probably be a doubling in the number of prestigious universities and a growth in the state university systems by the end of the century to meet such needs. The distinction between public and private institutions will become increasingly irrelevant because of the growing dependence of the latter on public funds. The relationship of intellectual institutions to the needs of society will generate an increasing lateral movement of academicians between government and the university or research center. (Bell, 1968)

6. Conclusion.

The world in each of the three scenarios in Volume One will be affected by the dominant social trends both in the United States and abroad. The paramount problem in future U.S. society can be viewed as a struggle to meet the challenges of change and to alleviate the present and forthcoming problems generated predominantly by the urban area and by technological advances. The dominant societal strains will most blatantly manifest themselves in the conflict between the rights of the individual and the societal needs for increased social controls and regulation.

CHAPTER VIII

MAN OF THE FUTURE

by

LCDR William H. Poe, U.S.N.

Perhaps the most useful conclusion to be reached about biological man in the year 2000 is that he will not be appreciably different in most respects from man of the 1970's. Ernst Mayr points out clearly that the mechanism of genetic change works slowly and its effects are measured in generations. As a result, for periods of less than several hundred years, we may safely neglect the impact of genetic change on biological man. (Mayr, 1967) In spite of this inherent constraint in the natural processes, some have suggested that the effective time required for genetic change in man will be drastically compressed by artificial techniques and devices. Francis H. C. Crick has given pause to such speculation with the following reply:

> Are we likely to be able to perform astonishing feats of genetic engineering, altering genes at will and correcting hereditary defects by ingenious chemical and biological methods? This may well be possible in the distant future, but so far no likely way of accomplishing such feats is in sight. (Crick, 1969)

Another group of scientists has expressed concern regarding accelerated genetic change as a result of runaway mutation rates caused by high levels of ionizing radiation. More sober consideration of this prospect suggests that if the present level of control of radiation is projected, the genetic mutation rate will be maintained at a level not significantly different from the spontaneous rate of the prenuclear era. (Cember, 1966) It can thus be said that the likelihood of any profound alteration of man's genetic nature is remote through the end of the century.

This is not to assert that the problem is not worthy of attention, since many scientists are already doubtful that a laissez-faire attitude is the wise one and have urged consideration of positive eugenics. (Mayr, 1967; Simpson, 1966) It has been pointed out that natural selection is not really survival of the fittest but instead is a mechanism favoring the genetic characteristics of those organisms that leave the most descendants under existing conditions in any given period. Some social scientists have observed that in high density human populations, conditions seem to favor those who can best endure the worst conditions and slums, i.e., the less intelligent, less provident, and less cooperative individuals. While the long-term implications of these effects are indeed serious, they can be discounted by choosing the year 2000 as our horizon.

Although the possibility of a dramatic change in man's biological nature has been ruled out, it is worthwhile to examine some significant incremental advances which will be achieved in the science of medicine. Matt Clark sets the tone of the future in medicine when he says:

> By the year 2000 the average citizen can expect to live beyond the age of 79 . . . New medicinal compounds deserve much of the credit for this remarkable achievement. (Clark, 1969)

He also mentions certain drugs that will stimulate RNA formation and may have potential as tools for improving memory and perhaps intellect. The Wall Street Journal echoes these predictions and foresees the following specific developments: a ten percent increase in life expectancy, control of sex in offspring, control of senility, conquest of arthritis, eradication of malaria by 1980 (a disease which caused 900,000 deaths in 1965), and by the year 2000 virtual victory over coronary heart disease and many forms of cancer with new anti-cancer vaccines. (The Wall Street Journal Staff, 1967) In the area of mathematical bioscience, future developments will include: storage and retrieval of data on patients, computer diagnosis using pattern recognition or sequential routines, cybernetic control devices for chemotherapy, computer cardiology (analysis of grams), advance prosthetics and orthotics (replacement and enhancement of organs), and computer modeling and simulation of complex physiological processes. (Bellman, 1968) The following rough timetable of medical developments was derived by delphi techniques involving twenty experts in a RAND Corporation study (Fishlock, 1969):

1975	Effective, simple, and inexpensive fertility control. New organs through transplant or prosthesis.
1980	Central storage of medical data. Implanted artificial plastic and electronic organs.
1985	Widely accepted use of non-narcotic drugs for changing the personality.
1990	Primitive artificial life created.
2000 (Post)	Some genetic engineering to control hereditary defects. Biochemical stimulation of regenerative processes. Direct interaction of brain and computer. Chemical control of aging. Drugs to increase intelligence.

Finally, it may be significant that six of the first twenty-five of Kahn and Weiner's predictions for the year 2000 are concerned with biological man. These predictions include:

major reduction in hereditary and congenital defects, extensive use of cyborg techniques, relatively effective appetite and weight control, new improved plants and animals, human hibernation during short periods for medical purposes, and controlled super-effective relaxation and sleep. (Kahn and Weiner, 1967)

At a higher level of biological integration, we may consider the behavioral changes that will characterize future man. Daniel Bell has asserted that the projected increase in longevity will accentuate individual concern with staying young and reinforce hedonistic trends. (Bell, 1967) Kahn concurs in this view when he describes his long-term multifold trend toward an increasingly sensate culture. McHale cites the emergence of cryogenic groups and life extension societies as a manifestation of this same phenomenon. (McHale, 1969)

The population explosion will be one of the most significant behavioral change agents. According to Carl Djerassi, birth control by governmentally imposed methods such as addition of a substance to drinking water will be totally infeasible for some time to come and will not occur soon enough to have impact by the year 2000. (Djerassi, 1970) Although improved birth control procedures such as the once-a-month pill could be developed by the 1980's, it is clear that population control measures for the foreseeable future will still be based on individual action and consent. Karl Deutsch forecasts that this freedom of action will mean very little change:

> I would expect two things not to change before 2000: the reproductive habits of most of the peasant populations of Asia and Africa, and the national habits of most people everywhere. (Deutsch, 1967)

As discussed in Chapter XI, continuation of the present rates of population growth would mean a world population of approximately seven and one-half billion by the year 2000. Fred C. Ikle strikes a cautionary note regarding birth rates:

> If one accepts the premise that living space is finite, one cannot deny that a population policy (either passive or active) that fails to bring birth rates down is a policy that must bring the death rate up again--if not in the short run, then certainly in the long run. (Ikle, 1967)

Desmond Morris makes a convincing case for the dysfunctional results of our phenominal success as a species by describing how overcrowding places great strain on the human pair-bonding instinct and disrupts the basic family unit by saturation of contact and sexual signaling. He urges "massive de-population" as the only sound biological solution to avoid disaster. (Morris, 1967) The same conclusion is reached by Desmond King-Hele when he relates how overcrowding and high population densities lead to violence and create conditions favoring the emergence of new Napoleons and Hitlers. (King-Hele, 1970) In a chapter based on a National Institute of Mental Health study of social pathology in rats under intense population density, Linton postulates the possible breakdown of human society under similar stresses. The prospect of widespread sexual deviation, cannibalism, dissolution of family groups, and high infant mortality may be somewhat fanciful, but there are some alarming symptoms of a social behavioral change already emerging from today's crowded megalopolis. No one is very sure where the human overload point is, and how far away we are from reaching it. (Linton, 1970)

No discussion of human behavior could properly omit the present and future prospects for human behavioral control and personality modification. In an excellent article on the subject, Gardner Quarton lists numerous possible methods and techniques including the following:

a. Modifications of the genetic code

b. Gene selection by controlled mating

c. Nutritional influences through controlled diet

d. Use of hormones of various types

e. Use of drugs (such as psychedelics) to control mood

f. Neurosurgically implanted chemicals and electrodes

g. Other surgical procedures such as gland removal

h. Environmental manipulation

i. Intense monitoring of individuals

j. Mixed methods or combinations of the above (Quarton, 1967)

This rather frightening array of methods represents a very real and constantly growing potential for an unprecedented level of control of human behavior.

Just how this potential will be applied in the future is by no means clear, but ignoring the capability will not make it go away. Quarton visualizes five alternative scenarios for the future use of behavior control as follows:

a. Extensive use justified on a humanitarian basis to postpone death and prevent pain and anxiety.

b. Extensive use justified on the grounds of efficiency to produce, for example, tireless and obedient soldiers.

c. Use of behavioral manipulation by premeditated social inefficiency and bureaucratic slippage.

d. Puritanical avoidance of behavior control.

e. Multiple parallel developments in which different segments of society use the techniques for their own ends.

Which of these scenarios emerges in each society will be determined by socio-political conditions which cannot be accurately predicted. Inevitably, serious civil rights issues will be raised even if the future application of these methods is limited to the obvious fields of mental health and penology.

A subject less fraught with peril but of equally weighty consequence is the matter of human motivation in the years ahead. Much has been written on the topic of the protestant work ethic and its importance in the making of America. Almost everyone agrees that the forces which have driven our society are rapidly changing today, and some think that technological progress is writing the final chapter in the book of economic man. Clearly the motivation of the man of the nineties will not be accomplished with the same mix of incentives that was effective in the fifties. As the fabric of society is altered, and as affluence emerges from the bounty of technology to satisfy physical needs, all large organizations will be forced to consider new concepts of management. Organizational models have progressed from authoritarian through manipulative to collaborative themes, and the end of this evolution is not yet in sight. Alvin Toffler treats this subject in Future Shock and points out that governments too may suffer a breakdown of their decision-making processes.

There are no easy answers to the question of how to organize and manage future man, but the direction has been clearly indicated by Dennis Gabor:

> We cannot stop inventing, because we are riding a tiger. We must now start thinking of social inventions to anesthetize the tiger, so that we can get off its back. (Gabor, 1964)

Space limitations have dictated a brief and highly selective look at Man of the Future. Based on the material presented, the following major conclusions can be identified:

a. No substantial alteration of man's genetic nature is foreseen in the next three decades.

b. Future man will enjoy about a ten percent increase in longevity and will be capable of a more active and healthy life.

c. Some enhancement of man's capabilities is anticipated both through cyborg devices and by means of drugs which may increase memory and learning, affect personality, and regulate or suspend body functions.

d. Future man will be more hedonistic in nature and his society will be a more sensate one.

e. Population pressures, if unchecked, will place enormous stress on individuals and the fabric of society and may cause widespread social disruption, violence, deviant behavior, and internal and external conflict.

f. Increasingly powerful techniques for the control of human behavior and alteration of personality will be developed and perfected. The use made of these methods by states is not predictable, but the capacity does exist and will increase.

g. Changing conditions in American society and growing affluence imply changes in motivational and managerial techniques if organizations are going to continue to effectively utilize their human resources.

The Navy is of course drawn from the larger society and will reflect many of the social changes at work among the general populace. The specific impact on the future U.S. Navy of the major conclusions identified above will include the following:

a. The future Navyman will be recruited from a pool of manpower which is healthier and may have increased personal capability to learn and think.

b. Techniques of behavior control have obvious military application. Potential uses range from administering drugs to submarine crews during extended patrol to achieve mood control to the extreme of total conditioning of men for loyalty to their commander.

c. The future man will require a different set of incentives to recruit him into the service and to elicit a high level of performance from him once he enlists. Increasing affluence will reduce the effectiveness of monetary inducements.

d. Military organizations will of necessity have to adopt newer management techniques in lieu of reliance on authoritarianism. Preserving the required level of discipline for combat situations will be difficult in this atmosphere.

CHAPTER IX

THE UNITED STATES POLITICAL SYSTEM

by

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1. Introduction. Any attempt to look at the future of the world, the United States and the United States Navy requires careful examination of the U.S. political scene. This chapter centers about the opinion of experts in various disciplines who were willing to forecast trends in U.S. politics.

2. Federal Government.

a. Structure. While attempts to institutionalize formal rules for the political game have incurred costly results for scores of nations, the United States, even in the midst of a bewildering amount of social and economic change, has managed to create and preserve one of the most stable sets of formal structures ever known. The United States possesses the oldest written constitution, the oldest continuous two-party system, and the oldest recurrent set of peaceful elections in history. (Sheldon and Moore, 1968) The stability of the U.S. political structure and the short period in the history of the United

States represented by the next thirty years have led Daniel Moynihan to speculate that the near future will see little change. The structure of the executive, legislative, and judicial branches of our government are likely to remain much the same as they are today. (Bell, 1968)

b. Expanding Role of Government. Whether we measure governmental activity by the cost of its services, the extent to which collectively made decisions replace private choices, or the extent to which society's resources are administered by government, one cannot escape the greatly increased significance of government today. It produces more services, engages in more activities, pays greater costs to produce them, administers more resources, and has supplanted or regulated many private market place processes and choices with political processes and choices. (Sheldon and Moore, 1968) The Federal Government now provides a wide range of professional and technical assistance, with many direct subsidies and special tax allowances and concessions to business, finance, industry, transportation, and communication--indeed, to the whole range of free enterprise. What we see emerging is the "Service State"--a government oriented to the enhanced well-being of its citizens. The acceptance of citizen welfare as the basic democratic task marks the arrival of the service state; each year sees the enlargement and extension of services furnished directly or financed by the Federal Government and reinforced by state and local agencies. These services embrace health care, improved housing and urban rehabilitation, educational facilities and programs from early childhood into adult years; also included are the improved care and support of the indigent, the handicapped, the impaired, and all others incapable of fending for themselves in our money economy. (Bell, 1968)

c. The Executive. The institution which has benefitted the most from the expanding role of government is the Presidency. The President is chief executive of a strengthened national government and leader of a national political party. "The strong Presidency," Clinton Rossiter has written, "is the product of events that cannot be undone and of forces that continue to roll." (Lazer, 1967; p. 164) How could it be otherwise when it is in the nature of modern politics that foreign policy is no longer "diplomacy" but rather an increasing round of strategic maneuvers in which crucial decisions have to be taken speedily by the executive branch? Because of new patterns of social change, the very need to plan policies rather than lay down laws gives the initiative to the executive. (Gross, 1966)

2. Power Centers. In addition to the increased volume and scope of governmental activity, new power centers are emerging within our society, rivaling if not already overshadowing the historic power centers of American politics such as the traditional economic interests. Peter Drucker identifies the new power centers as: education, the military, and big science. Education, while rapidly becoming the largest single employer in this country and the largest single investor of capital, is not organized at present as a power center. Yet surely the emphasis on the diploma as a condition of employment represents a tremendous social victory for the educator and puts him in a position of social control unmatched by other groups in the history of this country. Current calculations emphasize military strength and educational strength as twin pillars of national strength in the modern. These two power centers will benefit from this new perception of their contribution to national strength and from the continuing commitment of the government to science and technology. (Gross, 1966)

3. U.S. Populace.

a. Generation Shift-Political Shift. In terms of age structure of the population, the United States is not a particularly young country today--compared to developing Latin America, India, or China, where the population explosion triggered by a drastic drop in infant mortality is pushing the average age down to fifteen or so. But compared to its own history and recent experience, the United States has become a very young country indeed, with half the population less than twenty-seven years old. The younger generation is more highly educated than its predecessors and shares experiences and expectations that differ markedly from those underlying our social, political and economic policies. The middle generation (thirty to fifty) by contrast is under-represented today and will remain so for another decade--the result of the lean birth years of the thirties. Thus, power and position will likely pass from people now reaching retirement age to others for whom the Depression is at best a dim childhood memory and to an even younger group for whom World War II is something encountered in high school texts.

Even more influential than the chronological age shift described above will be a shift in outlook, perception and formative experience. This new generation of younger Americans considers the "normal" world to be one of long years of international involvement, advanced education, high job security, affluence, intense personal involvement, and the pervasive domination of science and technology. This generation shift will likely create a political shift which is bound to be disorderly. The predicted shifts imply a transition likely to be characterized by vocal dissent, partisanship, political passion, and sudden, sharp election landslides which bury familiar political landmarks. The transition will be neither a time of "consensus" nor a period of political apathy. Foreign affairs will be foremost among the political storm centers in this transition. (Gross, 1966)

b. Voting Environment. The increased educational level of the American people could change the character of American politics and perhaps political campaigns. Candidates will obviously appeal differently to the more educated electors than they would to a group most of which has not progressed beyond grade school. (Winter et al, 1968) Use of the instant referendum could change voting patterns. With computer consoles as commonly available as television sets, it would be feasible to present the electorate with the opportunity to vote directly and immediately on a variety of issues. Not only could citizens be asked to vote electronically, they would be supplied with information by direct library interrogation prior to casting their vote. (Bell, 1968)

4. Urbania versus Suburbia.

The ills of the metropolitan area will remain major undigested problems of the American society. The problem cries for attention most in the core city. Altogether, the core city, the old downtown, is increasingly likely to present yesterday's politics, yesterday's issues, and yesterday's political alignments. The presence of bloc voting is apt to be a major factor causing the core city to look to the past rather than to the future. This tendency will be accelerated by an affluency gap--the position of the core city as the least affluent part of an affluent society. The problems of the core city are best understood by examining the black. He clearly is emerging as an organized and powerful ethnic bloc in the core city. His tendency to act as a bloc in city politics will increase, since the individual black can achieve advancement and access to opportunities only through organized use of his political power. Use of bloc voting and patronage will therefore increase. The same imperative applies to the Puerto Ricans and the Mexican Americans.

In the suburban areas of the metropolis, ethnic blocs are likely to be less important than in the city center. The suburbanite will perceive himself to be characterized by his education--which tends t be advanced--and by his cultural level, rather than by his ethnic origin. He is likely to resent blatant appeals to his origin or questioning of his status in the American community. The role of ethnic or religious blocs is likely to become more complicated in the metropolis, with both appeal and non-appeal to them equally unpredictable. The suburbs, representing the younger generation and the more highly educated and more prosperous members of society, are likely to be concerned with tomorrow's problems, especially the problems of the greater metropolitan area.

Gradually, the two parts of the metropolis, core city and suburb, will continue to develop two diverse facets of metropolitan life. It is therefore conceivable that the array of politically opposed alignments in this country--North and South, town and country, agrarian and industrial society--may increasingly be replaced by opposition between the core city and the suburbs. (Gross, 1966)

5. Action Groups.

The United States has seen the emergence of Blacks, students and other action groups in the role of persistent and passionate protesters. A passionate minority may pursue strategies involving demonstrations, sit-ins, violence, and rioting, as well as the traditionally approved political actions, to attain ends or at least gain attention. These alternatives in political action are not new, but the extent of their use in this country and the methods available are unusual. Student political activity, until recently, has been unexpected and disapproved. Blacks have only recently been able to break the political bonds which restrained them for centuries. The next groups to become politically aroused will probably include Mexican Americans, native Indians, and Puerto Ricans. In the immediate future, the politics of street protest are likely to dominate the visible dimensions of American political life. Less visible--indeed, sometimes totally obscured by the prevailing rhetoric about the "repressive society"--is the gradual progress toward a new democracy increasingly based on participatory pluralism in many areas of life. The long range effect of this transition and its turmoil will be deepen and widen the scope of the democratic process in America (Brzezinski, 1970)

6. Bureaucracy.

One of the impacts the computer will have on government will be the strengthening of the top leadership and a weakening of the bureaucracy. The power of today's bureaucracy largely stems from monopoly of information. The formation of large data-based information-processing systems to support social services would certainly strengthen the policy-maker. He would enhance his power by his decisions concerning the operation of the system and the limitation of the information stored. The data system would also strengthen the power and increase the choices of the people at the bottom of the system who use the employment services. In general, one would expect to see the weakening of the intermediate organization and the increasing presence of a direct relationship between the leader and the led. This result would be a continuation of the pattern that has obtained since Franklin Roosevelt's fireside chats. This trend is furthered by management control methods made possible by the computer. The computer would facilitate strong top leadership in a struggle against the bureaucracy which it theoretically controls but which regularly opposes it. Ithiel Pool stresses the point thatthis hypothesis of his does not mean elimination of middle management but rather a relative reduction of bureaucracy's impact on its organization. (Bell, 1968)

7. Global Village.

Because the entire earth is becoming increasingly integrated through communications into one locus of immediate experience some social scientists articulate the concept of a global village. Increasingly the issues and problems of the world outside project deeply into domestic affairs. The old distinction between domestic affairs and foreign affairs will become increasingly blurred. The perception of the global village may neither make us more internationalistic nor lead us to greater willingness to help others; however, it may enable us to cease viewing the outside world in terms of the Western European value system which has always underlain the American liberal's perception. (Gross, 1960)

8. The Challenge--An Answer.

National reports pinpointing the society's failures, devastating critiques of national shortcomings, and elaborate efforts at social stocktaking reflect a more introspective and deliberately sober national mood than has prevailed for several decades. As a result, there is a more pervasive awareness among the leading sectors of society of the need for a deliberate response to present and predicted problems. Machinery must be established to ensure that the actions of all segments of our society are properly coordinated. In order to anticipate the social effects of technological innovation, a series of national and local councils could be established and tasked to evaluate both the operational effects of the new technologies and their cultural and psychological effects. These units would provide the cross-institutional cooperation so urgently needed among national and local government, academia, and the business community.

In the political sphere the increased flow of information and the development of more efficient techniques of coordination will make possible greater devolution of authority and responsibility to the lower levels of government and society. The new communications and computation techniques make possible both increased authority at the lower levels of organization and almost instant national electoral response. The rapid transferral of information, combined with highly advanced analytical methods will render feasible broad national planning, concentrating on national goals and more clearly defining ecological and cultural objectives. Deliberate management of the American future will become more widespread, with the planner eventually displacing the lawyer as the key social legislator and manipulator. This puts a greater emphasis on defining goals, and by the same token, on a more self-conscious preoccupation with social ends. Local, especially metropolitan, government will be strengthened. The devolution of financial responsibility to lower levels of the political system will both attract better talent and increase local participation in local decision-making. National management and local participation would thus be wedded by new systems of coordination. Widening social perspectives of the American business community will increase the involvement of business executives in social problems, thereby merging private and public activity on both the local and national levels. This will generate more effective social applications of the new management techniques, which, unlike bureaucratized governmental procedures, have proved both efficient and responsive to external stimuli. The trend toward the progressive breakdown of sharp distinctions between the political and social spheres, between public and private institutions, will be a major step toward participatory democracy. (Brzezinski, 1970)

CHAPTER X

INTERNATIONAL POLITICS AND WORLD STABILITY

by

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> The substance of international politics is conflict and its adjustment among groups of people who acknowledge no common supreme authority. (Fox and Fox, 1968)

1. Introduction. Consideration of international politics is obviously central to the problem of forecasting the environment to be faced by the Navy in the distant future. Whether or not they are actually brought into play, the military forces of each nation constitute principal determinants in the process of conflict adjustment referred to in the opening quotation. This chapter will discuss current aspects of interest in international politics, the changes in prospect among nations by the year 2000, and the possibilities for world stability. The discussion will highlight a number of the potential threats to international stability which may ultimately require the use of military and naval forces.

