Threat of modern warfare to man and his environment
REPORTS AND PAPERS
IN THE SOCIAL SCIENCES

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SS/CH 19 - Attitude Change: a review and bibliography of selected research, 1964 (out of print in English, available in French).
SS/CH 20 - International Repertory of Sociological Research Centres (outside the U.S.A.) (bilingual: English/French), 1964.
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SS/CH 24 - Guide for the Establishment of National Social Sciences Documentation Centres in Developing Countries, 1969.
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SS/CH 39 - Social and Economic Consequences of the Arms Race and of Disarmament: Review of Research Trends and an Annotated Bibliography
SS/CH 40 - Threat of Modern Warfare to Man and his Environment: An Annotated Bibliography
Threat of modern warfare to man and his environment

An Annotated Bibliography

Prepared under the auspices of the International Peace Research Association (IPRA)
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The manufacture and utilization of weapons and problems of disarmament have been central issues for peace research since the emergence of this field among the social sciences. Unesco has supported peace research from the beginning and has continually sought ways to contribute, within its fields of competence, to achieving the objectives established by the United Nations concerning disarmament.

At its seventeenth session, the General Conference of Unesco recommended to the Director-General to encourage research "on the dangers to man and his environment inherent in modern armaments and techniques of warfare" (17 C/Resolution 10.1, Part VI, paragraph 27 (iv)). Through its publications and assistance to peace research projects and institutions, Unesco has tried to encourage research on this subject, which is closely related to the study of the social and economic consequences of the arms race and of disarmament.

One of the obstacles to conducting valid scientific research on a subject like disarmament in many parts of the world, particularly in developing countries, is the profusion of references to published material in developed countries, much of which is difficult to acquire, and the lack of information on the exact content and quality of this material. In order to assist researchers, students and officials in such countries, Unesco has prepared two bibliographies containing reports on the trends in research on the fields covered as well as annotations to the references.

The first of these annotated bibliographies dealt with the Social and Economic Consequences of the Arms Race and of Disarmament and was published in English, French and Spanish as No. 39 in the series "Reports and Papers in the Social Sciences".

The present issue of "Reports and Papers in the Social Sciences" contains a companion bibliography on the subject referred to in the resolution quoted above, namely the dangers to Man and his environment inherent in modern armaments and techniques of warfare. It contains an introduction and a descriptive, annotated bibliography of 117 items. The purpose of this bibliography is to provide an overview of the available sources in order to encourage further research based on the experience and knowledge of the past and the realities and trends of the present. The introduction defines the concept of human ecology with particular reference to military activities, providing thereby a framework for the presentation of the bibliography itself. As the introduction and bibliography show, the subject has been rarely written about and the little that exists is, for the most part, quite recent. It is the hope of Unesco that the present publication will encourage more research, particularly in parts of the world where the environmental perspective of armaments issues has received little attention while the ecological damage of the manufacture and use of weapons has been tremendous.

The understanding of ecosystems and the impact of human conduct on them is essential for human survival and an important task of education and science. Unesco is therefore particularly concerned with the irrational squandering of the scarce resources, both human and material, of the planet while the needs of human beings in the fields of education, science, culture and information continue to increase.

Unesco expresses its warmest thanks to the two authors of this bibliography, who are both connected with the Stockholm International Peace Research Institute (SIPRI). Arthur H. Westing, a forest ecologist, is on leave from Hampshire college in Amherst, Massachusetts, U.S.A. Malvern Lumsden, a social psychologist, carried out part of the work at the International Peace Research Institute, Oslo (PRIO). The entire work was prepared under the auspices of the International Peace Research Association (IPRA), which is responsible for its content. The selection of items for inclusion in the bibliography and the opinions expressed do not necessarily represent the views of Unesco. Designations used do not imply the expression of any opinion whatsoever concerning the legal status of any country or territory, or of the authorities of any country or territory.

Unesco contributes, through bibliographies, reference publications and through research activities on direct assistance to institutions in developing countries, to the development of peace research and to the co-ordination of information and documentation in this area. Information and queries from persons or institutions interested in contributing to this programme are always welcome.