2. The Nature of International Politics.

Over the last three centuries, the nation-state system, which emerged in Europe and now encompasses the globe, has been remarkably successful in preserving the independence of states, although at the cost of intermittent war. Once born, both major and minor powers have demonstrated an impressive continuity. Increased potential for destruction has given new urgency to international politics in recent years. Some functional equivalent to large-scale war must be found for maintaining the system.

Other changes have characterized the nation-state system since World War II: the United States and the Soviet Union emerged as principal opponents in a bipolar world; many new nations were formed; the advanced countries became increasingly democratized while their problems simultaneously became more complex; and technology became an extremely important short-run variable in world politics. Although some polycentrism is beginning to develop, basic ideological differences continue to divide the most powerful groupings. The super-powers find it necessary to maintain high levels of peacetime military mobilization and pursue vigorous psychological strategies with as much emphasis on deterring war as on winning it.

Still other changes have affected the "actors" in international politics. With the emergence of many new nations following the break-up of the former colonial empires, fully half of the nations in existence today are of questionable viability, often lacking a "people," effective governmental control, internal stability, or economic strength. New supranational actors have been established, such as NATO, the United Nations, and many U.N. functional organizations. New transnational organizations, such as those in labor and in the scientific and professional fields, have strengthened transnational bonds, although evidence of a decline in primary loyalty to states is thus far limited. Multi-national corporations are developing as a source of new external forces on the behavior of states.

Throughout all these changes, national security continues to be the principal goal of individual nations. The vital security interest of each state is defined by those threats which it would wage war to resist. Threats to vital security interests range from violation of the physical integrity of a nation to indirect, long-range, or contingent threats to its way of life. If ultimate goals such as freedom, welfare, and human dignity are denied, the minimum goal becomes survival of the state as the promoter of the common values characterizing its people's way of life. Since survival cannot be rationally promoted by means which sacrifice values giving meaning to a way of life, the offensive use of nuclear weapons is increasingly regarded as an excluded means.

The potential of nations for achieving their national goals obviously varies widely. Some of the determinants of national power include:

Population. Population totals change slowly, but the skilled population can be changed significantly within a decade.

Science and Technology. Expanding knowledge in basic science and technology provides a force for economic and industrial expansion, and may lead to a scientific breakthrough, giving a nation significant advantage over others.

Gross National Product. Power can be assessed by analysis of the distribution of GNP: portions devoted to consumption, government spending, and investment; and the portions devoted to education, defense industry, and the armed forces.

National Morale and Foreign Assistance. These factors are two indicators of potential effectiveness in mobilizing material resources.

The adequacy of national power can only be determined in relation to a particular purpose, at a given time and place, and against a particular opponent. Although great resources are a prerequisite to super-power status in the missile era, a slender resource base can be entirely adequate to pose a fearful threat. Germany in World War II, the Soviet Union under Stalin, and Communist China and North Vietnam today all illustrate what can be accomplished in this regard by a sacrifice of other human values. Another significant factor for power potential which has become operational in today's environment is the unprecedented capacity of the weaker nations to extract favors from the powerful.

The modes of international action available to nations in attempting to exert their available power include the threat or actual use of military force, diplomacy, and psychological and economic strategies. General war, both nuclear and conventional, has become irrational because of the increased capability to cause unacceptable levels of mutual damage. Military capability is thus increasingly used in a deterrent or retaliatory capacity to compel an international adversary to settle conflicts at a less destructive level of competition. (Fox and Fox, 1968) The efficacy of diplomacy has declined since the Wilsonian emphasis on open diplomacy; actually secret alliances should have been the object of obloquy, rather than private or confidential negotiations. More recently, the communists have shown a tendency to use diplomatic negotiations as a propaganda forum, and the emerging nations are not practiced in the art of compromising in order to reach agreements of mutual advantage. These developments have contributed to decreased reliance on diplomacy. If successful, the Strategic Arms Limitation Talks could reverse this trend and open a new era of confidential negotiation. The final modes, economic and psychological strategies, are certain to play a larger role in the future as the military stalemate gradually extends to conventional as well as nuclear military conflict.

3. Changes in Prospect Among International Actors.

The Soviet Union. In response to internal pressures, some relaxation will likely take place within the U.S.S.R., resulting in greater flexibility, improved efficiency, and reduction in outside criticism. These changes may eventually lead to important political changes, including some form of organized political opposition, although the basic communist orientation would remain. The Sino-Soviet split will probably continue, with the Chinese criticising the Soviets for their revisionist tendencies, their fading confidence in world revolution, and their racism, as a multi-racial nation dominated by whites. The international communist movement is likely to become increasingly fragmented. Soviet and Chinese ideologies will change comparatively slowly. The vanguard of innovative communist thought and the active ideological leadership may well shift to the underdeveloped, politically unstable nations of the Third World.

Communist China. China will be weak in its ability to employ offensive military force in Asia, despite continued success in development of nuclear weapons. The massive Chinese population is more likely to be a weakness than a source of strength. The economic prospects for China are uncertain at best and perhaps may become poor. The economy will have great difficulty in generating surpluses because of burgeoning population. As a result the Chinese leadership will be primarily concerned with internal problems and unlikely to deploy mass armies to Southeast Asia or India in view of the staggering logistic problems such operations would pose. The widely advertised Chinese support of wars of liberation will continue to consist mainly of moral support and limited technical and arms assistance. With regard to the threat of nuclear war, there is no reason to believe that the Chinese leadership will not be as reasonable as that of any other nation, particularly in risking war with either the United States or the Soviet Union. Singapore, Hong Kong, Taiwan, South Korea, Thailand, the Philippines, and Malaysia are all likely to grow more rapidly than Communist China. Japan will continue its rapid growth economically and politically. China will not be allowed to cross important frontiers militarily, with the burden of containment falling upon the United States, the British, Japanese, Indians, Australians, New Zealanders, and possibly the Soviets. China will probably be admitted to the United Nations on a basis allowing continued membership for Taiwan. (Kahn and Weiner, 1967)

. Japan. Japan will emerge as the true leader of Asia, and with the United States and the Soviet Union will help to check Chinese ambitions. With its achievement-minded culture and intense desire for international prestige, Japan will continue to maintain high growth rates through the end of the century. The present reluctance to assume active international leadership will gradually fade and Japan will demonstrate increasing independence, following its own definitions of stability and progress. (Kahn and Weiner, 1967)

Germany. Germany will probably remain divided, with East Germany gradually becoming more viable and permanent. East and West will withdraw some of their troops from the two Germanies, probably by tacit agreement. The mutual German restlessness on the reunification question indicates a serious potential for trouble. The Soviets fear the potential of a united Germany and would undoubtedly react aggressively to counter any moves in that direction. In the Western camp, many authors feel that Western Europe has a more lively fear of an internationally active and independent West Germany than of Soviet aggression. Eastern Europe is likely to gradually gain more economic and political independence of the Soviet Union, although it will remain communist, with the possible exception of Yugoslavia. The Eastern European nations, except for Albania, will continue their active association with the Soviet Union, despite this increasing potential for independence of action. Ties with Western Europe in some economic and cultural areas, however, will be stronger than those with the Soviet Union. (Kahn and

Weiner, 1967).

Afro-Asia. Continued turbulence will characterize many of the emerging nations of Africa and Asia. Afro-Asians are demanding higher living standards and greater participation in political life, while their governments face crushing problems of deficiencies in administrative and technical talent, school shortages, inadequate lines of communication, and lack of a viable industrial base. The most critical need, particularly in Africa, is to put aside their intense nationalism in favor of economic cooperation. The present partitioning of markets cannot survive, and industrial development must take place on a pragmatic, multi-national basis. Capital, technical expertise, and management ability are all badly needed and for the most part are available only from foreign sources, which tends to reinforce the dependence on the developed nations. The OECD has set current per capita growth in income in Africa at one percent; even at growth levels of two percent, which is optimistic, the average per capita income for Africa would only reach $300 by the end of the century. (Africa 69/70) Failure to meet the growing expectations of the Afro-Asians portends continued instability for the area. Ithiel de Sola Pool has forecast that this instability will lead to the outbreak of major war in Africa in the late 1970's, and that large-scale U.N. intervention, followed by a protracted occupation, will be necessary to keep peace. (Bell, 1968; p. 318)

Latin America. Based on relative success in industrialization, a new kind of multi-racial society, successful societal revolution, and an improved ability to handle Americans, substantial progress is being made in Latin America. Much of the continent is becoming capitalistic and technologically oriented, and in contrast to Afro-Asia, most economic problems appear to be solvable or tolerable. Politically, the conditions inhibiting stable parliamentary government persist and violent, illegal changes of government are likely to continue. Complex systems similar to the Mexican government, if widely adopted, may help to maintain reasonable order. Latin America should achieve standards of living comparable to present-day Italy by the end of the century, although marked disparities between rural and urban incomes will persist. (Kahn and Weiner, 1967) Brazil and Mexico will emerge as new intermediate powers on the international scene, possibly assuming a greater role of leadership in the Western Hemisphere, lessening the role of the

United States. (Bell, 1968; p. 92)

4. Threats to the Stability of the International System.

The possibilities for conflict are endless. Theodore Gordon, after pointing out that war has long served a vital function in society as the final instrument for protection of territorial integrity and people, observed that conflict may well prove to be a basic problem of the human condition which will have to await the development of psychology into an exact science. (Gordon, 1965) Robert C. North, among others, believes that as population densities increase, interactions will inevitably intensify, resulting in increased conflict. (Wallia, 1970)

A useful concept in attempting to determine the effect which a particular conflict will have upon the stability of the system is that of the balance of power, considered by many scholars to be inherent in any political process. The world political process is in balance when the resultant of the amount and direction of pressures applied by all of the international actors is zero. Given the norm that no state is to become powerful enough to destroy the balance and overturn the system, states have built alliances and armed themselves to meet serious threats. Major powers are also generally unwilling to see other major powers become greater through absorbing smaller states, perceiving this to be a potential threat to long-term stability. In its classical form, the balance rested upon several major powers, some of whom were willing to intervene or change sides to prevent hegemony of the others. Today the system has been modified to a bipolar form, but the basic concept is still useful. (Fox and Fox, 1968) There are clear indications of increasing polycentricity at the present time. By the year 2000, the major power balance will probably include three to five members, drawn from among the following: the United States, the Soviet Union, Japan, a combination of European nations, and China.

Of the many possible threats to the stability of the system, this chapter will examine briefly five which are considered of major importance: the arms race, the disparities between the developed and the underdeveloped nations, insurgency and rebellion, and the ineffectiveness of institutional mechanisms for conflict resolution.

The Arms Race.

The arms race is frequently pictured as an endless spiral of action and reaction. Once such a competion is initiated, there is no readily apparent, natural stopping point. Such a spiral characterized the nuclear competition between the Soviet Union and the United States. The initial commanding lead of the United States was gradually reduced, resulting in an approximate nuclear parity which has been maintained since the late 1960's. The United States and the Soviet Union have both gradually adopted attitudes of coexistence in a mutual effort to avoid a direct confrontation which could lead to nuclear exchange. If at some point in the future either believed that it had attained overwhelming superiority, an important factor of restraint would be weakened, but it is difficult to imagine either nation gaining this degree of superiority. A reasonably stable nuclear balance is envisioned in the future, with first one nation and then the other attaining marginal superiority. Because of this approximate military parity and the dangers of escalation, the ideological competition between East and West will likely shift to other areas, such as industrial strength, economic growth, space feats, and similar aspects of international image. (Kahn and Weiner, 1967)

With regard to nuclear proliferation, it must be assumed that by the year 2000, a reasonably large number of nations will have nuclear weapons. The Joint Chiefs of Staff have reportedly estimated that there soon will be ten nuclear powers and that by 1975, there may be fifteen or twenty. (Taylor, 1971) Others have forecast that by 1980, as many as fifty nations will have the technological capability of building nuclear weapons. (Brennan in Foreign Policy Association, 1968) Although some disagreement exists, widespread nuclear proliferation, or the "Nth power problem," as it is sometimes called, is generally regarded as increasing the risk of nuclear exchange. Nuclear war might be initiated through inadvertence, escalation, or deliberate international mischief, such as anonymous attack on a superpower by a small nation. (Gordon, 1965) Mutual concern over this problem may lead to cooperative efforts by the United States and the Soviet Union in attempting to halt the spread of nuclear arms. Although some limited agreements may prove possible, there appears to be little chance of general nuclear disarmament by the end of the century.

During the 1960's, while attention was diverted toward the nuclear arms competition, many of the smaller nations also rushed to build up their conventional arms; the means of war are widely distributed, and the potential for armed conflict remains high. (Wallia, 1970) The one bright spot in arms competition is a growing acceptance of the concept of deterrence. As a result of the increased destructiveness of both conventional and nuclear weapons, military power is "conceived as an instrument designed not with the intention of actually using it, but with the intention of preventing antagonistic nations from using it." (Schwarz, 1969) Actual armed intervention "breaks the spell of deterrence," posing severe threats of escalation, and most likely will be used with greater caution by the close of the century, especially in the event of widespread availability of nuclear weapons.

<u>Economic and Developmental Disparities between Nations</u>. Without doubt, the problems of disparity between the developed nations and the so-called Third World will be of vital importance to political stability through the end of the century. In an analysis of this problem, Robert North identified three major considerations: environmental resources, population density, and the level of technology (broadly defined as the organization and application of human knowledge, skill, and tools). Differential rates of population growth in combination with differential rates of technological growth cause grossly unequal access among the

world's people to food, housing, health, education, work, justice, and general control over their environment. This problem is reaching critical proportions in much of Asia and Africa. Over 80 percent of the 500 million increase in population over the last decade occurred in the largely non-white populations of the underdeveloped areas. In two specific examples, China has hardly begun to confront its population problems, and India may be approaching virtually perpetual famine. The potentials for conflict posing serious threats to world stability are obvious, yet efforts to combat the basic ills are miniscule compared to the need. (Wallia, 1970) As Peter Kenen has remarked:

> Trade and aid do not assure development, and development does not assure political stability. It may, in fact, usher gigantic upheaval in the new nations. But failure to provide opportunities for trade, and to furnish much more aid will certainly inhibit growth at the periphery. Stagnation, moreover, will generate frustrations and discontent that can only bring worse sorts of disorder. To strengthen the industrial center and knit together center and periphery may be the most important and difficult tasks to face the United States in the second half of the Twentieth Century. (Kenen, 1967)

The situation in the underdeveloped countries therefore poses something of a dilemma. On the one hand, failure to achieve economic progress will enhance the possibility of conflict with the advanced nations; on the other hand, progress in economic development raises its own threat of internal upheaval. There is a very real possibility of massive social and political disruption in the underdeveloped nations as they industrialize and urbanize with the assistance of foreign aid funds. This possibility provides a strong argument for channelling future U.S. foreign aid through multilateral organizations.

Kahn and Boulding feel that even in concert, the underdeveloped nations do not present a serious threat because they lack the resources for serious military campaigns. Many others, however, indicate that national economies are becoming increasingly interdependent and that long-term economic growth and stability will require free access to the resources and markets of the world, including the underdeveloped nations. Robert McNamara, President of the World Bank, feels quite strongly that failure to redress developmental inequities will indeed pose a serious threat to world stability:

> If the wealthy nations of the world do not do more to close this sundering economic split, which cleaves the abundant northern half of the planet from the hungering southern hemisphere, none of us will ultimately be secure no matter how large our stock of arms. (Peccei, 1969)

Insurgency and Revolution.

The Twentieth Century has experienced the greatest economic, technological, and social change in history. The pace of these changes will continue to accelerate through the end of the century and beyond. Thinking people everywhere, educated and uneducated, are realizing that social change can be wrought by an active minority. Less than a quarter of mankind has been afforded the luxury of bringing about basic changes through the ballot; the remainder must resort to violence or suffer continuation of the status quo. Since World War II, rebellions, uprisings, coups, and insurrections have averaged better than one per month and the rate continues to rise. A world-wide attack on the historical institutions of society appears to be underway and gaining momentum. The communists have frequently taken advantage of these movements, using familiar skills developed in their own revolutions. By providing support for nationalist movements or infiltrating rebel groups, they can avoid charges of external intervention.

The desire for social and political change is widespread among developing countries, yet many governments tend to block change and maintain the status quo. The ability of many governments to meet the rising expectations of their people is severely limited by economic and developmental factors, which will further aggravate the situation. The potential threat to the stability of world politics from insurgency and revolution, employed as a method of achieving basic societal change, will remain high over the next several decades. (Sanger, 1970)

Rise of New Powers.

Economic growth will have tremendous impact on the future course of international politics. Although there is considerable variation in specific estimates of growth rates for individual nations, many economists agree that there are a number of cases where potentially rapid growth may occur. Power in international politics is directly related to economic strength, as noted earlier. Shifts in the economic standings are therefore regarded as a potential threat to stability. On this point Boulding states:

> One of the principal danger points in the international system occurs around what I have called an "overtake date." This is the date at which one nation or perhaps a complex of nations overtakes another in its relative power in the international system. The power of a nation . . . is equal to its GNP multiplied by some coefficient . . . . Hence, when the GNP of one country overtakes that of another defines the central date of a crisis period. (Wallia, 1970)

As has been observed by Robert North, tensions can be generated in several ways among competing nations: tension in a stronger nation being overtaken in some important dimension, tension in a weaker nation overtaking a stronger nation, or tension in a weaker nation as it begins to lose ground after a period of overtaking a stronger nation. A nation may also create tension in others if conditions change and it persists in following a former strategy which is no longer effective. (Wallia, 1970)

There has been some speculation regarding the effect on risk-taking behavior of a weaker nation during the tension of overtaking a stronger. For example, Kahn and Weiner raised the possibility that as the Soviets achieved nuclear parity or nuclear superiority, their attitude toward risk-taking could change from that demonstrated during their long struggle to overtake the United States.

The effect of tensions generated by the rise of new powers will depend heavily on the specific situation. To illustrate, Huntington has forecast that by the year 2000, American power will be in a relative decline, and into the gap will come China on mainland Asia, Indonesia in Southeast Asia, Brazil in Latin America, and powers yet to be identified in Africa and the Middle East. Because of the completely different cultural heritages, Huntington feels that this transition of power will be more stormy than the earlier one in which the United States expanded into the vacuums left by the decline of European influence in Asia, Africa, and Latin America. (Bell, 1968) In another example, Eugene Rostow has forecast that regardless of how international politics turns out, a vast industrial complex will emerge in Asia within the next generation by a pooling of Chinese and Japanese skills, resources and energies. The threat to stability and the risk of war in Rostow's view will turn on the conditions under which the development of China takes place--if China modernizes in an open world community with the United States, the Soviet Union, and Europe taking part, world stability could be enhanced. (Bell, 1968)

As mentioned earlier, there will be several new powers in the major power balance, and new intermediate powers will also emerge: Brazil, Mexico, Pakistan, Indonesia, East Germany, and Egypt. (Bell, 1968) The rise of these new powers is certain to create increased tensions for the international system. Depending on the international climate, these tensions may pose threats to world stability.

Institutional Mechanisms for Conflict Resolution.

The lack of effectiveness of the existing institutional mechanisms for conflict resolution is well known. The United Nations has been unable to act in many instances of superpower disagreement, and with the emergence of many new nations, the General Assembly has become a forum for the small powers. Peacekeeping forces have been difficult to obtain in times of emergency, and financial support for U.N. operations has been a continual cause of crises. Only about one-third of the nations have agreed in principle to accept the jurisdiction of the International Court of Justice, and many of these have made such crippling reservations that the Court is left almost without jurisdiction.

The requirements of a stable world order are reasonably well understood: international institutions empowered to enact the necessary rules, judicial institutions capable of rendering decisions for specific applications of the general rules, and methods for enforcing rules and decisions made. The perplexing problem is to devise politically acceptable means of reaching these goals. Many writers have pointed out that our technical knowledge is more than adequate to solve the world's problems, but that development of political knowledge and institutions has not kept pace. McHale characterizes the situation as follows:

> Our chances of survival are clearly based on our capacity to meet the largest challenge ever offered to man. Technologies and know-how are more than adequate to solve many of our largest problems. What we lack is that combination of vision, understanding, and innovative action that will enable us to use our knowledge more immediately and more effectively. (McHale, 1969)

The concluding section of this chapter will examine the possibilities of improving our institutional mechanisms for conflict resolution through the creation of a world federation and a stable rule of law.

5. World Government and a Rule of Law.

World government has long been an ideal of political man. Although the ideal has never been achieved, it remains a theoretical possibility and continues to attract adherents. The closest approximations to world government have been achieved through attempts at world conquest. In the most successful example, the Romans governed most of the known world before their empire collapsed under the assault of the barbarians from beyond its borders. In more recent times, the initial successes of the Japanese and the Germans in World War II could be called an attempt at world government by conquest. The League of Nations and the United Nations illustrate more peaceful attempts to achieve the same ideal of universal government. This discussion will consider briefly the possibilities for establishment of world government and some of the practical implications which such an eventuality might have for world stability. Since world conquest seems an implausible possibility without resorting to nuclear weapons, the discussion will concentrate upon peaceful attempts at world federation.

The nation-state system, as indicated in the opening quotation, is comprised of sovereign entities which acknowledge no supreme authority and are free to make decisions independently. The concepts of sovereignty and the nation-state system are thus mutually exclusive with the concept of world government. Since establishment of world government depends upon surrender of national sovereignty, the idea of more than 130 independent nations achieving a voluntary world federation by diplomatic agreement is, in the opinion of this writer at least, utopian and implausible.

If world government is to be achieved at all, it must come gradually, so that the surrender of national sovereignty takes place in small, relatively painless increments over a period of many years. This result might be achieved informally through gradual extension of non-controversial interstate relationships along functional lines, or by formal long-term agreements. As an illustration of the latter, the objective of extending the jurisdiction of the International Court of Justice might be achieved by an agreement under which every participating nation would select each year an additional major subject of international law over which it would grant the Court full jurisdiction. Over a period of years, each nation would annually select from the subjects listed those items perceived to hold the least threat, but at the end of a set period, say thirty years, would agree to accept full jurisdiction of the Court in all matters. (Louis B. Sohn in Wallia, 1970) Success in establishing a world government would of course require that similar incremental decreases in national sovereignty occur concurrently across the entire spectrum of international relations. The keystone to world government will be the establishment of an effective method of enforcing the rule of law, which can only mean international peacekeeping forces. The most difficult task of all will be the mutual disarmament of the individual nations, leaving the military power in the hands of the international forces. Achievement of voluntary world government is thus visualized as a slow and difficult process, which will be subject to reversal by the individual nation-state as long as any vestiges of sovereignty have not been surrendered. It should also be pointed out that world government is either universal or non-existent. "Partial world government" is a contradiction in terms which represents only a variation of the traditional concept of the power balance.

If the difficulties of establishing world government can be overcome, what would be the practical implications with regard to conflict and world stability? To some extent world federation defines away the problem--conflict on the nation-state level is ended by the disestablishment of the nation-state system. In actuality, federation may merely change the nature of conflict to civil war. The usual models for world federation are the United States and Switzerland. Both nations illustrate two important political aspects of federation which may be instructive for world government:

a. Prior to creating the federation, both the Swiss and the American people had established a long-standing, fundamental community of interest.

grave potential for abuse.

The ideal of world government thus appears to be difficult of accomplishment and something less than an unalloyed blessing even if it should be attained. Conflict would be likely to continue even in a world federation, in the form of civil wars. In the final analysis, the best hope of world stability may yet lie within the existing nation-state system and an enlightened and flexible application of the concepts of a balance of power.

CHAPTER XI

DEMOGRAPHY AND FOOD RESOURCES

by

LCOL Frank A. Hart, U.S.A.

1. Introduction.

This study includes population as an area of interest because of its roles as a determinant of power and as a problem of global magnitude. Although technology and the specter of overpopulation have lessened the power determinant role, developed countries are still concerned with the quality of their population, and some developing countries continue to seek larger populations to enhance their power. The analysis of population in this chapter is concerned primarily with population in a problem framework and with the demographic characteristics which will affect future society.

An increasing number of scientists, academicians, and political officials point to overpopulation as the preeminent problem for the United States and the international community.[1] These individuals assert a limitation on earth's ability to provide sufficient air, food, and water to its expanding masses. Food resources are highlighted as the critical factor limiting the size of the earth's population. The number of alarmists continues to increase. (Ehrlich and Ehrlich, 1970; Hauser, 1970)

The interaction of population growth and food resource capability does appear critical, although perhaps not catastrophic. The Green Revolution, the agricultural revolution of the 1960s, furnishes confidence that the world can feed its burgeoning population for the coming three decades. This prediction assumes expansion of the Green Revolution and some slowing in the world population growth rate. If the Green Revolution is not fully implemented, if its results are distributed in an uneven fashion, or if the population growth does not begin to slow, then major questions of world-wide stability will arise. The danger exists that a lack of understanding of this new agricultural revolution will generate overconfidence and delay implementation of necessary population control measures. The world food and population problem has not been solved; its predicted grim results have been deferred two to four decades by the Green Revolution, which has provided mankind time to attack the problem.

The following subjects are discussed in this chapter:

population growth and other demographic effects; food resource production; and the implications of the population growth/food production problem. The chapter centers on the interaction between population growth and food resource production.

2. Demography.

a. Population Growth. World population has increased exponentially over the past ten thousand years. Table 11-1 displays world population figures and doubling times. It should be noted that the world population doubling time drastically decreased over the past three centuries. The rate at which population is growing is without precedent, whether we consider the world as a whole or by major regions or continents. Current forecasts indicate that the present population will double in 35-37 years, leading to a population of about seven billion by 2005-2007. Philip Hauser, the noted University of Chicago demographer, reported last fall that the 1963 U.N. population forecast has already been proven too low. Hauser, generally an optimist in the population problem field, forecasts a 2000 world population of 7 to 7½ billion. (Hauser, 1970)

Table 11-2 displays United Nations population estimates by major geographical area for the year 2000. The table

TABLE 11-1

WORLD POPULATION GROWTH AND DOUBLING TIMES

Date	Estimated World Population	Time for Population to Double
8000 B.C.	5 million	
1650 A.D.	500 million	1500 years
1850 A.D.	1,000 million (1 billion)	200 years
1930 A.D.	2,000 million (2 billion)	80 years
1975 A.D.	4,000 million (4 billion)	45 years
	Computed doubling time around 1970	35-37 years

Source: Ehrlich and Ehrlich, 1970, p. 6

TABLE 11-2

PRESENT WORLD POPULATION AND PROJECTIONS TO 2000

Region	1969 Pop. (in millions)	Pctg. incr. by 2000 (high proj.)	Projections (in millions) Low	Med.	High	Constant Fertil.
World Total	3,551	97%	5,449	6,130	6,994	7,522
Developed Regions	1,078	46%	1,293	1,441	1,574	1,580
Underdeveloped Regions	2,473	119%	4,155	4,688	5,420	5,942
East Asia	1,182	38%	1,118	1,287	1,623	1,811
South Asia	809	202%	1,984	2,171	2,444	2,702
Europe	456	24%	491	527	563	570
Soviet Union	241	71%	316	353	403	402
Africa	344	151%	684	768	864	860
Northern America	225	67%	294	354	376	388
Latin America	276	150%	532	638	686	756
Oceania	19	84%	28	32	35	33

Source: Ehrlich and Ehrlich, 1970, p. 43 as reported in 1963 U.N. World Population Prospects.

includes low, medium, and high projections based upon specific forecasts using the best demographic data available. Assumptions concerning fertility, death rates, and migration are included in the forecasts. The final column, "constant fertility, no migration," assumes current trends in fertility and mortality will continue and that no migration will take place. Past experience indicates that demographic forecasts have consistently underestimated population growth. In view of this performance record and Hauser's recent report, it would be reasonable to accept the high projection Table 11-2 as a planning figure. The most important trends to note are that while the developed areas increase 46% by the end of the century, the underdeveloped areas will increase 119% with Latin America, South Asia, and Africa exceeding 150%.

Population growth is usually expressed in terms of the population growth rate, the increase in population per thousand or the percentage of increase. World population growth rate has increase gradually from 3 per 1000 per year in 1650 (0.3%) to 18 per thousand per year (1.8%) for the decade of the 1960s. (Annals, 1967) This increase resulted from three demographic transitions. The decline in death rate in western countries undergoing industrialization occurred first. The second demographic transition was the decline in birth rates in western countries following industrialization. This trend occurred as children became consumers rather than producers, negating the prior economic benefits of large families. A third demographic trend, a decline in death rates in lesser developed countries, began around World War II. The decline was caused primarily by the rapid export of modern drugs and public health services from developed countries and produced the most rapid, widespread demographic change known in the history of population dynamics. Individual lesser-developed-country population growth rates multiplied as death rates fell drastically and high birth rates continued unchecked. (Ehrlich and Ehrlich, 1970; Annals, 1967)

For comparative purposes we must note that the recent death rate decline differs in kind from the long term death rate decline that took place in the western world over a period of almost two centuries. Over a short period of time the lesser developed countries received the impact of all the agents which decrease mortality. In contrast to the western world these agents were imposed from without the lesser developed countries. The social motivation which led to birth rate reduction in the developed countries is not yet present in the LDCs. Hence, birth rates and population growth rates will probably not decrease in the LDCs until national governments impose population control measures. (Freedman, 1964)

b. Population Control Measures. Significant changes in the population control picture have occurred during the past decade. By 1970, 23 developing countries possessed an official family planning policy or program or major governmental involvement and another 11 countries were officially involved in family planning in a minimal way. These countries represent well over half the population of the developing world. In every case except India the action was initiated in the 1960s. Although most programs are too new to expect results, falling birth rates are quite apparent in a few of the more economically progressive countries in East Asia such as Taiwan, South Korea, and Singapore. (Ehrlich and Ehrlich, 1970)

Admittedly, results are mixed. India's program, the oldest (1952) of any developing country, is continuing to encounter extreme social resistance and has enrolled less than one percent of the childbearing population. In South

America and Africa, many sociocultural elements such as marriage, customs, religion, and general value system, contribute to continued high fertility. (Annals, 1967)

Although progress in population control exceeded 1960 expectations, the result is still merely surface scratching. Some countries persist in believing population expansion a requisite to national power and pursue policies to that end. The several countries with significant birth rate reductions and the 34 countries with involvement in population control are insufficient evidence to assume the problem has been brought under control. However, the situation does indicate a growing international recognition of the liabilities of unchecked population growth.

c. Other Demographic Aspects. Increasing urbanization will continue in both developed and lesser developed countries. No meaningful figures can be cited on this trend because of the wide variations in percentages involved and the lack of reliability in developing country projections. In the lesser developed countries, the mechanization or rationalization of agriculture as well as a perception of increased economic opportunities will motivate many rural inhabitants to migrate to the cities. Such a trend can well lead to rising unemployment and increasing social pressures amid the chaotic urban conditions. (Bogue, 1969)

In the lesser developed countries, demographic structures and population median ages will vary considerably in the future. The mortality decrease in these countries will significantly increase the size and percentage of the young in the national populations, creating a young population. Young populations generate burdens and lead to stability problems. This problem will be alleviated only as the young come of productive age and as the birth rate falls. (Annals, 1967; Tomlinson, 1965)

In the developed countries where life expectancy at birth varies from 69 years (Finland) to 74 years (Sweden), individual longevity will increase slightly. Significant changes are expected in many developing countries where present life expectancy at birth is only 25 to 35 years as in Gabon or Guinea or is only in the 40s as in much of South East Asia. Attainable goals are represented by such countries as Taiwan (65 to 70 years), South Korea (55 to 60 years), and Thailand (65 to 70 years) which have achieved respectable life expectancies. The increase in life expectancy will increase the percentage of the population dependent on society. (Ehrlich and Ehrlich, 1970; Annals, 1967)

d. U.S. Population. Table 11-3 displays current parameters and projections for the U.S. population. Other demographic trends indicate that the average U.S. citizen at the end of the century will have a slightly higher median age, be more educated, face a slightly increased life expectancy, and be more apt to live in an urban environment. Population median age declined steadily from 30.2 years in 1950 to 29.2 in 1960 before bottoming at 27.6 in 1970. It should rise to 30.0 years in 1985 as the post-World War II babies age. The percentage of young adults with high school diplomas increased from 38% to 75% from 1940 to 1970 and the percentage with one or more years of college increased from 13% to 38% during the same period. These trends are expected to continue. Life expectancy at birth will increase by several years as medical research attacks the diseases which afflict the middle aged and the elderly. The percentage of the population in urban areas will increase from 70% to 85% by the end of the century. (Annals, 1967; New York Times, 4 Feb 71, p. 1)

On a voluntary basis Americans have decreased the average

TABLE 11-3

UNITED STATES POPULATION PROJECTIONS

Population Estimate-mid 1969 (millions)	203.1
Birth Rate per 1000	17.4
Death Rate per 1000	9.6
Current Rate of Population Growth	1.0%
Doubling Time	70 years
Current Life Expectancy at Birth	71 years
Population Projection to 2000 (medium projection) (millions)	300
Population Projections to 2000 (high projection) (millions)	336

Source: Ehrlich and Ehrlich, p. 332, 1970.

number of children per completed family from six in 1800 to three in 1960 to 2.5 in 1970. Recent polls indicate that this statistic will continue to fall. Zero population growth requires only a slight decrease to 2.11 children per completed family.

3. Food Resources.

a. Introduction. The primary importance of the population problem lies in the assertion that the earth's population, if it has not already done so, is exceeding the ability of the planet to sustain it. Unfortunately, most of the problem's critical dimensions are too intangible to measure. It is only in food resources that we can, with some degree of confidence, compare population to a critical variable to ascertain if life can be supported adequately.

b. Overview. The prominent writers and scientists disagree on the food resource picture for the future. The difficulties in fathoming the problem lie in change, statistical accuracy, interpretation, and definition.

The outward appearance of the world food/population balance changed radically several times in the past two decades. During the 1950s the world community appeared to be solving slowly the problem of raising sufficient food to feed an ever increasing population. By the early 1960s the picture appeared less bright; rates of population growth reached frightening proportions and rates of food production increase gave some evidence of slowing. A partial failure of the South Asia monsoon in 1965-66 and continued poor weather in 1966-67 turned the earlier uneasiness into dark despair; talk of widespread famine in the developing world became commonplace. The outlook changed again in the last three years because of startling developments in the production of wheat, rice, and other grains. (Cochrane, 1969)

Table 11-4 displays indices of total food production which demonstrate the agricultural production increase since the mid-fifties. Food production in the developed countries could have increased more rapidly during 1961-67 as the United States held more than 50 million acres out of production during most of the period. Some of the increase in the LDCs resulted from bringing new land under cultivation, but most of the gain was derived from the modernization of agriculture. The LDC drop in 1965 and 1966 resulted primarily from India's serious droughts in those years. (Cochrane, 1969)

Table 11-5 displays per capita production indices for the 1956-67 time frame. It demonstrates how food production

TABLE 11-4

INDICES OF TOTAL WORLD FOOD PRODUCTION, EXCLUDING COMMUNIST ASIA, 1956-67

(1957-59 EQUALS 100)

Region	1956	1957	1958	1959	1960	1961	1962	1963	1964	1965	1966	1967
World[1]	96	95	102	103	107	108	111	114	118	118	124	128
Developed Countries	96	96	102	102	106	107	110	112	116	117	126	128
Less Developed Countries[1]	94	95	101	103	108	110	112	118	121	120	120	130

1. Excludes Communist Asia

Source: Cochrane, 1969, p. 19; obtained from U.S. Dept. of Agriculture

TABLE 11-5

INDICES OF PER CAPITA WORLD FOOD PRODUCTION, 1956-67, EXCLUDING COMMUNIST ASIA

(1957-59 EQUALS 100)

Region	1956	1957	1958	1959	1960	1961	1962	1963	1964	1965	1966	1967
Less Developed Countries	99	97	101	101	103	102	101	104	104	101	98	104
Developed Countries	98	97	102	101	103	103	105	105	108	107	114	117
The World	100	97	102	101	103	102	103	103	105	103	106	107

Source: Cochrane, 1969, p. 24; obtained from U.S. Dept. of Agriculture

TABLE 11-6

ANNUAL RATES OF GROWTH IN GRAIN PRODUCTION FOR THE LESS DEVELOPED COUNTRIES PROJECTED TO 1980 UNDER ALTERNATIVE ASSUMPTIONS

Country or Region	Historical Trends (percent)	Moderate Improvement in Production (percent)	Rapid Improvement in Production (percent)
India	2.0	2.8	3.8
Pakistan	2.9	3.2	3.9
Other Nonexporting Developing Countries	2.7	3.0	3.9
Grain-Exporting Developing Countries[2]	3.1	3.6	3.6
Total, All Less Developed Countries[1]	2.6	3.1	3.9

1. Excluding Communist Asia
2. Argentina, Mexico, Burma, Cambodia and Thailand
3. Cochrane, p. 22: obtained from U.S. Dept. of Agriculture

matched population increases during the period.

Recent U.S. Department of Agriculture studies produced the food production projections contained in Table 11-6. USDA considers that all three alternatives are projected under realistic sets of conditions. The medium and high projections are sufficient to match population increases.

c. The Green Revolution. The new agricultural revolution, known as the "Green Revolution," represents a breakthrough in research initiated over twenty-five years ago and designed to capitalize on the unique natural advantages of tropical and subtropical areas. The breakthrough was first effected in new wheat and rice strains capable of accepting a variety of growing conditions and of absorbing extensive fertilizer. The new seeds require extensive water; their use has been facilitated by new irrigation techniques. In turn, the new seeds, new irrigation techniques, and extensive use of fertilizer have made possible multiple cropping. The resulting grain yield increase has been as much as 1600% per acre. (Brown, 1970)

Several cautionary comments are in order. The increased use of irrigation means that water, rather than land, could well be the new limiting factor in agricultural production.

The individual irrigation devices and the required quantities of fertilizer are expensive and would require government supported programs in most developing countries. Multiple cropping produces a deficiency of some minor soil nutrients and can create pest and disease problems. These problems are not insurmountable but they serve notice that the Green Revolution will not be cost-free. (Ehrlich and Ehrlich, 1969)

d. Grain Production Increase. Grain production can be increased by increasing the amount of arable land under cultivation or by increasing the yield per acre. Estimates on the additional land which could be brought under cultivation vary from a few hundred million acres to four billion acres. Each large land area not under cultivation has some major shortcoming ranging from a shortage of available water to deficient soil conditions. Very little land is available for profitable cultivation in the next several decades unless unexpected breakthroughs are made in the desalinization of water or in the use of tropical forest soils. (Ehrlich and Ehrlich, 1970)

The Green Revolution is an example of yield increase which combines several techniques. Yield increase techniques include new grain strains, irrigation, multiple cropping, fertilizer, and pesticides. Few areas in the world have reached their potential in the use of fertilizer or irrigation. By 1970 only one-sixth of the land under cultivation in Asia employed the techniques of the Green Revolution. Considerable potential for yield increase seems present. The primary constraint today appears to be the capital investment required.

e. Loss Decrease. In most less developed countries the amount of grain available for distribution can be increased significantly by decreasing grain losses. Most LDCs suffer large grain losses in the field, in storage, and in transit as a result of rodents, pests, and molds. In 1968 rats destroyed 10% of India's grain production. The prospects of economically reducing these losses are favorable. (Cochrane, 1969; Ehrlich and Ehrlich, 1970)

f. Protein Deficiency. One aspect of malnutrition, protein deficiency, is capable of early solution. Protein deficiency is important because of its relationship to mental retardation. Scientists estimate that about 50% of the world's children during the past decade did not receive adequate proteins. The deficiency represents by weight about

12% of the world protein supply. This shortcoming lends itself to early solution through production of single cell proteins, use of fortified grains, or the direct feeding of proteins. The desired protein quantity can be obtained directly from today's level of fish harvest and fed directly as fish protein concentrate or obtained from seed oils and mixed with grains. The major constraints inhibiting such schemes are the lack of efficient distribution systems in many developing countries and the cultural tastes in these countries. Rejection rates for protein supplements in Africa have been high. (Altschul, 1967)

g. Novel Solutions. Scientists are investigating novel schemes for increasing food production. Proposals include: (1) culturing of single cell organisms on petroleum or other substrates; (2) herding animals such as the African elands and South American rodents not currently being herded; and (3) cultivation of algae in the fecal slime of sewage treatment plants. None of the schemes offers any substantial potential for significantly contributing to the world food supply over the next several decades. (Ehrlich and Ehrlich, 1970)

h. Ocean Resources. Food resources obtained from the ocean are discussed in Chapter XVII, "The Exploitation of Ocean Resources." For the purposes of this chapter we need only note that the ocean harvest at present provides less than 2% by weight of the world's food supply. The projected ocean harvest at the end of the century will probably not increase the sea's percentage of the world's food supply. The fish harvest is slightly more important than the above figures would indicate because it constitutes about 3% of man's direct protein consumption and through its use as an animal feed provides the basis for about 10% of all animal protein production. (Emery and Iselin, 1967)

4. Implications.

Many observers forecast the occurrence of famine with increasing frequency in the developing world. Even if world food production increases as predicted, starvation will remain a real threat in large parts of Asia, Africa, and Latin America. The problems include: inadequate transportation and food distribution systems; shortages of foreign exchange to purchase food imports; absence of sufficient personal income to create consumer demand; and inability of donor and recipient countries to mount large scale food aid programs.

Additionally, the phenomenon of rising expectations means that many Third World inhabitants will be increasingly dissatisfied with a subsistence standard of existence. (Ehrlich and Ehrlich, 1970; Hauser, 1970)

The expected population increases in the developing countries will create difficulties in economic development as well as subsistence. Many developing countries even now are unable to increase their per capita GNP significantly because population increases match, and in some cases, outpace, GNP. The situation is not beyond solution. The means for population control are present if developing countries perceive such programs to be in their interest and pursue them vigorously.

The impact and implications of the food resource/population problem are not unpredictable. Famine, rising expectations, and development failures will create instability in a number of developing countries. Governments will fall because of such problems. The resulting instabilities might well affect the use of bases for the United States, the availability of natural resources, and the balance of power or alliance structures in certain regions.

The United States needs to undertake a closer examination of its foreign assistance program with an eye toward identifying those countries whose policies indicate they can successfully utilize outside assistance. The key to the United States effort will be the integration of food, development, and population planning programs. The three subjects are bound together so closely that all must be examined. Development assistance to a country which is not attempting to check a rapidly expanding population would probably be wasted. In an environment of decreasing foreign commitments, the United States must take cognizance of the food resource/population growth interaction to ensure the viability of its foreign assistance programs.