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INTRODUCTION

The well-being of the human race depends upon the care with which it treats its environment. This environment - shared with all other living things - is beginning to suffer the strains of pollution and other destructive human activities. Moreover, science and technology have advanced to a stage at which Man can threaten the very survival of his species. Indeed, the most spectacular means of such self-destruction are the nuclear and other weapons of mass destruction to be found in the major arsenals of the world. There are numerous additional weapons and military activities capable of doing substantial harm to the environment in both war and peace. Below are outlined some of the basic concepts dealing with Man and nature that will provide a conceptual framework within which to consider the military contribution to the debilitation of the human environment.

Ecology: some basic concepts

Ecology is the study of the interrelationships of living organisms and, especially, of groups of living organisms among themselves and between them and the non-living (or physical) environment. These interrelationships are unified within the framework of an ecological system - or ecosystem - that is comprised of the entire community of interacting living things together with the non-living environment with which they come in contact. Such an ecosystem is considered to be a self-sustaining life-support system that is self-sufficient with the exception of a continuing need for an external source of energy, usually the sun. The living community of the ecosystem, that is, its entire biotic component, is comprised of many populations, each of which is an interacting group of individuals of a separate species of plant or animal. Each of these populations is considered to play some role in maintaining the ecosystem.

Ecology includes the study of the adaptability of populations of plant or animal species - including Man - to a given environment or ecological niche. This process of adaptation occurs on a number of levels. The individuals that comprise the population exhibit physiological or behavioural adaptations to their living environment, that is, to the other individuals in their population and to those of the rest of the community. The population itself adapts over time by means of changes in its gene pool, brought about largely through natural selection. Most plant and animal populations show remarkable degrees of physiological, anatomical and morphological specialization, for the most part the result of genetic adaptation over many generations to a particular ecological niche. For human populations, on the other hand, the behavioural adaptations, both individual and organizational, are of greater importance.

A number of complex and in some instances fragile processes must be maintained in perpetuity in order for an ecosystem to maintain its continuing life-support function. For example, a continuous cyclical interchange of nutrients must be maintained within and between the living and non-living components of the ecosystem; that is, between the biota on the one hand and the soil, water and air on the other. Nutrient losses by the system must thus be replenished by external inputs to maintain the long-term viability of the system. There must also be a continuing conversion of light energy to chemical energy by the green plants of the ecosystem, in turn followed by repeated transfers of this energy along the intricate food chains within the system. One can readily recognize that anthropogenic and other disturbances might lead to the deterioration and even disintegration of such a system.

These concepts form an appropriate basis for the study of the ecological impact of war and other military activities.

Ecology and military activities

The relationship between military activities and ecology has virtually endless ramifications. Military activities can disrupt ecosystems both in peace and war, both on the battlefield and off it. Such disruption has often in the past been the incidental by-product of a military activity, but is increasingly often also the result of specific intent. Moreover, it can stem from a diversity of energy or material inputs, the results of which can take numerous forms. These include the destruction of existing living or non-living components of the ecosystem or else the introduction of new ones. The impact of the military disruptions can range from local, transitory and mild to widespread, long-lasting and severe.

Disruptive military activities include, inter alia, the employment of such armaments and techniques as nuclear weapons, conventional high-explosive fragmentation bombs, incendiary weapons, chemical agents, biological agents, mechanical means of land-clearing, rain-making agents and other geophysical modifications. They include as well all of the routine environmental insults normally associated with the civil sector of society, among them pollution...
of streams and of the lower atmosphere by manufacturing processes and of the upper atmosphere by jet aircraft.

Modern armaments and techniques of warfare can dissipate their destructive energy or introduce their destructive agents on the land or in the sea, in the air or in the space above it. The ecosystems at risk may be either terrestrial or oceanic and either arctic, temperate or tropical. The terrestrial ones may be continental or insular, either forest, grassland or desert; the oceanic ones may be estuarine, littoral (near-shore), over the continental shelves or within the ocean basins. Damage may be inflicted either directly or indirectly and range from subtle to dramatic.