CHAPTER XII

THE ENVIRONMENT OF THE FUTURE

by

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Any consideration of future environmental conditions properly begins with a discussion of Ecology. The earth's ecosystem has been described as an open energy system in homeostasis but the real contribution of the ecologist has been to point out the importance of the phenomenon of closure as it applies to limited resources, and to emphasize the delicate nature of the complex balance required to perpetuate such living systems.

Accepting a useful two dimensional model of the ecosystem, (Ripley and Buechner, 1967), on one axis is plotted the level of biological integration (cells, organisms, or populations), and along the other axis is specified a point of view which may be one of the following:

a. Components of system-atoms, cell, planets.

b. Structure or morphology - organization of parts including social organization of animals, cells, or organs.

c. Functions or processes - physiology, regulatory mechanisms, homeostasis at any level of organization.

d. Distribution in time-ontogenetic or phylogenetic.

e. Distribution in space-zoography or human geography.

f. Relationship to environment-interaction between the entity and the environment influencing either or both.

Since these categories encompass many of the traditional scientific disciplines, the true significance of the future emphasis on ecology may be found in its potential for synthesis of many different techniques, ideas, and personalities to find solutions to the important problems facing mankind in the final third of the 20th century. Of the points of view mentioned, there is a general belief that the human-society--plus environment level is the key one, and that humanistic considerations are assuming a dominance in the new interdisciplinary approach of the ecologist.

F. Fraser Darling (Darling, 1967) makes a particularly good case for the view thatpolitics must be recognized as a major ecological factor. Since there is only one ecology, he urges that the ecologist take his place at the council tables where his insight may be injected into the planning and decision-making process at an early stage. It is quite conceivable that the future environmental emphasis will demand of all large organizations, including the military, a staff ecologist to represent this point of view in much the same way that all large staffs receive input from a legal counsel.

The dimensions of the current ecological and environmental crisis are not clearly understood and the one statement that can be made without fear of contradiction is that more research is required to establish the magnitude and specific mechanisms that comprise the problem. Although experts will differ on the degree of seriousness and immediacy to be assigned, there can be no doubt that man today stands in imminent danger of causing irreversible changes in the delicate ecosystem of this planet. As Barry Commoner has pointed out, we are approaching a point of no return due to a potential breakdown in the earth's ecological life support systems. He writes, "I believe that we have, as of now, a single decade in which to design the fundamental changes in technology that we must put into effect in the 1980's--if we are to survive." (Commoner, 1970)

Kenneth E. Boulding, (Boulding, 1970) emphasizes the gravity of the crisis when he says, "There is no second chance for man. If he cannot succeed in organizing his little spaceship on a permanent, self sustaining basis before he has exhausted the source of geological capital on which his development now rests, he will never have another chance."

Many writers have described the horrors of pollution in vivid and detailed terms; such works as <u>TERRACIDE</u>, (Linton, 1970) and others cover the possible future effects of the menace in adequately gruesome detail. Difficult to assess at the present juncture are the implications of the forces and mechanisms already in motion, let alone the effects of future technologies. It is relatively easy to develop seemingly alarming facts such as: refuse produced in the U.S. is estimated to be increasing at a rate of 4% per year (the same as the annual increase in our GNP); DDT can be recovered virtually anywhere on earth from the Artic ice pack to the flesh of Antarctic seals; or U.S. Food & Drug Administration sources estimate we are now exposing ourselves to over a half million chemicals while adding 400-500 new ones a year, (Cole, 1970).

The hard questions concern the effects, both present and future, of these readily verifiable statistics. How much refuse can we dispose of? What is the level of DDT concentration that poses a threat to Man or to other organisms? How many chemical substances can man be exposed to without danger, and in what concentrations? The answers are neither easy to obtain through research nor are many of them presently available.

An excellent illustration of this deficiency in knowledge and the confusion surrounding environmental effects of known processes can be found in one facet of the air pollution problem, the oxygen/carbon dioxide balance and its relationship to global weather. A recent study by more than seventy participants representing a dozen disciplines and drawn from universities, industries, laboratories, and federal agencies, (M.I.T., 1970) minimizes the harmful effects of fossil fuel burning. The study observes that atmospheric O_2 content remains practically constant at 20.946%, and would be reduced by only a fraction to 20.800% if all the world's recoverable fuels were burned tomorrow. This study assumes, however, that DDT and other substances will not have significant effect on the ocean phytoplankton that convert CO_2 to O_2. Recognizing that burning is producing a gradual increase in CO_2 they find the possibility of climatic changes from this source small during this century. Some scientists (Haagen-Smit, 1966) have reached the same conclusions independently and foresee no ill effects for several generations; others are less certain. Citing IGY measurements, one author (Gates, 1970) points out that the CO_2 increase is quite measureable and is acclerating so that by the year 2000 an additional 60% will have been injected into the earth's atmosphere. He reports that an 1885-1940 warming trend may well be attributed to this CO_2 increase in the atmosphere. Since 1940, however, a steep cooling trend has set in despite continuing increase in CO_2 content. This may be related to a rise in air turbidity or dustiness which has been measured, or it may be the result of jet contrails which form cirrus clouds in the upper atmosphere. Both these effects reflect sunlight into space and reduce radiant heat reaching the earth's surface. S. Fred Singer (Singer, 1970) echoes the confusion and emphasizes the fact that radiation and other measurements are essential to clarify climatic effects and resolve the doubt. Another scientist, H. C. Willett of M.I.T, discounts all these mechanisms and holds that climatic change is in fact a result of cyclic sunspot activity.

One result is certain: the thermodynamic niche of many plants and animals is narrow, and seemingly small temperature changes can impair their chances for survival. The predictions have so far failed to isolate the actual mechanisms which play a critical role in making the world weather nor do they address potential dangers to life from a CO_2 increase; they only emphasize our lack of knowledge.

Although the dimensions of the ecological crisis are not adequately known, and the need for more study and research is acute, it has been possible to identify some of the causes of our dilemma to assist in determining the probable future course of events. Clearly, one of the causal mechanisms has been the failure of classical economic theory to assign the environmental costs of production to industry. External side effects have, until now, not been reflected in costs nor has the market mechanism communicated the demand for environmental quality. As John Krutilla, (Krutilla, 1967), puts it, "The conventional market operation does not provide adequate information or rewards to ensure the preservation of rare and irreproducible natural phenomena."

Moreover, there is yet no scientific way of determining what should be spent on environmental quality, nor can we relate productivity to such expense. The market mechanism is not responsive to extra-party costs and external diseconomies. In order to assess these effects we need environmental experts in the planning and decision process at an early stage. (Wollman, 1967)

One of the primary causes of the ecological crisis has been the devil of suboptimization which is defined as "finding out the best way to do something which should not be done at all," (Boulding, 1970). Total ecological planning and thinking based on the principles of closure are some ways to exorcise this demon. Boulding goes on to emphasize that it is the state or condition of man that is the true measure of economic welfare <u>not</u> the GNP or some other misleading indicator.

This idea is echoed by Melvin Anshen, (Anshen, 1970) when he asserts that the very nature of the social contract is undergoing change with respect to U.S. business enterprises. He adds, "It is becoming clear that in the emerging new contract, social progress (the quality of life) will weigh equally in the balance with economic progress ", and further he points out that this idea, "strikes at the central concept that the job of private business management is to maximize profit." Clearly the future holds the promise of a new economics that will reflect social and environmental values.

Some writers have asserted that the only solution to the problems of pollution lies in federal control to establish uniform national rules and to provide the funds required for abatement, (Patterson, 1967). Others argue just as vehemently that federal standards are not the rational or realistic answer and should be avoided in order to maximize cost effectiveness for pollution abatement, (Teller, 1967). Almost everyone agrees that some form of recycling will be essential and at least one ecologist predicts total recycling wherein the consumer becomes merely a user or renter of goods, (Spilhaus, 1967).

For a full appreciation of the future impact and scope of environmental problems the question of population must be considered. Realizing that demographic factors are discussed in another chapter, it is hardly possible to divorce the subject of population from a treatment of ecology. The control of human population growth and attainment of relative stability is prerequisite and crucial to solution of many environmental problems. Burgeoning populations can place tremendous pressures on an already imbalanced ecosystem and unless control measures are instituted before the end of this century it appears certain that preservation of our natural environment will be a moot question.

Taking a relatively undramatic example of the problem, let us survey the future of recreation. Roger Revelle, (Revelle, 1967) has pointed out that recreation is no longer a mere adjunct to work but it is a human need in the hyper-productive society. By the year 2000 the concentration in our national parks, as measured in visitor days per acre at the popular sites, will have become so great that a ticket to a reserved seat in the woods will be a necessity. In the America of the turn of the century it is conceivable that on some Sunday in August 150-200 million people might want to go to the beach. This equates to about two people for every foot of coastline in the unlikely event that they could all reach it. The recreation problem will be exacerbated by increased leisure in the form of three day weekends and month long vacations so that the American worker will have six months off per year by the century's end. (Papageorgiou, 1967)

In an excellent treatment, John McHale, (McHale, 1969) points out that the environmental problem will increasingly be international as it will be impossible to confine ecological effects to arbitrary national boundries. The essential organizations that maintain the human ecosystem are no longer national in any real sense. There is increasing general acceptance of ecology as an expression of international interdependence; a growing belief that man possesses only one ecology and one earth for his use will characterize the decade to come.

Some promising ideas emerge from the McHale work, which reports, "At the point, then where man's affairs reach the scale of potential disruption of the global ecosystem, he invents precisely those conceptual and physical technologies that may enable him to deal with the magnitude of a complex planetary society." McHale specifically refers to the possible future uses of satellites and computer simulation for ecological resource management and points out the closed ecology of life support systems in spacecraft as a model for the solution of some of our recycling problems. Others, (Handler, 1970), support this optimism and assert that computer simulation of ecological problems will develop as a function of increased technical sophistication of the ecologists with regard to quantification coupled with availability of data in sufficient volume and precision.

Frank Press, (Press, 1967), stresses the possibility of computer weather forecasting and earthquake prediction and develops the concept of weather modification and control by pointing out that precipitation of moisture by cloud seeding and techniques of hail and lightning suppression have already been demonstrated and verified by the U.S. National Academy of Sciences, the National Science Foundation, and the U.S. Forest Service. These techniques will be refined and expanded in the future.

A greater public awareness of the problems of ecology should lead to a better world ecological balance by the year 2000 (Ginsburg, 1970). To summarize the environment of the future, we can draw a number of important implications from the works examined. The following list, while not definitive nor exhaustive, is representative of a wide survey of literature and sifting of the incomplete evidence currently available.

1. The science of Ecology holds important promise and may emerge as a synthesis of many scientific disciplines applied to the solution of environmental problems in such a way as to emphasize humanistic considerations.

2. The phenomenon of closure is gaining widespread acceptance as a key concept which may permeate the thinking of the next three decades.

3. There is a consensus that highlights the need for the input of an ecological view or the introduction of environmental considerations into the planning and decision-making process at an early stage. Ecologists will play an increasing role in the public and private councils.

4. Virtually universal agreement exists that a significantly greater research effort is required to define the nature and magnitude of the environmental crisis, identify the mechanisms that influence it, and arrive at feasible solutions. This effort will be undertaken and supported widely by public concern.

5. There is widespread recognition of the fact that man has the technological capability to alter the earth's ecosystem in profound ways and often does so by accident without realizing the consequences of his actions. Increased prediction and more powerful forecasting techniques will result.

6. Many eminent ecologists feel great immediacy about the environmental crisis and there will be growing popular

support for and awareness of their concern.

7. Many ecologists believe that the various forms of pollution will be arrested and substantial progress made toward restoring a natural balance if the necessary resources are applied and some new techniques are developed within the next decade.

8. A number of theorizers have highlighted the need for a new kind of economics that will be developed to account for environmental costs and apply them in a way that recognizes the unique value of natural phenomena. Some means of ammortizing the accrued costs of degradation will also emerge.

9. The probability of increasing governmental control and regulation of the environment is great and should be manifest in the coming years.

10. The impact of the population explosion on the environmental problem is so profound that it is hardly possible to divorce these two pressing issues. Future population stabilization is essential to permit significant progress toward greater environmental quality.

11. Demand for recreational facilities will multiply in the next three decades resulting in high usage of scenic national resources.

12. The universality of the environmental problem implies either future international cooperation as a solution, or a new source of conflict among nations.

13. The use of satellites for environmental resources management and for global weather observation is predicted and should occur in the near term future.

14. Computer simulation of environmental problems and techniques for accurate long range weather forecasting will be developed by the 1980's.

15. Sophisticated recycling techniques based on the model of spacecraft life support systems will provide a partial solution to the problem of pollution. Many such techniques are within the state of art today.

16. A limited capability to control and modify the weather will be in use by the year 2000.

CHAPTER XIII

ECONOMIC PROJECTIONS

by

CDR John L. Carenza, U.S.N.

> Outlays for defense activities can be raised--if we need extra defense programs more than other things. (Hitch and McKean, 1966; p. 47)

> The often heard argument that "we can't afford it" may be taken literally in a subsistence economy where a new expenditure would cut into the minimum standard of living. In a modern rich economy such as the United States, it typically means, "I am opposed to it." (Kindleberger, 1970)

Each of the scenarios in Volume One touches in some way upon the ability or the willingness of the United States to pay for the Navy of the future. The slogans, "guns and butter" and "reordering of priorities," relate to this constant weighing and balancing at the national level of government. The opening quotations illustrate the alternatives and pressures which each nation must face in allocating its limited resources.

It can readily be seen that each projection of the future has its own military and economic implications. Not only are the external threats and the related naval forces different, but the economic basis which provides the funds to support the Navy is different. It is very possible that these two factors will be working in opposite directions. For example in World-wide Withdrawal as described in Chapter III, we may wish to spend more for national defense in order to build a strong defensive capability and insure continued access to vital natural resources around the world. Yet in withdrawal, it is quite probable that gross national product (GNP) will be declining, or the rate of growth will be declining, and less money will be available than desired.

All three of the scenarios envision a more sophisticated and technologically complex Navy of the future. These developments will require improved reliability in equipment and highly qualified personnel for both operation and maintenance. These factors indicate a constantly rising trend in the cost of weapons systems and defense. Because of this trend, long-term (10-15 year) procurement programs may be required and authorized in the future. These long-term commitments must be based on accurate estimates of both the availability and allocation of resources over an extended period.

Economic projections are therefore a key to extended-range forecasting for the Navy. Table 13-1 presents projections of the U.S. GNP and its principal elements for 1980 and 2000. Table 13-2 presents similar forecasts for that portion of the GNP which will be allocated to national defense.

Implicit in these projections are assumptions concerning the increased productivity per worker and how this is achieved, the changing mix of the work force and the work week, the relative changes that appear in government purchases vs consumer purchases and extensive data on population growth as it effects Gross National Product.

Projections of defense expenditures, such as Table 13-2 contain assumptions as to the relative expenditure of funds for personnel, and operations and maintenance vs research and development during periods of low, medium, and high world tension. Table 13-2 provides low, medium and high projections to allow for variations in the way the United States will view the world situation in the future. It is interesting to note that the medium projection for defense expenditures in the year 2000, which is based on ten percent of GNP, is $220 billion. The growth in GNP

TABLE 13-1

PRINCIPAL ELEMENTS OF FUTURE U.S. GNP

	1960	1980	2000
Population	180	245	331
Labor Force	73	102	142
Annual Output/Worker (Thou. $)	6.9	10.4	15.5
GNP (Billion $)	504	1,060	2,200
Purchased by Consumer	329	660	1,320
Purchased by Govt	100	240	550
Invested	72	170	360
or			
Durable Goods	96	229	514
Non-Durable	162	293	518
Construction	57	130	281
Services	189	415	909

Sources: Landsberg, Hans H., et al. Resources in America's Future. Baltimore: Johns Hopkins Press, 1963.

Kahn, Herman and Weiner, Anthony J. The Year 2000. New York: The Macmillan Company, 1967.

TABLE 13-2

PROJECTIONS OF U.S. DEFENSE EXPENDITURES

(BILLIONS $)

	1980			2000		
	**Low	Med.	HI	Low	Med.	HI
Military Personnel	6	16	26	7	22	47
Operations & Maint.	5	20	34	8	34	77
Aircraft	3	13	23	5	25	57
Missiles & Space Craft	4	17	30	11	51	114
Other Procurement	3	10	17	6	27	60
R&D	5	18	32	9	42	95
Construction	3	11	19	4	19	44
	29	106	181	50	220	494

**The low, medium, and high figures are based on percentages of GNP as follows:

Low: 3% of GNP
Medium: 10%
High: 15%

Sources: Landsberg, Hans H., et al. Resources in America's Future. Baltimore: Johns Hopkins Press, 1963.

Kahn, Herman and Weiner, Anthony J. The Year 2000. New York: The Macmillan Company, 1967.

could thus provide sizable sums with relatively modest percentage allocations to defense.

The economic projections in Tables 13-1 and 13-2 are all typical straight line projections to the year 2000 with a standard rate of growth built into each year. This type of projection assumes that although fluctuations or deviations may occur for short periods of time, over the long run these will average out and the standard growth rate will be closely approximated.

Economic growth itself is based upon several important factors that are at work in the world today. First and most important is that nations throughout the world have adopted sustained economic growth as a national policy.

To carry out this policy, a freer flow of technical knowledge has been encouraged across national barriers. Greater knowledge and control of the business cycle is constantly being sought. Some experts predict that within 50 years effective control will be achieved, not only in the industrial countries, but in the underdeveloped countries as well. Monetary reform and the establishment of an international currency are striking at the international monetary liquidity problem. Increased international trade and the development of multi-national corporations, trading and working across national boundaries, will implement the economic law of comparative advantage to the fullest. Regional trade unions also are helping to break down economic barriers to growth and provide for the maximum utilization of economic resources.

Finally the tremendous development of transportation and communications systems has contributed greatly to economic growth throughout the world through the transmission of ideas and demand for new products as well as through the fast and efficient physical movement of goods.

Impediments to economic growth could, of course, reverse any of the factors cited above. In addition, underdeveloped countries are faced with overcoming poor educational systems which greatly inhibit a nation's capability to develop. But the key impediments to economic growth are those factors such as subsidies, tariffs, and labor unions which inhibit economic flexibility and mobility in a free international economic system.

There are other concerns that enter into the formulation of a policy of economic growth such as: (1) insuring that all citizens participate in gains from growth, (2) conservation of natural resources, (3) problems of the new leisure, (4) population growth, (5) achieving higher rates of savings to enhance investment, and (6) international balance of payments.

Finally, the part that defense spending plays in fostering economic growth must be considered. The Committee for Economic Development has said:

> . . . Defense expenditures represent a continuing drag upon our economic growth. This happens because such spending lessens the recources available for raising living standards and for business investment that would foster further growth. (Committee for Economic Development, 1969)

In long range projections then, all of the above factors are working on the rate of growth of a nation, and a drastic change in any one could alter a projection significantly.

World scenarios set forth in Chapters III, IV, and V have utilized the standard straight-line economic projection as a basic starting point. Yet it must be pointed out here that there are alternative economic courses which must be considered, for the potential root causes for their occurrence are discernable.

There are several key economic trends evident in the world today. As these trends continue to develop several options could occur, each having different implications for the United States and the world. The possible permutations of these options point out the difficulty in projecting the economic world of the future.

First, there presently exists a wide economic and technological gap between the United States and the underdeveloped countries of the world. The current trend is that this gap is not significantly closing, and there are indicators that because of its tremendous lead in the fields of electronics and computer science the United States could further open this gap, and also further increase its lead over the other industrialized countries of the world.

Alternatives available to those being left behind are: (1) accept their own small gains and progress even though the gap is not closing, (2) resist by causing temporary and minor economic disruptions, but no major upheavals, (3) band together, using economic sanctions against the leading industrialized nations, join the socialist bloc, and (4) institute armed aggression to right perceived wrongs in order to get a fair share of economic progress.

The second key area is the economic interdependence and economic stability of the world. Here the trend indicates that all nations are becoming more dependent upon one another, economically, and that the problems of inflation and international monetary liquidity are growing to such significance as to effect world stability.

Alternatives available to the world community are:

(1) World cooperation will result in solutions to the inflation and monetary problems, with resultant great increase in world trade.

(2) Limited cooperation will result in temporary control of inflation, money problems, and tariffs, but crises will continue to develop, causing minor disruptions treated primarily by stopgap solutions.

(3) Individual national interests will predominate, and international trade will break down, causing world depression and monetary chaos.

Thirdly, it is evident that the relation between East and West has evolved to an economic battle over trading partners and raw materials (resources). The current economic trend is that the intense competition between East and West will continue unabated. The range of possible outcomes includes:

(1) East and West will solidify their positions,

remaining content with the status quo and its existing divisions.

(2) East or West will begin to pull ahead, causing increased tension and pressure until the former balance is restored.

(3) East or West will begin to pull ahead and one or the other, because of political or social reasons will concede and accommodate to the dominance of the other.

(4) East or West will begin to pull ahead causing increased tension leading to armed conflict.

Finally the world is faced with the economic development/population growth dilemma, particularly in the underdeveloped or Third World. Current trends indicate that in vast areas of the world and in great population areas of the world, population growth is outstripping economic development.

Alternatives available to the world community are:

(1) Major increases in technological and monetary aid, rise in educational level, accelerated economic growth and controlled population growth.

(2) Technological breakthroughs in either land utilization and food production or population control which will

provide the basis for development.

(3) Famine and disease, major internal conflicts, loss of natural resources and world conflict.

It can be seen from the above alternatives that a wide range of world economic conditions can result in the future, ranging from the standard projection of growth and development, through a continuation of the status quo, to world depression and conflict. The related implications that these factors hold for the military posture of the United States are key to the future of the Navy.

Because of the complexity of projecting many types of worlds, a standard economic projection, as previously stated, was utilized in the basic scenarios in Volume One. However, it is considered necessary and essential that Navy planners develop a range of probable economic projections of the future and study the effects these situations would have on the Navy.

Economic projections, prepared through the use of computers from the vast bank of statistical data available today, can provide a useful tool to the military planner. Analysis will provide guidelines for the availability of resources, potential fluctuation of resources, the alternate utilization mixes from resources made available, and in regard to long-term procurement programs, the foundation from which to plan.

Another interesting aspect of the analysis of economic projections is the relationship of international political power to economic power. John McHale in <u>The Future of the Future</u> has written:

> The Malthusian and utilitarian feeling that the future was limited to those most able to prove their material strength and mastery is a viewpoint which, in its more negative and large scale aspects, is increasingly confined to our military establishment. (McHale, 1969; p. 5)

The above statement appears to be a rather harsh indictment of the military mind and its thought processes. The negative aspects of this statement imply that, from a military viewpoint, the weak and poor nations of the world do not have a future, and cannot look forward to social and economic development and growth.

Taking a positive look at this statement, however, it is not a military function to judge whom the future belongs to, or to decide if it will be limited to a select group. It is, however, a vital element of the military establishment's planning process to identify those sources which will be capable of posing a threat to the nation, with whose defense it is charged.

Herman Kahn states:

> Yet this probably does not imply any serious confrontation between the halves of the dichotomized world in the twentieth century, for the underdeveloped countries, even in concert, are unlikely to possess the resources, either economic or military, to wage serious military campaigns against one or more developed countries. (Kahn and Weiner, 1967; p. 364)

In addition, Ferdinand Lundberg states:

> While industrialization will no doubt spread, the prospect that China, India, Africa, and South America will be industrial counterparts of Europe or the United States in 150 years seems to me extremely dim. (Lundberg, 1963; p. 10)

It can be stated then, that from the military viewpoint the future threat to the United States will be limited to those most able to prove their material strength and mastery.

In an attempt to identify future threats, the close relationship of politics and economics, and of economics and power must be considered. Table 13-3 arrays nations of the world in the order of their projected Gross National Products in the year 2000. International power is made up of many factors that cannot be quantified such as the

TABLE 13-3

PROJECTIONS OF U.S. AND FOREIGN GNP'S

GNP (BILLION $)

SUPER			
U.S.	692	1669	3231
U.S.S.R.	297	788	1640
LARGE			
JAPAN	84	471	1393
W. GERMANY	112	271	525
FRANCE	94	227	439
CHINA	74	196	408
U.K.	98	216	389
MEDIUM			
INDIA	48	128	266
ITALY	57	137	265
CANADA	48	128	266
POTENTIAL			
BRAZIL	23	89	246
MEXICO	19	62	149
ARGENTINA	11	29	61
INDONESIA	10	33	80

Sources: Landsberg, Hans H., et al. Resources in America's Future. Baltimore: Johns Hopkins Press, 1963.

Kahn, Herman and Weiner, Anthony J. The Year 2000. New York: The Macmillan Company, 1967.

aggressiveness of the society, ambition, national image and the willingness to devote resources toward achieving international power. The GNP of a nation is an indicator of its wealth, and its capability to support and project its desired national power image. As the one major factor that can be quantified in determining a world power structure, continuing analysis of GNP standings, trends, and changes can be useful in identifying possible sources of instability.

Some research and writing has been done in this area of analysis. Kenneth Boulding equates the power of a nation to its GNP multiplied by some coefficient of international power. He then writes, "When the GNP of one country overtakes that of another defines the central date of a crisis period." (Wallia, 1970; p. 132)

By observing the relationships among GNP's of nations as they grow or decline, an indication of a danger point may be discerned. This relationship can also apply to the growth of a complex of nations that are joined by a common bond, be it political, geographic, or cultural. The United Kingdom's relative decline through the power standing and the attendant withdrawal of forces from the Far East, Middle East and the European continent, and Japan's projected rise through the standings, closing in on the Soviet Union with its potential for power projection, are examples of possible crisis periods or danger points.

Robert North also points out a possible source of tension. He points to the:

> . . . tension felt by a nation that perceives that its real capability is greater than its ascribed capability, rank or status. And this is particularly true of nation states that are coming up very fast. (Wallia, 1970; p. 177)

It is striking in the study of power relations that nation-states tends to behave somewhat like individual people. As described above, a nation that is rapidly growing more powerful will tend to strike out or project this power, because others fail to recognize this strength early enough. It would be prudent to recognize this growth in power before it must be forcibly brought to our attention.

Another similarity noted is that nations, like people, do not tend to aid or assist those in the economic class closest to theirs, but are willing to help those who are at least two levels away. Nations tend to measure themselves continually against the next stronger and the next weaker. Any perceived change results in tension. The Soviet Union, for example, will provide economic assistance to Egypt, North Vietnam, India but would deny aid to China or Japan.

A review of the power structure gives a clear indication of who is capable of projecting power, or who will have the material strength to pose a serious threat to the interests of the United States. Careful analysis will yield insights concerning when and from what source a threat might come, how a nation perceives its strength and standing among nations, and which nations should be cultivated or assisted to insure their friendship and cooperation.

CHAPTER XIV

MANAGEMENT AND TECHNOLOGICAL FORECASTING

by

CDR Angus D. McEachen, U.S.N.

The future of management is a topic of substantial interest which contributes directly to the objectives of this study. This chapter will consider some current trends in management and then examine in some detail the subject of technological forecasting, a new and rapidly developing technique of management.

In his book The Shape of Automation, Herbert Simon rhetorically asks, "Will corporations be managed by machines?" (Simon, 1965) In reply, he initiates his analysis by identifying those factors affecting management which are expected to change and those expected to remain invariant. Change will come principally from the growth of human knowledge. One of the principal trends in this growth will be an improving capability to substitute machines for most of the human functions in organizations during this century. The possession of this capability does not mean that computers will necessarily replace all managers or production line personnel, however. Substitution will take place where it is comparatively advantageous to do so. The routinized functions, whether managerial, clerical, or production-oriented, will better lend themselves to automation than would decision-making or problem solving. Indeed, it is probable that humans in the 1985 era will be engaged in roughly the same array of occupations as they are now. (Simon, 1965) Increasing automation will not require that those who manage the system have an intimate knowledge of system details. On the contrary, processing ideas through a computer will be continually simplified in the future as computer language becomes more natural with the aid of new compiler techniques.

From an understanding of the nature of management and the ways in which it will change in the future, some perception of organizational structure can be gained for 1985 and beyond. Organizations will continue to be hierarchical in nature, but each step in progressive automation will raise fundamental questions. For example, automated data-handling could provide the basis for an unprecedented centralization of management authority and detailed accountability of subordinate levels. Another potentially serious problem will be that of form overwhelming content. Marshall McLuhan succinctly made this point regarding mass communications by noting that "the medium is the message." (McLuhan, 1964)

The basic structure of the future organization will be founded upon physical processes of production and distribution. Programmed decision-making will govern daily operations of these physical systems, primarily through automated control systems. The non-programmed decision processes such as planning, feedback, and control can technically be automated. Costs will govern which of these processes will actually be automated. (Simon, 1965)

In response to the growing interest in managing the future, a substantial amount of investigation has been conducted in the field of technological forecasting (TF), a method for predicting trends and developments in the social and physical sciences.

There are two basic and somewhat polarized views of the process which generates technological change. On one hand, invention and innovation of a technical and scientific nature are considered to follow directly from opportunities or challenges. This view is intrinsic and envisions science as an unchecked body of inquiry with its own internal motivational process. The contrasting view is that invention and innovation are processes which are responsive to social needs and economic demands. This view, which emphasizes external influences, is sometimes referred to as the normative process. The concept of the idea whose time has come typifies this process. (Ayres, 1969)

In actuality, technical innovation can originate at one of the two poles described above or anywhere on the "idea development axis" that joins them. Hence, a missile weapons system may evolve from any one of many possible points on the axis. At the innovation pole, a new system could evolve from ideas that generate a new technological capability in missiles. At the normative pole a new missile system could evolve from varying degrees of external threat which increase the demand for a new or improved military countermeasure.

This range of intrinsic and external factors influencing the development of new ideas has been recognized in technological forecasting. Different techniques have been developed which are applicable not only at the two poles of the idea development axis but at intermediate points as well. Among these techniques are those which focus on the following:

a. Objectives. Programmed budgeting is as example.

b. Needed Developments. Relevance analysis pertains in this case, in which an objective or set of objectives is given. The contribution which each possible sub-objective would make is analyzed to determin the best set of incremental actions to adopt in order to achieve the overall objective.

c. Relationships Among Developments. Contextual mapping is an example. This technique implies that as developments accumulate and knowledge increases, it must be organized if it is not to be lost or neglected.

d. Process Dynamics. Formal modeling is employed to the extent that empirical or logical connections among variables can be made explicit.

e. Informed Judgment. The Delphi technique solicits and pools the judgments of informed persons about future events, feeding back non-attributed results for adjustment or explanation of deviations.

f. Synthesis. Scenario construction illustrates this approach. Scenario writing involves putting together pieces of knowledge into meaningful wholes in order to invent a credible path between present and future and to examine the interaction of complex factors.

Quantitative methods which are often used in technological forecasting include curve fitting, correlation analysis, network theory, and decision tree analysis. These techniques are most frequently used in describing future innovations closer to the intrinsic pole of the idea development axis. Toward the normative pole, less analytical methodologies such as scenario writing are usually employed. (Dory and Lord, 1970) For comprehensive technological forecasts, both methods would play an important role.

In applying technological forecasting to the Navy, a two-step process would be involved. First, an understanding of the various TF techniques must be mastered. Second, an idea development axis of the intrinsic and external factors impinging on the Navy must be constructed, and the TF methods which apply to inventions and innovations originating at points along the axis must be determined. For instance curve fitting could be used to project a speed trend curve, aircraft power trends, or electronic noise reductions. Scenario writing, on the other hand, might be employed to forecast the future international climate in which naval forces will interact.

The Delphi technique might also be applied to the Navy with interesting and helpful results. For example, a questionaire might be used to solicit forecasts of future trends in the Navy as envisioned by carefully selected individuals in various groups, e.g., senior officers, junior officers, senior enlisted men, enlisted men in their first enlistment, and prominent civilians. Feedback and re-evaluation of the results in the Delphi idiom would provide a long-range prediction for the ideas being considered.

An accelerating pace of change, increasing scarcity of resources over at least the next few years, and the increasing cost and complexity of future weapons systems developments--these and many other factors will make sound management and improved technological forecasting imperative for the Navy of the future. In working toward that goal, full advantage must be taken of advanced techniques, such as those mentioned above, as they become available. The establishment of extended-range forecasting on a continuing basis, as recommended in Chapter VI, would provide the mechanism to evaluate these new techniques and implement those which prove applicable to the Navy.

CHAPTER XV

DIRECTIONS IN INFORMATION

by

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The twin technologies of computers and communications simultaneously entered a new era in the early 1950's with the development of solid state electronics. The advent of the transistor followed by solid state electronic innovations, such as integrated circuits, provided the communication and computer capabilities which then led to a revolution in information transferred between and among individuals and institutions. As a result of the revolution in information available, particularly the multiplying volume and sources in a post industrial society, education policies and practices are being influenced significantly. Trends in communications, computers, and education--all intimately related to information transfer--are discussed below.

Communications Advances.

Perhaps the most significant communications advances will be in the field of satellites. It is feasible, for example, for the evolution of satellite communication technology to proceed from transocean relay of commercial communications and television to world-wide person-to-person visual communications approaching the universality of the current telephone system. (Punchard, 1970)

Other advances will appear with the adaptation of holographic devices to the extremely wide bandwidth inherent in communicating with laser beams. The transmission of three dimensional images is one future outcome of the laser and holography marriage.

Specific communication capabilities foreseen within the next thirty years include transmission bandwidths to ten to the tenth megahertz. (Konecci, 1967) Along with the transmission of three dimensional images will come the transmission of touch, taste and smell. (Punchard, 1970) However, one point that is often repeated is that communications developments will depend more upon economics, government policies, and human reactions than upon technical feasibility.

Computer Technology.

The concept of stored program logic coupled with solid state electronics provided us with the phenomenal capabilities of the electronic computer. The growth in capability and impact of this device is legend.

Turning to the future, the minicomputer is a development likely to have substantial impact within the next decade. The strength of the minicomputer is that it is the cheapest digital logic system on the horizon. Applications for the device are theoretically no more limited than its counterpart, the large general purpose digital computer, since all system elements are common to both. However, the modest size of the minicomputer makes it adaptable to specific tasks such as: systems tester, stored logic numerical process control, remote process monitoring, and communication process control, remote process monitoring, and communication processing applications. (Jurgen, 1970)

Further into the future, substantial improvements will be available in computer memory storage density. Ten to the tenth bits per square centimeter represents the current limit available in laboratory evaluation of hologram storage densities. (Mikaeliane, 1970) As in the case of communications, the limiting factor in computer developments over the next thirty years is not technical feasibility. The allocation of financial resources and the expression of governmental and public preference will limit computer developments long before technical capability is exhausted.

Information.

The simultaneous expansion in communication and computer developments is no coincidence. As noted, advances in solid state electronics were an important ingredient in the rapid expansion of innovation in both technologies.

The growth of communication and computers in turn brought on the explosion in information. Example after example demonstrates that the rate of information flow (both one to one and many to one) is increasing far faster than population, energy consumption, GNP, or virtually any other socio-economic parameter except perhaps the destructiveness of weapons. (Ayres, 1969)

Some of the advances in information processing and handling that can be expected over the next thirty years were considered at the Third Annual Symposium of the American Society of Cybernetics at their October, 1969 meeting. Items included were:

A system of national and international technical data banks will be created; it will be operational by 1980.

Managers of large corporations and government agencies will have access to it via their own electronic systems; by 1985 most individual scientists will access this system through desk top devices; by 1990 it will even provide electronic language translation capabilities on an international scale.

Laboratories, as we know them today, may go out of style by 1993, as experimentation by computer simulation will be less expensive and more reliable. Laboratories will then only be used to validate the research done "on the computer."

Office and home use of computer utilities centralized on a city wide basis will be fully accepted by 1985.

Advanced communication terminals, including graphics and some form of voice input and output, will allow many managers and professions, by 1985, to carry on their work at home, eliminating most person-to-person contacts and commuting travel as well.

Post Office services as we know them today will be almost non-existent by 1987; they will be replaced by point-to-point digital transmission of data and information.

The acceptance and use of a Universal Personal Identification Code (UPIC) for the unique identification of individuals will occur about 1980. This code, likely in the form of "voice-prints" will herald the era of a cashless and checkless society in which individuals can even be called upon to vote in "real-time" if the occasion demands it.

Micro-electronic and medical technologies will reach a point, likely beyond 2000, where it will be possible to directly stimulate (by implantation or other means) the appropriate areas of the human brain in order to produce sights and sounds as an aid to the blind and deaf.

Cost per operation in electronic computers will drop from current levels by a factor of 200 by 1978.

A significant increase in the use of small computers suitable for procurement by individuals will take place by 1980; they will perform such functions as climate and lighting control in homes and offices, systematic information retrieval from various sources such as stock brokers, banks, and retailers; and scheduling of such functions as maintenance, budgeting, and medical care.

Three-dimensional color replication of living and moving objects will be technically feasible by 1981, requiring only optical devices for "sensing" by the viewer.

Speech recognition devices capable of identifying dozens of speakers using the system will be available by 1983; beyond 2000 computers will accept spoken input and produce audio output employing the same level of vocabulary and idiomatic usage as does an educated person.

By the 1980s man-machine interactive capabilities will allow a user to examine in great detail, at various levels, and in real-time, the output results of management information reports. With this event will come the opportunity to experiment, through simulation, with overall results and plans by causing changes in variables used in projecting from the established basis and this stored information. As a result, there will accrue a greater understanding by the managerial user of the scientific methods employed to derive this information and of the effects which changes in certain variables will have in selected areas.

The foregoing expectations could prove to be significant to the Navy. For example, computer utilities with terminals in homes will represent an educational tool in itself. The contemporary man of 1985 will view the home and office computer in much the same way we perceive television. We are conditioned to it. Hence, a Navy bid for continuing its trends toward automation of shipboard control and weapons systems will have a sound base for development in the civilian community. Control of propulsion processes, communications, electronic warfare, management information, maintenance and testing, and weapons systems are among the applications of advanced data processing techniques aboard ship.

Ashore, the management and scientific application of computer technology is already well established within the Navy. The expanded application of computers, afloat and ashore, could be enhanced with the widespread introduction of computer assisted instruction in Navy training courses.

Education.

The foregoing thoughts lead to a consideration of education and the interaction between education and information.

Tremendous advances have been achieved in the mass education of our youth. Similar advances are taking place at the community college level. It is estimated, by the Bureau of Census, that by 1985 almost eighty per cent of the nation's young adults will possess a high school education. A large percentage of this number will also be community college graduates. (Conant, 1967)

The character of education should undergo substantial changes within the next thirty years. Francis Kappel, (1966) expects a revolution in the quality of U.S. education. J. P. Guilford, (1970) sees genuine planning and experimental educational efforts headed in the direction of problem solving programs. This is consistent with the view of Barzun, (1968) who sees the American university abandoning survey courses in favor of short courses.

Another mark of education in the future will be trends following the new math approach. For example, a scientific treatment of English, Symbolic English, appears to be on the horizon. (Nelson, 1970)

These advances hardly match the potential educational gains achievable with advanced information handling and computer techniques. Theodore H. Nelson, (1970) a young computer expert, suggests that computer aided instruction developed as a new teaching medium, and not as a one-for-one replacement of traditional classroom techniques, will provide benefits currently unattainable. He champions an environment that discards sequences, and allows the student to move freely through materials at a pace he himself controls. An ultra-rich learning environment is envisioned in which the student chooses what, when, and how he will study and be tested.

An example of the comprehensive nature of computer aided instruction can be seen in the combination of student, computer, and teacher investigating trigonometry with the aid of a cathode ray tube and light-pen. The student draws an angle on the scope. Adjacent to the angle, in bar chart fashion, the pictorial trigonometric values of the sine, cosine, and tangent of the angle appear. The student could:

a. Change the angle and observe the value and relationships of the trig definitions change.

b. Vary the rate of change of the angle and another bar could show the numerical value of this concept of differential calculus.

The differences in future views on education appear to be polarized between two concepts of learning. On the one hand, traditional but higher quality education is espoused by professional educators and implies a linear relationship with knowledge imparted from the subject through either teacher or computer to the student. One the other hand, computer specialists would have the teacher, computer, and student interact on a nonlinear basis with the student pursuing knowledge at a pace and in the direction of his individual interests.

<u>Conclusion</u>.

The impact of computers and communications increased substantially with the development of solid state electronics. Similarly, the mass distribution of facts and knowledge was facilitated by the synthesis of communications and the computer. The information revolution resulted.

With advances an accomplished fact, traditional systems, such as education, find it necessary to review their modus operandi. Invariably, factions arise to conserve methods and others to liberalize them. A divisive atmosphere develops and opportunities for innovation are missed. For example, in education the major debate focuses on improved quality. The discussion assumes preservation of the current form; i.e., linear teacher, pupil relationship. The overlay of computer aided instruction upon existing teaching forms is the most frequently heard alternative. While dispute over these two alternatives ensues, whole new options for imparting knowledge go relatively unexplored.

In the Navy, many opportunities appear to be opening in information handling and education with the advent of advanced communication and computer techniques. A totally new view of command and control relationships is possible with the broadened reach offered by improved information systems. Organization by mission vice type, both operationally and administratively, is now conceivable. Moreover, other potential benefits can be derived from an objective appraisal of advanced communications, computers, information and education concepts. Some thought should be devoted to:

a. Efficient training courses emphasizing individualized computer aided instruction.

b. Maintenance refresher courses reinforcing original training.

c. Automated ship propulsion processes limiting manpower needs.

d. Integrated intelligence and fire control sensors for an automated process from detection to kill.

e. Retraining senior personnel, officer and enlisted, for wider range of technical and management roles.

f. Developing Information Systems that focus on critical tasks and decisions.

CHAPTER XVI

RESOURCE AVAILABILITY

by

LCDR William M. Pitt, U.S.N.

This chapter deals primarily with physical resource availability during the next thirty years. In general, the worldwide resource outlook is optimistic in the sense that there do not appear to be many areas in which the world supply of a particular resource will be exhausted, or if exhausted, a suitable substitute not found. On the other hand, there are several areas in which the geographic distribution of available supplies of resources will have changed significantly, possibly producing local shortages and requiring changes in the present patterns of international resource distribution.

The area of greatest naval interest will be the availability of energy resources, and in particular, the availability of oil. For the United States, Hans Landsberg's summary is noteworthy.

Unless novel sources become available sooner than anybody thinks, the total energy supply picture will probably look about like this: domestic crude oil supplies adequate until around 1980, with a likely tightening of domestic supplies in the latter half of the century (sic); foreign sources of oil adequate to provide a much larger proportion of crude than is now imported, coal as a comfortable cushion; shale oil as a supplement later in the century; demand for natural gas approaching domestic resource limits well before 2000, but with--gas imports--likely emergence of synthetic gas--more than enough gas liquids to meet growing demand--hydropower a declining energy source; nuclear fission a growing energy source--with expected improvements in reactor efficiency, should see us through to the end of the century and beyond. (Landsberg, 1964)

The most significant portion of this forecast is the increasing scarcity of oil and gas as energy sources with a subsequent shift to nuclear power. Hubbert supports these contentions somewhat more rigorously, arguing that U.S. production of crude oil is peaking out now and will fall to about 2.5 billion bbls. in 1980, 1.5 billion in 1990, and 1 billion in 2000. On a world wide basis he contends that production of crude will peak sometime between 1990 and 2000 at 25 to 38 billion bbls. per year. The ranges of these predictions are dependent upon total world reserves, the lower, earlier figure corresponding to total reserves of 1350 billion bbls., the higher, later figure corresponding to total reserves of 2100 billion bbls. Hubbert also argues that domestic gas production will peak about 1980 at 24 trillion cubic feet per year, assuming total reserves of 1290 trillion cubic feet. (National Academy of Science and National Research Council, 1965)

A large portion of the reserves, both oil and gas, are offshore. Estimates of the amount of offshore oil that is potentially recoverable vary over a range of 200 billion bbls. to 2,500 billion bbls., with 700 - 1000 billion bbls. being the most commonly accepted estimate. (National Academy of Science and National Research Council, 1969). This figure is very significant when viewed in comparison with the extent of currently proven onshore reserves of about 580 billion bbls. At the present time, more than 16 per cent of the world's total oil production is offshore. By 1980, 25 - 30 per cent, and perhaps more, will come from beneath the sea. Deep water production problems rather than drilling problems are the major factors limiting deep water extraction. It is generally agreed that sub-sea completion and servicing of wells will be the only economical solution in depths greater than 75 meters. Once these sub-sea techniques are developed, they will also become increasingly attractive for use in shallow waters. (United Nations, Economy and Social

Council, 1968) The picture for offshore gas is very cloudy as compared to that of oil. For the United States, estimates of offshore reserves of gas are two to three times that of our potentially recoverable onshore reserves of 1200 - 1700 trillion cubic feet.

The estimates above do not take into account the potential of oil recovery from shale and tar sands. Domestically, about 80 billion bbls. of oil are recoverable under present conditions. World-wide, some 190 billion bbls. are recoverable, with some estimates much higher than this. The Canadian Tar Sands are estimated to have a potential of 300 billion bbls. of recoverable oil. If these resources can be economically developed, oil will be plentiful into the early part of the next century. (Landsberg, 1963)

The pace at which extraction from shale and tar sands is developed will depend largely on the price of such oil, as compared to the price of crude oil and nuclear power. The more likely course is that shale and tar extraction will proceed slowly, with the United States becoming more and more dependent upon crude oil imports, importing 50% or more of its total oil requirements after 1985. A large portion of these oil imports will enter the United States via tanker.

As crude oil becomes economically more scarce, the attractiveness of nuclear energy as an energy resource will increase. Present world reserves of 1.5 million tons of uranium are sufficient for 20 to 30 years with present and planned burner type reactors. Price pressures will probably force conversion to breeder type reactors by 1980. The estimated installed nuclear generating capacity in 1980 is 150,000 - 175,000 megawatts, about 18 per cent of all generating capacity at that time. By the year 2000, nuclear power will represent about 50 per cent of the total.

In the area of mineral resources, "The amount of metal consumed in about thirty years at the current rate of increase in consumption approximates the total amount of metal used in all previous time." (National Academy of Science and National Research Council, 1969) Of the most commonly used industrial raw materials, reserves of iron, aluminum, and manganese are large enough to supply projected demands through the year 2000. It appears, however, that copper, lead, and zinc will be exhausted in the 1990 - 2000 decade unless exploration and research keep pace with diminishing grades of ore, changes in mineralogy, and the need to exploit different types of deposits. Even with such exploration and technological innovations, costs are likely to follow the same pattern now evident in the copper industry, where real costs per unit of production have been rising as lower grades of ore are extracted.

Covering each mineral in somewhat more detail (Landsberg, 1964) worldwide resources of iron are more than adequate to meet requirements through 2000. The United States, however, will become increasingly dependent upon imports to meet its requirements, importing one half of its 100 million ton requirement in 1980, and three fourths of its 160 million ton requirement in 2000.

For manganese, the United States will continue its heavy reliance on imports. Cumulative free world demand is projected at 300 million tons through 2000 of which only 105 million tons are covered by high quality free world reserves. Worldwide reserves, however, are 450 million tons; and there is much more low grade ore available at higher extraction prices.

Projected world consumption of chromium through 2000 is 200 million tons, which is more than adequately covered by worldwide reserves of 250 - 1000 million tons. However, the only western reserves are located in Cuba, which, for the immediate future, means that chromium must be imported over considerable distances from the Soviet Union or Rhodesia.

Free world demand of nickel through 2000 is projected at 37 million tons, about equal to reserves. Satisfaction of demand in 1990 - 2000 will require development of new reserves in Indonesia, the Philippines, and the Caribbean.

Projected demand for aluminum through the year 2000 is 900 million tons. While this demand will exhaust present high quality reserves of 800 million tons, there is a dearth of lower quality reserves.

Projected demand of copper through the year 2000 is 400 - 500 million tons, with present reserves of 200 - 500 million tons (including low quality ores). Working low grade deposits will be essential to meet demands through the last decade of the period.

Projected demand for lead is 80 - 130 million tons, with 70 - 75 million tons available in reserves. Projected zinc demand is 170 million tons, with reserves of 120 million tons. Even with new discoveries of reserves, the picture looks bleak for the 1990 - 2000 period. Fortunately, there are adequate substitutes for these materials, e.g., aluminum vice galvanized steel, nickel and cadmium for batteries.

Tin reserves are now 5 million tons. The projected demand for tin is unknown due to increasing substitution of other materials, primarily aluminum, for tin, in manufacturing. A projected demand of three million tons through 2000 is suggested; this is well within available reserves.

In ocean resources, the most significant aspect of resource recovery during the next thirty years will be, as discussed above, oil and gas recovery from the continental shelves, and later, the continental rises. While both sea water and ocean floor mining will increase significantly over present levels, the total output from such activities will remain relatively small in comparison to offshore production of oil and gas, and all forms of earth extraction and mining. In sea water mining, only magnesium, bromine, and salt are now being extracted in significant quantities. Industrial recovery seems to be feasible for sodium, sulfur, potassium, iodine, and perhaps fluorine, strontium, and boron. The troublesome difficulties are those of inventing and applying concentrating processes, and of handling economic volumes of water. (National Academy of Science and National Research Council, 1969)

Total production of ocean floor mining was valued at

$200 million in 1967, fifty per cent of which was sand and gravel, about thirty per cent iron, tin, and sulphur extracted from placer deposits, fifteen per cent seashells, and about five per cent diamonds. Potentially, the most important deposits are the phosphorite on the shelf, slope, and ocean floor, and manganese nodules on the abyssal floor. Although these nodules are often quite rich in manganese, they also have a very high silica content which makes refining by present techniques economically impracticable. Development of an economical refining process could result in large scale mining of the nodules, not only for their manganese, but also for significant quantities of copper, cobalt, and nickel. (United Nations Economic and Social Council, 1968) The phosphorite deposits mentioned above have generally proved to be of poor quality, but they are good enough to be competitive in some areas far removed from land deposits.

In the area of water resources, the principle concerns in the United States will be continuing the extensive investment and development required to provide the far western states with adequate supplies of water. In the east, the maintenance of adequate water quality will become a problem, but a manageable problem. Internationally, water requirements for the next few decades can probably be met with adequate investment, development, and increased efficiency in use. In certain arid, water-deficient areas--some fifty have been identified--economic development will continue to be hampered, perhaps even halted, by lack of usable water. (Fisher and Potter, 1964) The most significant of these fifty areas are the Mahgreb and India.

In the area of forest products, the projected increase in the United States yearly demand is 19 billion cubic feet, compared with the present 11.6 billion cubic feet. Under present cutting practices, U.S. eastern softwood forests will remain substantially stable through 1980, undergoing rapid depletion thereafter. Western forests will hold up longer, but by the end of the century they will also be moving toward depletion. (Landsberg, 1964) There is some question as to whether world forests will fare any better. The United States will be substantially dependent upon Canada after 1980, while western Europe will become dependent upon Russian softwood. More than likely, softwood shortages and costs will make it economically feasible to begin development of the extensive hardwood forests in the underdeveloped countries.

In summary, there is very little evidence that would support a contention that there will be severe depletion or exhaustion of world resources during the next thirty years, other than the problems associated with lead and zinc. On the other hand, it is very apparent that many countries will become much more dependent upon international supplies of resources than they are at present. In particular, the United States will become heavily dependent upon international supplies of crude oil, iron ore, and forest products. In sea resources, the most significant developments will be in offshore extraction of crude oil and natural gas. Ocean bottom mining will increase significantly, but even so, will represent only a fraction of the world's total resource production.

CHAPTER XVII

THE EXPLOITATION OF OCEAN RESOURCES

by

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1. Introduction.

Enthusiastic accounts of the tremendous resources lying virtually untapped in the oceans of the world and of the near-term prospects for their development are appearing with increasing frequency. Debates in the United Nations and other international forums indicate a growing interest in the institutional and legal setting for exploitation of these resources. Concern is increasing among the underdeveloped nations that they will lack the capital resources and technology required to participate in ocean exploitation. This fear has given rise to a movement for establishing an international regime which will insure that the benefits of ocean exploitation accrue to mankind as a whole. Indonesia and some of the Latin American countries have made exclusive claims to sizable ocean areas not previously subject to national control, partly to guarantee themselves benefits from future exploitation. Given the differing perspectives of individual nations, exploitation of the ocean's resources will be an important future variable in international relations. The outcome could range from peaceful, cooperative development under international auspices to major conflict over exclusive claims, on the pattern of the Colonial Wars.

This chapter will examine the existence of marine resources and the future prospects for their exploitation. The discussion will highlight future technological developments and economic factors which will bear on the exploitation of ocean resources, and conclude with an assessment of the implications which development of these resources may have for the United States and the Navy.

2. Fisheries.

The present world production of fish and shellfish is approximately 64 million metric tons, which represents about ten percent of world production of animal protein. Although the fishing industry has declined in importance in the United States, for many nations it represents an indispensable source of protein, vital employment, or an important means of earning foreign exchange. Improvement in world production will depend upon: (1) international conservation of fishery resources, (2) use of additional species, and (3) development of more economical methods for catching and preserving these resources through the application of modern technology. Estimates of the annual yield which could be taken on a sustained basis range from 55 to 200 million metric tons, with the majority of the estimates less than 100 million tons. (U.S. President. Commission on Marine Science, Engineering and Resources, 1969; v. III, p. VII-11; cited hereafter as Panel Reports.)

Until very recently, fishing methods had not changed substantially in nearly 2000 years. Now however, modern technology is gradually being applied, as illustrated by the modern fishing fleets and factory ships of Japan and the U.S.S.R. In another example, the development of fish protein concentrate (FPC) has increased the potential of marine food resources through utilization of hake, a previously unexploited species. (Butler and Holston in Soule, ed., 1968) Over the next several decades, improvements in locating methods are expected through the use of sonar, optical detection devices, spectro-photographic and infared techniques, and aerial and spacecraft spotting. (Panel Reports, 1969; v. III, p. VII-56) Aquaculture on a commercial scale has been successfully developed in Communist China, Israel, and Japan. Despite very impressive yields per acre, marine aquaculture does not appear to hold great promise in the near term as a technique for bulk production of cheap protein food because of high labor costs. Scientific cultivation, possibly employing waste heat from nuclear power plants to produce upwelling of nutrient-rich water, and controlled genetic improvement may increase the long-range potential of aquaculture and are worthy of continuing investigation. (Panel Reports, 1969; v. III, p. VII-61)

In sum, application of scientific research and modern technology to fishery and aquaculture will result in increased commercial activity, primarily foreign, and increased yield from the sea. While fish and shellfish will continue to be of great importance to some nations, the total yield will constitute only a small percentage of the world protein production.

3. Oil and Gas

The world is now undergoing a tremendous surge in demand for energy, but the extent to which that demand will be met by oil and gas as opposed to other energy sources depends on technological, economic, and political factors. The Free

World has proved reserves amounting to 36 times present consumption, about 75 percent of which lies in Arab nations. Domestic proved reserves are declining; the ratio of proved reserves to annual consumption has declined from a high of 13:1 in 1959 to less than 10:1 at present. U.S. requirements for the rest of the century will amount to three times the cumulative domestic production over the last hundred years. Natural gas requirements are also expected to increase rapidly, reaching a level two and half times present consumption by the year 2000. The ratio of proved domestic reserves to annual consumption has declined more rapidly in natural gas than in petroleum, falling from a level of 27:1 in 1950 to approximately 16:1 in 1968. In meeting increased demand, a major concern of the industry and the nation will be to prove additional reserves. In this search, producers will turn increasingly to the sea to find new reserves which can be developed more economically than those on land. (Panel Reports, 1969; v. III, p. VII-187 ff.)

Although still in the early stages of development, offshore production has grown rapidly and currently accounts for 17 percent of world-wide petroleum production and six percent of natural gas. By 1980, it is estimated that one-third of the world's oil will come from offshore sources. Production has been established off 22 countries and exploration is underway off 75 coastal states on five continents. Principal offshore reserves are located off Venezuela, in the Persian Gulf, and in the Gulf of Mexico, with others scattered widely on the continental shelves of Africa, Asia, South and Central America, and California and Alaska. It is likely that outer shelves and upper continental slopes contain considerable petroleum. Conditions in the continental rise are less favorable because of the absence of large-scale folding and warping which create pockets of hydrocarbons. There is little chance of deposits under the abyssal plains. In natural gas, the only known deposits outside the United States are under the North Sea, the Adriatic, and off Australia. Rapid growth of offshore gas production is expected over the next several years, with the North Sea becoming a major producer. (U.N. Dept. of Economic and Social Affairs, 1970)

Exploration for offshore oil and gas is highly developed and has the unique advantage of being less expensive than similar exploration on land. Approximately 28 percent of the North American shelf has been surveyed, employing ships of the potential of offshore oil and gas will proceed at a rate determined primarily by economic and related political factors, rather than by technology, which is already highly developed.

4. Hard Mineral Resources.

Although such estimates necessarily include considerable uncertainty, it is estimated that world demand for minerals will double by 1985 and perhaps triple by 2000. The world supply from land resources will in general be adequate, with some possible exceptions as discussed in Chapter XVI. Many developed nations, however, are dependent upon foreign sources for many minerals. In the United States, for example, of 72 strategic materials for defense industries, more than 40 are largely imported. The stability of the international situation is thus central to any determination of the adequacy of mineral resources. (Panel Reports, 1969; v. III, p. VII-89 ff.)

There are a number of mineral deposits in the sea which have future economic potential. Sand, gravel, and calcium carbonate are already dredged more cheaply from the sea than from land in many urban areas. Placer deposits of potential interest include: the heavy metals gold, tin, and platinum, occurring in the submerged extensions of streams; slightly lighter minerals in present and submerged beaches; and diamonds in streams and beaches. Except for tin off Indonesia, Malaysia, Thailand, and the United Kingdom, and diamonds off South Africa, however, these deposits are not likely to be either as rich or as abundant as land deposits. Submarine phosphorite occurs on the ocean floor as nodules, phosphatic sands and muds, and in consolidated beds, but these are generally of lower grade than land deposits. Manganese nodules occur in abundance in the abyssal depths. Although these nodules are lower in manganese content than land deposits, they are of interest as low-grade ores of copper, cobalt, nickel, and manganese, rather than manganese alone. Extraction is complicated by high silica content, however. A breakthrough in beneficiation of these low-grade ores of phosphorite or manganese would also bring large lower-grade land deposits into competition. Metalliferous muds containing concentrations of iron, manganese, zinc, lead, copper, silver, and gold have been located in large areas of geothermal activity in the Red Sea. (U.N. Dept. of Economic and Social Affairs, 1970) A major European consortium is planning to exploit one of these deposits known as the

Atlantis II Deep; engineering and economic studies are currently in progress. (Flipse, 1970)

Ocean mining technology is presently rather limited. Commercial extraction of unconsolidated materials and placer deposits is limited to dredging near shore in depths of 300 feet or less. Dredging offshore is twice as expensive as land methods and is highly susceptible to disruption by bad weather. Mining of consolidated deposits is presently accomplished primarily by conventional mining techniques, tunneling from land or from artificial islands. There is no capability at present for commercial deep ocean mining of surficial deposits. (Panel Reports, 1969; v. III, p. VII-109) Development of this capability will require many possible types of new equipment: (1) submarine crawlers or bottom hovering submersibles to explore for and recover deposits, (2) stationary or neutrally buoyant platforms, (3) ocean floor drill rigs, (4) submarine dredges of various types, (5) high capacity, low cost vertical transport systems, and (6) high capacity horizontal transport systems. The long-range possibilities for mining consolidated deposits include the development of sub-floor mines. These mines would be serviced by submersibles through locks installed on the ocean floor. Solution mining, another promising possibility, has been used offshore for years to extract sulfur by the Frasch process. The British are currently developing an offshore potash deposit by solution mining, and methods of chemical and bacterial solution mining are under development for a wide range of other minerals. Controlled use of nuclear explosives has great promise for fracturing the ore bodies beneath the floor in preparation for solution mining. (U.S. Dept. of Economic and Social Affairs, 1970) All these methods of ocean mining imply great expense. Estimates of capital investment for systems capable of harvesting manganese nodules, for example, are in the range of $100 to $150 million. Dr. John Craven, Chief Scientist of the Navy's Deep Submergence Project, however, is optimistic:

> It has been suggested by some that the problem of deep ocean mining is remote and that exploiters will be relatively few. The presumption here is the projected high cost for vehicles and equipment designed to operate on the ocean bottom. On the contrary, although they do not exist at present, it is contended that low cost vehicles capable of exploitation are technologically feasible and will be realized within the next two decades. (Craven, 1967)

Technological feasibility, however, does not necessarily imply that large-scale mining of the deep oceans will be undertaken within this time-frame. In view of the uncertain legal status of the deep seabed, the scale of capital investment required, and the economic factors, such development seems uncertain at best for at least the next two decades. Development will probably slowly progress into deeper water as technology gradually improves. As in the case of the offshore oil and gas industry, economic factors will be controlling rather than technology.

5. Chemical Extraction.

Approximately $400 million worth of chemicals are recovered annually from sea water, with approximately $135 million of this world-wide output contributed by the United States. The principal products obtained, in order of dollar value, are: sodium chloride, magnesium metal, desalinated water, bromine, and magnesium compounds. In the United States salt and desalinated water constitute only a small portion of the value of products recovered, with 90 percent of the value attributed to magnesium metal, magnesium compounds, and bromine. Some 77 elements have been identified in sea water, although chlorine, sodium, magnesium, sulfur, calcium, potassium, bromine and carbon account for over 99 percent of the dissolved elements. Some of the critical trace elements in order of decreasing concentration include: zinc, uranium, titanium, tin, silver, and gold. (Panel Reports, 1969; v. II, p. VI-190 ff.) The next material to be extracted commercially will most likely be uranium. The British have developed a method for extracting uranium from sea water which may make it possible to produce uranium oxide for $20 per pound, a cost competitive with low-grade ores. (U.N. Dept. of Economic and Social Affairs, 1970) Other future possibilities include the extraction of the zinc, copper, and other metals from the hot, concentrated brines found in the Red Sea.

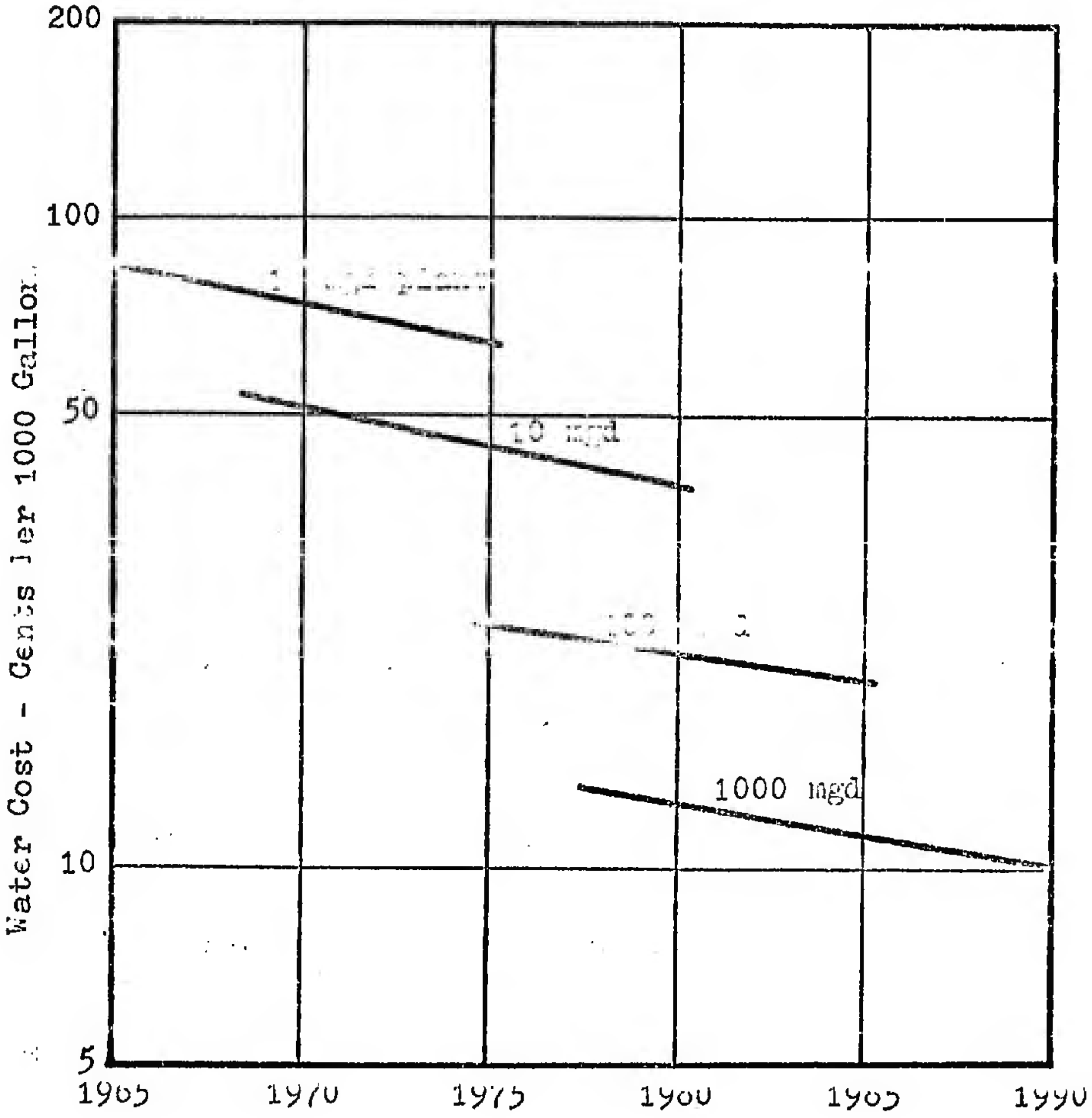
6. Desalination.

The United States has been active in development of desalination techniques and equipment since 1952, with the objectives of developing sources of water for coastal areas and improving the quality of brackish and minerally charged waters for inland communities. Current processes include distillation, crystallization, membranes, and a number of advanced processes in initial development. At the end of 1967, there were some 625 plants with a combined capacity of 222 million gallons per day (mgd) in operation or under construction throughout the world. There are five plants in the United States with capacity over one mgd; the largest, with a capacity of 2.6 mgd has been in operation in Key West since 1967. About 95 percent of the plants now in operation employ the multi-stage flash distillation process.

Continuing progress is being made in improving plant efficiency and reducing the cost of water. See Figure 17-1 for a forecast of future desalting costs for various plant sizes. Growth in installed capacity during the period 1960-1965 averaged 12 percent annually. The Office of Saline Water has forecast growth rates of 24 percent to 1975 and 32 percent for 1976-1980. By 1980 it is estimated that total capacity will reach four billion gallons per day. It should be noted that the price level of sixteen cents per 1000 gallons ($50 per acre-foot), which may be obtainable with a billion gallon per day plant, will be well above the present cost of agricultural water in the United States. (For example, in the Rio Grande Valley, water costs $10-$15 per acre-foot.) Even so, at this level it may be feasible to use desalinated water as a supplement to improve the quality of available agricultural water, or in drought years to protect investment in long-term crops such as citrus orchards. In general, the cost of desalinated water should not be compared

FIGURE 17-1

PROJECTION OF SEA WATER DESALTING COSTS
FOR A RANGE OF PLANT SIZES



Source: Commission on Marine Science, Engineering and Resources, Panel Reports: Industry and Technology (Washington: U.S. Govt. Print. Off., 1969), v. II, p. VI-208.

with the present cost of water, but with the cost of providing additional incremental supplies in today's environment of construction costs and water scarcity. There are many locations today in the United States and around the world where desalination is competitive with alternative sources. While desalinated water will probably not be used "to make the deserts bloom" by the year 2000, as some would have us believe, desalination has already proven economically competitive in many areas and will be employed on an increasing scale in the future where conditions warrant. (Panel Reports, 1969, v. II, p. 197 ff.)

7. The Sea as a Source of Electric Power.

a. Undersea Nuclear Plants. Consideration is being given to locating nuclear power plants on the ocean floor to supply electric power for undersea installations or for cities. Undersea plants would be remote from population concentrations; could use the ocean as a heat sink, avoiding thermal pollution in rivers; and would partially offset the increased costs by savings in the cost of land and shielding. Preliminary studies indicate that there are no technological or physical impossibilities in the concept. (Panel Reports, 1969; v. II, p. VI-213 to 216)

b. Tidal Power. The concept of harnessing tides as a source of electrical power has been actively studied by several countries with potentially feasible sites: France, Australia, the Soviet Union, the United States, and Canada. England and Argentina also have sites with large potential. The only tidal project under development is the $100 million Rance project in France, which will have an installed capacity of 320 megawatts. The United States and Canada have been studying the Passamaquoddy project since about 1922. Although development was found to be economically feasible in 1961, more recent studies have determined that with current interest rates and costs, the benefit-cost ratio was reduced to uneconomic levels and the project has been dropped. (Panel Reports, 1969; v. III, p. VII-233, 234)

c. Other Sources of Ocean Power. Other concepts for generating power include harnessing the energy in waves and currents, but there is currently little possibility of developing these sources in commercial quantities. It may be feasible to provide small amounts of power for buoy lighting and signals in this manner. Another possibility is the conversion of the potential energy represented by thermal differences between surface waters and those at great depth.

To date it appears that costs would be prohibitive because of the size of the turbomachinery required for such a low temperature operation. (Panel Reports, 1969; v. III, p. VI-234)

d. Within foreseeable technology, it is considered unlikely that tidal energy, currents or waves, or thermal differences will provide a significant percentage of the total electric power by the end of the century. It is likely that undersea unclear plants will be constructed, but primarily as small power sources for undersea installations.

8. Development of Multi-Purpose Technology. Spurred by industrial interest, research and development sponsored by the government, and growing interest in the ocean by universities, institutions, and associations, rapid progress is being made in ocean technology. Forecasts of the future development of multi-purpose technology include the following highlights:

a. Free Diving. Saturated diving techniques reach approximately 650 feet at present, with experimental wet chamber dives to approximately 1100 feet and laboratory dry chamber tests to 1700 feet. Progress in free diving is continuous and rapid; achievement of the capability to work as a free diver at depths approaching 2000 feet is almost certain within a few years. Some experts forecast exceeding this level eventually. Within twenty years there is a good chance for development of liquid breathing techniques which would permit even greater depth capability. (Panel Reports, 1969; v. II. p. VI-56 ff.; Eleson, 1970; Booda, 1971)

b. Vehicles. A large number of experimental and prototype submersible research vehicles with depth capabilities down to 8000 feet have already been built by industry. Operating depths to 20,000 feet are within the reach of present technology. There are some current indications of "overbuilding" beyond the existing demands of the market. Westinghouse Electric, for example, has stopped construction of DEEPSTAR 20000, which was designed to operate at 20,000 feet and would have been launched in 1972. Because of the high cost of both development and operation of deep submersibles, further development and construction must be based on an exacting technical and economic analysis of the specific requirement. (Shenton, 1970) Unmanned, remotely controlled vehicles will find increasing application. The Japanese firm of Komatsu already has in practical use new submarine bulldozers which can operate at 200 feet. The vehicles are electrically-powered via cable from a support barge, where an operator controls the excavation operations, aided by sonar, underwater lights, and television. (Merrill Lynch, 1971) As the requirements arise, a variety of research and work vehicles will be developed for non-military missions over the next several decades.

c. Habitats. Existing technology permits construction of "dependent" habitats on the continental shelf. Within ten years, completely self-contained stations, independent of surface support, will be possible. The next significant development in habitats will probably be the construction of a seamount station. Within 20 years a laboratory habitat could be installed on the mid-Atlantic Ridge, and by the year 2000, an ocean-bottom habitat at 20,000 feet will be possible.

9. The Institutional and Legal Setting of Ocean Development.

The principal source of international law concerning the exploitation of the resources of the ocean is the 1958 Convention on the Continental Shelf. In brief, this convention granted to the coastal state sovereign rights on the continental shelf for the purposes of exploration and exploitation of natural resources. The continental shelf is defined in the Convention as "the seabed and subsoil of the submarine areas adjacent to the coast but outside the area of the territorial sea, to a depth of 200 meters, or beyond that limit, to where the depth of the superjacent waters admits of the exploitation of the natural resources of said areas." (U.S. Treaties, 1964; v. XV, pt. I, p. 471-526, Article 1) The exact extent of the continental shelf is thus not fixed, but moves outward as exploitation becomes technologically feasible. Article 1 also provides that "similar areas adjacent to the coast of islands" are included within the definition of the continental shelf. Interest in ocean exploitation may therefore vastly increase the economic and strategic importance of islands, however small, if they are located in shallow waters and have extensive continental shelves. Despite the expandable definition of the continental shelf, it is clear from an examination of the record that the conference delegates did not feel that they had disposed of the entire ocean floor. They evidently sought to retain sufficient flexibility to take into account technological and economic progress and anticipated that a more exact definition would be made at a future time. (Burke, 1969)

The United Nations, through its Committee on the Peaceful Uses of the Seabed and the Ocean Floor, has been debating for several years the establishment of an international regime for the exploitation of the ocean's resources. The basic principle guiding the discussion has been that the ocean's resources are the heritage of all mankind and must be developed for the benefit of all, rather than for the few technologically advanced nations. The issues involved are many and complex. Many differing national viewpoints have been advanced on such matters as the nature and powers of the international organization; licensing arrangements, including the question of whether licenses should be granted only to nations or also to national and multi-national corporations; the methods for sharing the revenues which would be generated; potential economic problems for present suppliers of resources; liability for damages and claims adjudication procedures; and protection of the environment. The United States has submitted a draft U.N. Convention on the International Sea-Bed, which would place the continental slope and rise under the administration of the coastal state, on behalf of the international authority, while the "International Sea-Bed Resource Authority" itself would administer the deep seabed beyond the continental margin. Other nations have submitted divergent proposals. The complex, sensitive questions at issue are central to the conflict between the developed and underdeveloped nations. (U.N. General Assembly, 1970) A new Law of the Sea Conference will convene in 1973 to address these matters, but it is difficult to be optimistic regarding the outcome. The chances of reaching an agreement which will create a strong, viable international regime and also be satisfactory to a substantial number of nations are judged less than even.

The degree to which the legal issues are satisfactorily resolved will be a principal determinant in the rate of future exploitation of the ocean's resources; in an environment which requires large capital outlays and has high inherent risks, legal uncertainty will impede investment. Should the conference prove unable to reach any substantial agreement, a proliferation of unilateral claims on the pattern established by Chile, Ecuador, Peru, various other Latin American nations, and Indonesia can be anticipated, which will increase the probability of conflict over exploitation.

10. Implications for the United States and the Navy.

There is considerable potential for industrial exploitation of the sea, although this potential is often exaggerated in popular writing. The well-established industries will continue to grow: offshore oil and gas on the continental shelf; chemical extraction; mining of sand, gravel, and sulfur; shrimp and tuna fishing; and marine recreation. Recently established industries which also appear promising include desalination, bulk and container transportation systems, freshwater and estuarine aquaculture, and undersea recreation. Future industries expected to develop within fifteen years include mining of placer minerals and development of oil and gas beyond the continental shelf. Over the longer term, exploitation of offshore oil and gas in the continental slope and rise will lead the way for industrial development in deeper water. Deep-water mining of surficial and sub-bottom deposits appears uncertain over at least the next two decades because of legal and economic factors, but will be technologically feasible by the end of the century. Ocean exploitation will proceed at a gradually increasing rate, and will be well established on a broad front by the year 2000.

There are a number of aspects of ocean exploitation which generate forces for international cooperation. The scale of activity is too large for any single nation to handle. Even the simple problem of ocean mapping is so large that it would take several decades to complete with the dozen or so vessels that any one nation could devote to the task. There is also an imperative need for access to the data and experience of many nations in order to conduct research, particularly in conservation of the ocean's living resources. The objects of research are frequently affected by many nations and will require cooperative effort for satisfactory conclusion, as in the case of pollution. Cooperative international effort is needed simply to establish uniform standards so that research data will be complete and reliable. The technology for ocean exploration and exploitation is extremely expensive and is therefore limited at present to the advanced nations. The underdeveloped nations, however, are anxious to share in potential profits and are increasing the pressures for cooperative effort.

The degree of cooperative effort and peaceful progress in ocean technology will depend to a considerable degree on the international climate. The greatest progress would be made in conditions similar to those of the Cooperative World in Chapter IV. Conversely, the diversion of funds and effort into internal problems in World-wide Withdrawal as outlined in Chapter III would probably severely impede ocean exploitation.

Increased non-military use of the oceans seems assured, and this activity will inevitably impact on military freedom of operations. The need to protect the lives and property of U.S. nationals in this new environment will generate requirements for underwater navigation aids, deep search and rescue capability, and safety inspection and certification of submersibles and other equipment, some of which could become Navy missions. The broad advance in ocean technology will certainly improve the capacity of the developed nations to use the ocean environment for military purposes, but at the same time the pressure from many of the smaller nations to restrict the use of the oceans to peaceful purposes, narrowly defined, will increase.

CHAPTER XVIII

SPACE TECHNOLOGY

by

LCDR Jon R. Ives, CEC, U.S.N.

1. Introduction.

The birth of the Space Age was heralded in 1957 by the launching of Sputnik. In the brief time since that event, space technology has made remarkable progress, the impacts of which have been widely felt. Progress in science and technology, much of which is space-related, has become an extremely important short-run variable in international power politics, as well as an important source of societal change. Consequently, an attempt to forecast the future for the United States and the world should consider the developments in prospect for space technology. This chapter will therefore explore some forecasts by experts in the field of space, the current long-range space program of the United States, and the implications which space technology may have for the United States and the Navy by the year 2000.

2. Forecasts in Space Technology.

The American Astronautical Society held a symposium in 1966 with the specific objective of forecasting developments in space technology by the year 2000. The papers presented by space scientists at this conference provided an invaluable source of expert long-range forecasts, many of which are reflected in the following discussion.

a. Propulsion Systems. Wesley A. Kuhrt, Director of Research for United Aircraft Laboratories, has forecast developments in space propulsion technology as follows:

Chemical Systems. By the year 2000, more efficient nuclear systems will replace chemical rockets for primary propulsion. Because of their simplicity, chemical rockets will continue to be used and further refined in applications requiring only moderate energy, such as attitude control, navigation correction, and excursion modules. Solid rockets will have limited use, primarily in applications requiring rapid response, low volume, and mechanical simplicity. Liquid rockets of highly sophisticated design will be in common use. New designs will employ much higher chamber pressures and new fuels developed through cryogenic technology.

Nuclear Fission Systems. The major development in propulsion by the year 2000 will be in nuclear fission rockets. Solid core nuclear rockets of high specific impulse will be developed for a wide variety of applications. The development of high-pressure chemical rockets will provide the technological basis for the development of gaseous core nuclear rockets, marking the beginning of true space transportation systems. Nuclear-electric ion propulsion systems will be developed to provide the basis for exploration of the outer planets. Contamination hazards will probably restrict the development of nuclear pulse systems. Similar ranges of specific impulse will be provided by development of the safer gas core nuclear rocket.

<u>Nuclear Fusion</u>. Direct thrust nuclear fusion systems and indirect nuclear fusion gas core systems will be in the experimental stage, but will not have sufficient advantage over the gaseous core fission rocket to warrant large-scale development by the year 2000. Developmental work on nuclear fusion rockets, particularly the fusion-electric ion propulsion system, will continue, however, in order to meet the power requirements of far-space exploration in the next century.

<u>Photon Systems</u>. By 2000, photon rockets for

interstellar propulsion will be under study, and testing of nuclear-powered, gas laser photon directed propulsion may be taking place in an orbiting laboratory. (Konecci, 1967; p. 24-27)

b. Satellite Technology.

Communications. One of the most important general uses made of satellite technology will be in communications, including visual communications and data transmission. By the year 2000, satellite communications will have vastly increased the flow of information, both within the United States and internationally. The implications of these developments are discussed in greater detail in Chapter XV.

Weather Satellites. By the year 2000, a network of synchronous satellites will gather world-wide weather data, including that relayed from land and ocean stations. A prototype synchronous satellite for meteorological use is currently being developed by Philco-Ford under contract with the National Aeronautics and Space Administration. The data from the satellite network will be analyzed by giant computer complexes in order to improve long-range weather forecasting. It is estimated that accurate two-week weather forecasts would save the United States $2 billion annually. (Foreign

Policy Association, 1968: p. 31) This system of synchronous weather satellites would be essential to monitor the effectiveness of any attempts at weather control. Because of the potential adverse effects, weather control must be attempted only with great caution and with close monitoring of effects.

Oceanography. Use of satellite techniques in oceanography is potentially very attractive because of the ability to rapidly cover the vast areas involved. Present usefulness is somewhat limited by the inability of existing sensors to penetrate to any depth. Ocean data buoys, capable of gathering and relaying a vast quantity of surface and subsurface data have already been developed and tested. These could be readily used in combination with satellites to provide a global oceanographic data-gathering network with both civilian and military applications. (Foreign Policy Association, 1968; p. 172)

Navigation. Satellite systems have great potential for navigation aids and traffic monitoring and control. The Omega Satellite System enables positioning within 50 meters based on a single measurement and an accuracy of five meters can be obtained with repeated measurements and statistical techniques. (Konecci, 1967; p. 87) A system of simultaneous photography of a satellite from separate locations on the earth's surface has been developed which greatly improves our ability to precisely locate the continents with respect to one another. Continued development of satellite navigation aids will permit the exact determination of locations anywhere on earth with a high degree of accuracy. This development will be of great significance in navigation, in the precision surveying of the oceans and the continents, in exploiting the ocean's resources, and in intercontinental targeting of both land and sea-based missiles.

World Resources Survey. Presently available sensors can detect and differentiate crops; near surface minerals; water resources; forests; and the works of man. By the year 2000, advanced satellite-borne sensors will be able to take an inventory of relevant data, and relay it to large computer complexes for analysis and direct production of resource maps for the entire world. (Foreign Policy Association, 1968; p. 32)

Surveillance. Development of a wide variety of sensors to supplement photo coverage is continuing and by the year 2000 will have reached a high degree of sophistication. Continuing improvement in resolution will be achieved which will eventually permit gathering of information in such detail that defense planners will be able to accurately project another nation's total capabilities. This development will constitute a massive threat to national privacy. (Foreign Policy Association, 1968; p. 33-34)

d. Materials Science. Considerable basic research in materials science will be necessary in order to develop materials with the properties required in space systems. Many of these new materials will find applications in a broad range of problems, both military and non-military. For example, deliberate manipulation of the atomic structure of metals to reduce friction without lubrication has already been achieved as a result of basic research supported by the space program. High-strength filaments developing one to two million psi tensile strength are forecast by Wesley Kuhrt. High-temperature composite metals capable of maintaining their mechanical properties at temperatures close to the melting point will be developed in rocket technology. New superconducting alloys with transition temperatures in the liquid hydrogen range will be developed. These alloys will provide the basis for tremendous advances in electrical devices requiring high-strength magnetic fields. Dr. Mac C. Adams, Associate Administrator of the Officer of Advanced Research and Technology for NASA, has forecast application of this technology in advanced shielding concepts. Spacecraft will be shielded by a combination of magnetic and electrostatic forces rather than by metal shields. The resultant saving in weight will permit significant increase in spacecraft payload. (Konecci, 1967; p. 23, 51)

d. Biomedical Science. The space program will support considerable basic research in biomedical science in connection with life support systems. This research will make a major contribution toward the progress foreseen in medical science and the behavioral sciences by the year 2000. These developments and their implications are discussed in Chapter VIII.

e. System Reliability. Continued improvement is expected in system reliability. Dr. Konecci has forecast reliability of five to ten years in space transportation systems by the year 2000. Daniel Fink expects space communications systems with a reliability of ten years within this same period. Improvements in reliability will undoubtedly be applied to military electronic systems in order to reduce maintenance, improve system availability, and reduce costs.

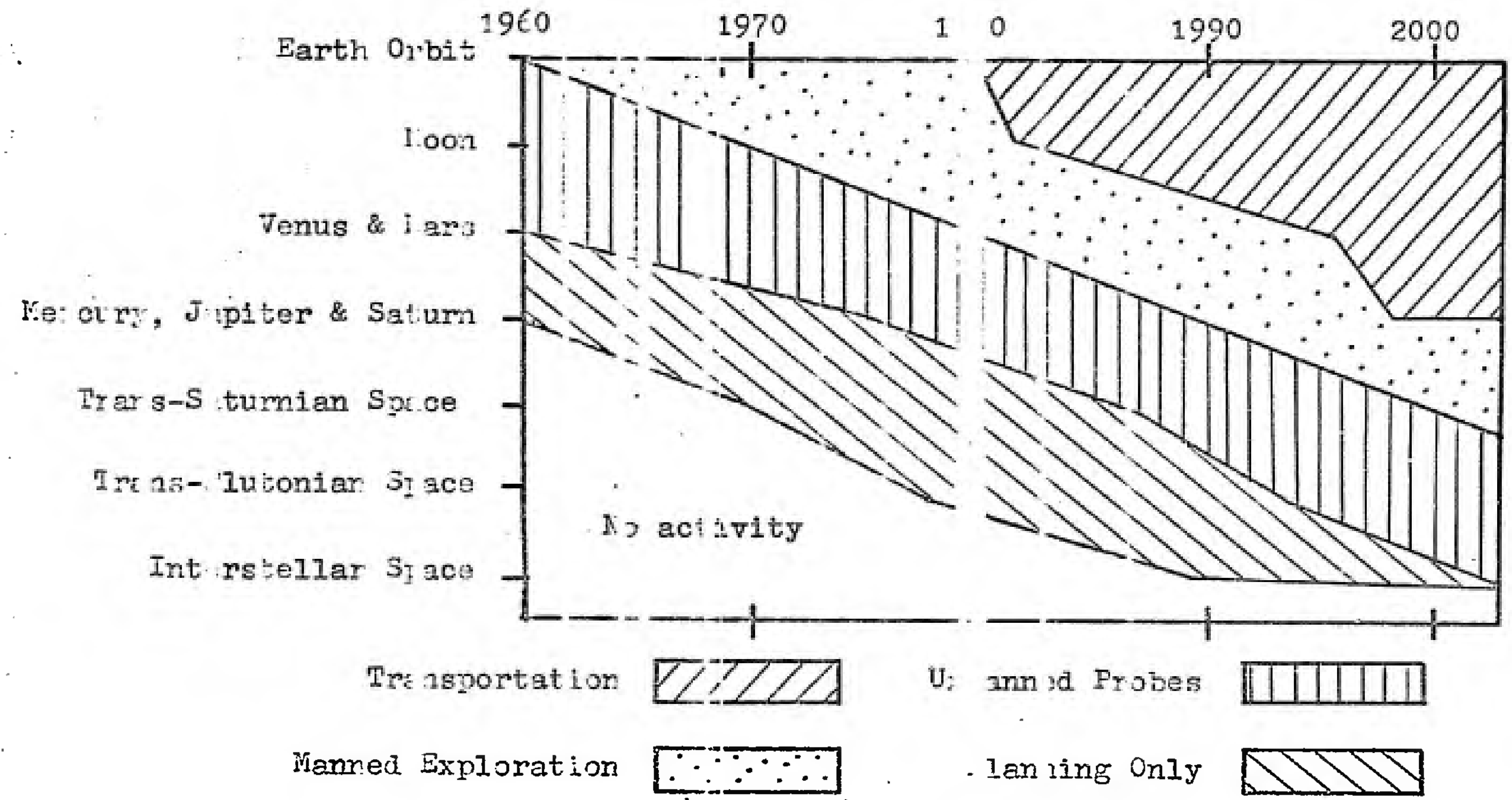
(Konecci, 1967; p. 2, 63)

f. Systems Management Technology. An active space program, as the Apollo Program conclusively demonstrated, will require effective management of very complex systems. Dr. Walsh anticipates that systems management techniques developed for this purpose will have broad application to a wide range of national and international problems, including environmental pollution, traffic safety, urban planning, population control, and the efficient use of resources. (Konecci, 1967; p. 13)

3. Feasible Schedule for Solar System Exploration. Exploration of the solar system will go through successive phases of unmanned probes, manned exploration, and finally the development of transportation systems. Wesley Kuhrt estimates that by the year 2000, the Moon, Venus, and Mars will be in the transportation phase; Mercury, Jupiter, and Saturn will have been under manned exploration for approximately ten years; and manned exploration of the trans-Saturnian planets will be just beginning, following a series of unmanned scientific probes which will begin about 1987. Unmanned probes of trans-Plutonian space will begin about 1993. (See Figure 18-1 for an illustration of a technologically

FIGURE 13-1

SOLAR SYSTEM EXPLORATION SCHEDULE



Source: Wesley A. Kuhrt, "Space Propulsion in FY 2000," Eugene B. Konecci et al., eds., Space Age in FY 2000 (Tarzana, California: American Astronautical Society, 1967), p. 3.

feasible solar system exploration schedule. Chemical propulsion technology will be used in the early phases of solar system exploration, followed by solid core and gas-core nuclear technology in the later phases. The need to reduce round-trip times to the trans-Saturnian planets will provide the impetus for the development of nuclear-electric propulsion. Kuhrt also indicates that the economy of the United States will support the extensive space exploration which he has forecast, without neglecting other areas of government interest and concern. (Konecci, 1967; p. 35)

4. Current Space Program of the United States. Progress in space will depend primarily on the national will to allocate the necessary resources. This section of the chapter will discuss the current space program of the United States for two underlying reasons: first, to examine the present national commitment to space programs, and second, to determine if the current commitment is consistent with the preceding long-range forecasts, which are based primarily on technological feasibility.

In a speech before the Economic Club of Detroit on September 14, 1970, Dr. Thomas O. Paine, then Administrator of NASA, discussed the plans of the current administration.

The program for the 1970's, which is based on a level of support of less than one percent of the Gross National Product, reflects the previously expressed desire of the Congress for a program of "diversified and practical space goals pursued at a moderate and economical pace." Dr. Paine considers the program reasonable and economically feasible, but noted that carrying it out will depend on sustained leadership and national will over a period of many years. The three primary goals for the 1970's will be: (1) development of a reusable space shuttle rocket plane, (2) the development of a permanent space station in orbit around the earth, and (3) development of space tugs, for economical transportation between points in earth orbit.

The space shuttle now under development will be NASA's most important single effort during the next ten years. It will provide the basic transportation into earth orbit for all future manned and unmanned programs. The present Saturn, Titan, Atlas, and Delta rockets will all be retired in favor of the more economical, reusable space shuttle.

Preliminary design of the various modules which will make up the space station is currently in progress. In 1973 the Skylab program--the last manned flights before the shuttle--will keep astronauts in orbit for up to two months, developing and testing concepts for the design of the space station. When completed, the modules of the space station will be ferried into orbit by the new space shuttle, where they will be joined together. By the end of the decade, the permanent space station is planned to include large optical and radio telescopes for astronomical observations, biomedical research facilities, and many earth observation capabilities.

The space tug will spend its entire life in orbit, providing transportation between space stations, satellites, and other points in orbit. Preliminary design of the space tug is now underway in the United States and Western Europe, with a target of the late 1970's for availability.

The last Apollo moonshot will take place by the end of 1972, ending manned lunar missions for the 1970's. Further lunar exploration is planned for the 1980's using transportation systems based upon the space shuttle. Initially, a space station will be placed in lunar polar orbit, from which astronauts will descend to the lunar surface for up to fourteen days at a time. Long duration visits, surface travel, and lunar shelters are not planned until later phases.

The current plans also include extensive unmanned exploration of the planets during the 1970's. These unmanned flights with automated spacecraft will prepare the way for manned trips to Mars and Venus prior to the end of the century. (Space Task Group, 1969; Paine, 1970) Some of the highlights of the unmanned program are as follows:

a. An unmanned Viking mission landing instruments on Mars in 1976.

b. The Grand Tour of the Outer Planets. During the late 1970's the outer planets will be positioned to permit a multiple-planet flyby with a single spacecraft. Current plans provide for two such shots: one past Jupiter, Saturn, and Pluto in 1977; and the second past Jupiter, Uranus, and Neptune in 1979.

c. Two Mariners in 1971 will start the hundred million mile voyage to Mars with the objective of attaining Mars orbits and transmitting back the first complete map of the Martian surface.

d. A third Mariner will depart in 1973, swing by Venus, and travel on to give us our first view of the surface of Mercury.

e. In 1972 and 1973, Pioneers will be launched on the first flyby of Jupiter.

f. Helios, an advanced satellite developed by West Germany, will be launched in 1974 and 1975 on trajectories to pass near the sun for scientific observations.

Although the pace of the space program has slowed somewhat from that of the hectic years which culminated in the successful moon landings, the present commitment is sizable and should provide a sound basis for realization of many of the longer-range forecasts in section three. The present plans for solar system exploration are slightly less ambitious than the forecast of Wesley Kuhrt, and place less emphasis upon manned trips into space. If the history of past extended range forecasting is any guide, however, both estimates could well prove conservative. Much depends upon what future demands arise to compete with space programs for the resources and energies of the nation.

5. Implications of Space Technology.

From the developments which have been forecast, it is apparent that by the year 2000, man will have taken a giant step into space unless social imperatives dictate a drastic reordering of priorities. Technology will not limit space endeavors; the extent of manned and unmanned exploration will depend primarily on the political will of nations to allocate resources for this purpose. A vast array of new technological developments will flow from an active space program, with significant and widespread impact upon individuals, nations, and the international community. It is virtually certain that major developments have been omitted in this discussion; many of the major implications of space and other technologies will be the result of developments not yet foreseen.

One impact of space technology already much in evidence is that of raised expectations for progress in the social and political spheres. For generations "reaching for the moon" has epitomized the impossible; accomplishing that impossible goal within ten years has had a marked effect upon the national imagination and our sense of the possible. If we can spend billions to send a few men to the moon, it is difficult for many to understand why we are unable to spend whatever is required to help the millions affected by urban problems, poor education, inadequate housing, inequality before the law, rural and urban poverty, and a host of other ills. Continued progress in space technology may heighten the contrast between technological and socio-political progress, increasing the demands for a drastic re-ordering of national priorities.

The desire to capitalize upon the potentials of space technology will provide a significant impetus for international cooperation. Satellite communications, world-wide monitoring of environmental data for weather forecasting and control, and earth resources surveys, for example, all require implementation on a global scale for maximum effectiveness. Many nations, including the industrialized nations, will not by themselves have either the capital resources or the numbers of scientific and technical personnel required. The full potential of this technology can be realized only through international cooperation and pooling of resources.

Satellite surveillance capabilities will be improved to such a degree that national privacy as traditionally conceived will be greatly diminished. The security once provided by physical geography and national boundaries will be further eroded. In a tense, conflictual international environment, surveillance by satellite could aggravate already strained relations, perhaps leading to destruction of foreign satellites and an escalation to armed conflict. Sudden, significant improvement in surveillance capabilities of one nation might precipitate this type of conflict. In a cooperative, supportive international environment on the other hand, the decreasing significance of international boundaries under the combined impacts of surveillance, communications, increased travel, and similar factors could contribute to a global outlook, successful arms limitations, and gradual changes in the nation-state system. The certain development of this surveillance capability has implications which must be squarely confronted by the United States to ensure that world stability is not adversely affected.

Progress in space technology and its related implications will both depend on the international atmosphere in which these future developments take place. Some of the differing implications under the world conditions developed in Chapters III, IV and V are briefly sketched below.

Scenario I - World-wide Withdrawal. As a result of mounting internal problems and the related diversion of funds, progress in space technology will be less in Scenario I than in either of the others. Very little international cooperation will be possible because of the inward focus of national attention in most countries, and many of the opportunities for global technology will be unexploited. Surveillance by satellite will be extensively used, however, to guard against a build-up in threats from abroad while funds are diverted from national defense into more pressing internal problems.

Scenario II - Cooperative World. In this scenario, the diminished conflict will permit a larger investment in space technology by individual nations. The growing international cooperation will also permit joint space projects, sharing of research, and elimination of duplicative effort. This scenario will permit a greater degree of progress in space technology than either of the other two. The pace of technological change will therefore be greatest in this scenario, with related magnification of the social impacts flowing from new technology.

Scenario III - Conflictual World. In the face of the increased international conflict of this scenario, joint development of space technology will prove impossible. Without the synergistic effects of international cooperation, the overall progress in space technology will be considerably less than in Scenario II. The emphasis will shift toward military applications of space, such as surveillance capabilities and intercontinental rockets. In a climate of conflict, the threat posed by sophisticated surveillance capabilities may even lead to abandonment of overt warfare in favor of new "anonymous" types such as weather modification or advanced types of bacteriological warfare.

The implications of space technology for national defense and the Navy are both negative and positive. Space programs will compete with defense for funds and technically trained personnel. On the other hand, research in space technology will yield many developments which will have military application, and the space program will help to sustain the highly technical industrial base which is essential for national defense. There is a very good possibility that new missions for the Navy may arise as a result of developments in space. The use of naval forces for recovery of returning space vehicles and the recruiting of naval personnel for astronaut training are two examples of current space-related tasks. The use of space for weapons systems, such as orbital weapons platforms, seems relatively unlikely because of the ease with which such vehicles can be detected, tracked and destroyed. Improvements in surveillance will greatly increase the attractiveness of submarines as platforms for both nuclear and conventional weapons systems, at the expense of surface vessels. The combined potential of future capabilities in surveillance, satellite communications, and long range missiles may make the surface an unacceptably hostile environment for the future warship.

CHAPTER XIX

FUTURE WEAPONS SYSTEMS

by

CDR Donald E. Repass, U.S.N.

1. Introduction.

An effort to look into the future and predict the changes which might occur in the field of weaponry is fraught with difficulty. D. G. Brennan, a mathematician, member of the Hudson Institute, and weapons "futurist," elaborated on this theme when he stated that because military technology draws on many sub-fields of technology and is additionally dependent on non-technical influences, it is one of the fields least subject to long-range forecasts. Among the non-technical influences, Brennan included fashions--that is, a rough prevailing consensus on admissible kinds and uses of warfare, based on much-less-than-detailed analysis of all possible alternatives--and prevailing trends and "temperatures" in international diplomacy. (Foreign Policy Association, 1968) In 1937 a detailed study of future technology conducted under high-level government auspices failed to forecast the development of jet engines, radar, inertial guidance of missiles and aircraft, cruise missiles, ballistic missiles, nuclear weapons, nuclear submarines, computers and artificial satellites, all of which were in use or under development within the following ten to twenty years. (House Documents, vol. 18, no. 360, 75th Congress, First Session, 1937) This chapter will approach this difficult problem of weapons forecasting by examing the prognostications of "futurists" of various disciplines in order to determine which technologies in the weapons field are advancing and may have increasing importance in the future.

2. Weather Control.

If significant control of weather is achieved, it may well have major military applications. Precipitation enhancement would have some value in classical tactical situations. One could, for example, imagine field commanders calling for local enhancement of precipitation to cover or impede various ground operations. An alternate use of cloud seeding might be applied strategically. Preliminary analysis suggests that there is no effect 200 to 300 miles downwind, but that continued seeding over a long stretch of dry land clearly could remove sufficient moisture to prevent rain

1000 miles downwind. This extended effect leads to the possibility of covertly removing moisture from the atmosphere so that a nation dependent on water vapor could be subjected to years of drought. (Calder, 1968) Naval planners have often thought of sending a hurricane against another nation's fleet or of grounding enemy aircraft with storms. (Foreign Policy Association, 1968) Herman Kahn and Anthony Weiner believe that some control of weather and possibly climate is very likely during the last quarter of the Twentieth Century. (Kahn and Weiner, 1967) Professor Gordon J. F. MacDonald cautions that at present we are a long way from having the basic data and understanding necessary to carry out such experiments; nevertheless, he believes that the long-term possibility of developing techniques for weather control under the cover of nature's irregularity does present a disquieting prospect. (Calder, 1968)

3. Subsurface Operations.

When looking at naval technology which will be developed by the 1980's, Dr. W. A. Nierenberg, Director of Scripps Institute, wrote that the chief trend in submarine technology will be toward operations at very great depths. (Calder, 1968)

Even now vessels can reach ocean depths of 20,000 feet or more, but they lack pressure hulls able to float by means of internal buoyancy. It is probable that material developments in the coming years will make possible submarines with a depth capability of 20,000 feet or more. This development would render approximately 98 percent of the ocean floor accessible to submarines and submarine-supported technology. Dr. John P. Craven believes that control of the ocean depths affected by deep submergence technology will dominate anti-submarine warfare in future years. Deep underwater "fortifications," defensive barriers, and weapons centers might be employed in this effort. (Foreign Policy Association, 1968) General Andre Beaufre supports the thesis that the "invisibility" provided by the ocean depths will result in more intense national efforts to capitalize upon the advantages of the undersea environment. The modern quiet submarine is virtually undetectable when submerged because sea water rapidly attenuates most forms of radiated energy which could provide a basis for detection. Low frequency sound continuous to offer the most promise for detection. General Beaufre wrote that by the 1980's someone may possibly discover a practical means of tracking submarines at depth, but he believes that nothing is less certain. It is therefore plausible that naval forces will tend to become more subsurface, with missile-carrying submarines, hunter-killer submarines, and even transport submarines. (Calder, 1968)

4. Aerospace Plane.

Several advanced concepts for aircraft and space vehicles have been combined in the aerospace plane. This plane would take off from an airfield, using some form of air-breathing propulsion and aerodynamic lifting, and fly higher and faster until it achieved earth orbit. The system in its initial configuration would probably employ two or more stages, analogous to multiple-stage rockets. The first stage would provide the thrust and airlift required for initial launch and would return to the launching airfield for re-use in subsequent flights. Vehicles of this type have potential for a number of military uses, such as bombardment, reconnaissance, and interception; their overall importance, however, is by no means well established. (Foreign Policy Association, 1968) As mentioned in Chapter XVIII, the United States will develop an aerospace plane known as the space shuttle under the space program for the 1970's.

5. Lasers (Disintegrator Ray).

With the discovery of the laser, light beams with a very small angle of divergence and with a very high rate of energy delivery are now possible. A weapon that will blind the unprotected eye is technically feasible with current technology. The developing technology of the laser constitutes a threat against unprotected and naturally soft targets such as satellites or astronauts in space suits. (Calder, 1968) Once out of the dense atmosphere, a high-powered laser beam might be used for destruction of missiles or for anti-aircraft defense. A system of satellite-borne lasers could be developed to provide a defense against long-range enemy ballistic missiles. (Elain, 1967) Battlefields of the future may look like Buck Rogers comics of the past with laser-powered hand guns, field pieces, and anti-tank weapons. (Foreign Policy Association, 1968)

The laser may also provide the basis for an inertial navigation gyroscope of a very high accuracy, lacking moving parts which wear out, and almost unaffected by vibration or acceleration. Recent work has shown that an increase in gyroscope sensitivity of more than a million times can be obtained by the use of the highly coherent light of lasers.

Although there are still difficult technical problems to be solved, the laser gyroscope is likely to bring a major increase in accuracy and may also reduce the cost of inertial guidance and control. (Calder, 1968)

6. Gravity Control.

We still know little about gravity control, but it is conceivable that control might eventually be achieved. One of the most interesting applications would be in individual lifting devices for soldiers. Even if the anti-gravity mechanism did not itself provide horizontal propulsion, relatively modest sources of thrust could easily be provided. A cheap form of such three-dimensional mobility for individual infantrymen could revolutionize the tactics of land warfare. (Foreign Policy Association, 1968) Herman Kahn considers anti-gravity a "far-out" possibility by the year 2000. (Kahn and Weiner, 1967)

7. Surface Effect Ships (Hovercraft).

Professor Nierenberg believes that future solutions to the classical problem of keeping the sea lanes open against hostile submarines will require fundamental changes in technology at the surface. The increased speed of the submarine poses a far greater threat to the surface vessel and simultaneously makes the submarine less vulnerable. This trend, combined with advanced surface-to-surface missiles, may bar conventional ships from effective use of the seas for transport in time of war. High-speed surface effect vessels, such as hovercraft and captured air bubble vehicles, may help to reduce the advantage of the submarine. These machines are capable of operating at 100 knots in high seas and can be built to a size of 5000 tons or greater. By the 1980's craft for amphibious landings will probably be using surface effect techniques to enhance, by means of greatly increased speed, the possibility of achieving surprise. This change will affect the entire nature of the current assault force, whose low speed in the past has made it exceptionally vulnerable to submarine attack. The surface effect vessel may also be used as a submarine hunter of a very deadly sort. (Calder, 1968)

8. Robots.

The traditional function of the soldier, whether on foot or in a vehicle, is to find the enemy and destroy him with a weapon. To do so he must propel himself across the land until he is close enough to detect the enemy by sight and aim his weapon. All these functions can be performed far better by a sophisticated walking mechanism. A regiment of such robots could be controlled by a human soldier. They might be deployed to move at fifteen kilometers per hour through a jungle and destroy all men encountered. In conditions where anti-personnel weapons or radioactive fallout make battlefields untenable for human troops, robots may be the only means of carrying out the traditional military task of occupying and holding ground. Manned fighting vehicles have reached a very advanced stage of development. As long as men are present in the fighting vehicles, their safety constitutes a compelling consideration. Safety requirements severely restrict the destructive payload carried by the vehicle and halve the distance from its base at which it can deliver that payload. Great attention must be devoted in design to safety features, to comforts, and to durability. The technical requirements can be met completely by the development of the robot pilot for bomb delivery machines on land, in the air, in outer space, and underwater. (Calder, 1968)

9. Doomsday Machine.

An earth-orbiting satellite containing a nuclear fusion weapon could be put into outer space today, where it could not be distinguished from the increasing number of satellites placed in space for peaceful purposes. Upon command, this weapon could re-enter the earth's atmosphere to be exploded over an enemy nation. Numerous instruments of war of this type could be placed in orbit and then used at some propitious time to coerce or destroy a rival country. Some weapons futurists foresee a single satellite carrying a multi-megaton nuclear weapon capable of destroying all or part of human life on earth if so directed. Such an infernal machine is not technically absurd. There is little doubt that it could be constructed. (Calder, 1968)

10. Holography.

A holograph is a photographic record of an interference pattern between reflected light waves from an object and a second wave of interfering light. Future development in this field may lead to practical three-dimensional holographic photography. This would be a true "three dimensional image and not an illusion, in the sense that if one changes his position then the image changes correspondingly; in particular one can see around and behind objects by such changes in position."

For military purposes holograms will be used for three-dimensional satellite reconnaissance and intelligence photography, increasing further the value of strategic intelligence by satellite and the use of satellite reconnaissance in tactical warfare. They will also be useful in side-looking radars and "foolproof" cryptography. (Kahn and Weiner, 1967)

11. Anti-matter.

Particles called anti-protons, anti-neutrons, and anti-electrons (positrons) can be made in minute quantities and at great expense in high energy experimental machines. When one of these encounters its corresponding normal particle, they both disappear, releasing a burst of energy. The engineering problems of making and storing anti-matter in militarily interesting quantities are so overwhelming, however, that the possibility can be safely discounted for the foreseeable future. (Calder, 1968)

12. Fuels.

Useful power from controlled, sustained thermonuclear fusion is also a possibility. Development of this technology would permit mankind to tap deuterium, or heavy hydrogen, readily available in natural water, as an effectively unlimited source of energy. The odds that sustained fusion will be in commercial use by the year 2000 are often judged to be about even. Fusion reactions will also produce very inexpensive neutrons, opening up all kinds of possibilities for the transmutation of elements--in particular the manufacture of tritium. Having tritium widely available, of course, makes it easier to manufacture small, efficient, lightweight fusion weapons. Fusion power could be applied to spacecraft propulsion, as discussed in Chapter XVIII. (Kahn and Weiner, 1967)

The science of very low temperatures, cryogenics, has emerged from the laboratory and is becoming increasingly important in fuel technology. Cryogenic fuels are gases which are liquids at temperatures below -250°F. Liquid hydrogen (-423°F.) is already the most promising rocket fuel, and lower cost and better insulations would open many applications in earth-bound transportation systems. Liquid hydrogen may be used in aircraft within twenty years. (Prehoda, 1967)

13. Conclusions.

Future progress in basic science and technology will provide a large number of technological opportunities of potential interest to the military establishment, of which those discussed here are but a small representative sample. The wealth of opportunities indicates quite conclusively that economics rather than technology will be the limiting factor in the introduction of new weapons systems. Additionally, it must be realized that the introduction of a major new weapons system may require ten to fifteen years from the discovery of a new basic principle. (Calder, 1968) New systems can be delivered in approximately five years, but only with overriding priority and additional funding. (Nicholson, 1969) Most major weapons systems will therefore go through only two generations by the end of the century.

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