As suggested above, the concept of the ecosystem is a powerful unifying principle of ecology, but basically it is only a theoretical construct. This becomes evident when the attempt is made specifically to relate the concept of the ecosystem to most actual situations. Indeed, the concept is fully applicable in nature only to the entire earth, which can be considered as one huge interacting life-support system. But for many purposes this immense global ecosystem is far too cumbersome a unit with which to deal. Any method of subdividing the global ecosystem into ecosystems of greater or lesser magnitude of the concept. The shortcomings notwithstanding, it is highly useful to divide the global ecosystem into a number of major climatically determined habitats (sometimes referred to as life zones or as biomes). In addition to a number of quite specialized categories, these life zones conveniently include temperate forest, tropical forest, temperate grassland, tropical grassland (savanna), desert, tundra, estuary, shallow ocean and deep ocean. These entities can be considered as operational ecosystems either in toto or in subunits determined by the quirks of geography and topography. A number of further ecosystems, based on human manipulations, can also be recognized, including those resulting from various agricultural, horticultural and silvicultural activities as well as urban and suburban areas.

Many of the operational ecosystems enumerated above are subject to direct or indirect military disruption, which can lead to greater tragedy for some and less for others. The overall degree of potential calamity for any one of the ecosystems depends upon a number of factors. To begin with, different ecosystems are variously vulnerable to upset. Insular or arid ecosystems, for example, can be exceedingly species-poor and are thus intrinsically fragile. Moreover, especially in the case of islands, some of the species themselves are ill-equipped to cope with adversity. Some ecosystems, including arctic and alpine ones, are very slow to recover from disruption owing to the harshness of the climate or terrain, or to other factors such as soil fragility. The vulnerability of other ecosystems hinges upon their overall limited global extent or to their degree of geographical fragmentation. Many individual species of plants and animals require relatively large contiguous areas of habitat for survival. The ecosystems associated with them are thereby vulnerable to the extent that important biotic components are unable to survive such fragmentation. In fact, some ecosystems are of particular concern since they constitute the habitat for species in special need of protection because of a danger of extinction or for some other reason. Finally, numerous ecosystems - either natural or managed to varying degrees - are of importance inasmuch as human populations derive food, shelter, clothing and other amenities from them.

Human ecology

Human ecology is, inter alia, the study of the ways in which human populations adapt to their environment. Human beings, in contrast to other animals or to plants, are endowed with few structural or physiological characteristics that appear to be adapted to any particular environment. Rather, Man owes his adaptability largely to his use of tools and to his forms of advanced social organization made possible by speech and other means of communication.

Human groups adapt to a particular physical environment by: (a) using tools to manipulate the environment; (b) using other physical artefacts (e.g. dwellings, clothing, ceremonial objects) which are among the products of such manipulations; and (c) developing social organizations that co-ordinate the activities of individuals. The totality of the physical and social attributes of human groups is known as "culture"; and thus, for human populations, the ability of the culture to adapt to changes in the environment is of the greatest importance. Whereas one culture may be well adapted to a particular environment, either the physical attributes or the form of social organization may be little suited to the demands of some radically different environment thrust upon it. A second culture may be more able to cope with changed environmental conditions.

The basic concepts of ecology are readily applicable to human populations. Human beings, like other biological organisms, are dependent upon a continual interchange of nutrients and waste materials with their ecosystem. Moreover, the mental development and stability of the human being are dependent upon the stimulation of the nervous system by external inputs, especially those resulting from the individual's own manipulation of his environment. Human societies, like individuals, are also dependent upon a continual interchange with the environment. Imbalances in the interchanges among members of the human population, or between the group and its environment, may set in motion the decay or disintegration of that society.

Human ecology, therefore, is much more than a biological science, though biological considerations form its basis. Human ecology includes the study of the ways in which Man actually arranges and constructs his living space by means of greater or lesser manipulations of nature, ranging from simple agricultural to automated factory and transportation systems. Further, human ecology must take account of social organization as well as of material and non-material aspects of human culture as essential intervening variables in the relationship between Man and nature.

Human ecology and military activities

To study the impact of war and other military activities on human ecology involves not only the study of the extent of the physical destruction of
The human environment - whether rural or urban, natural or man-made - but also the effects of this destruction on the human populations involved. If it were not for culture and social organization one would expect more or less of a one-to-one relationship between the amount of physical destruction on the one hand and the decrease in population size as a result of direct casualties, indirect losses through starvation and disease, declining birth rates and so forth on the other. Some human societies have deteriorated under the impact of war, especially where pre-existing structural strains within the social system have been exacerbated. Others have demonstrated a remarkable ability to adapt to extremes of military destruction.

In principle, therefore, the study of the human ecology of war involves a wide range of biological and human sciences. An interdisciplinary study on such a scale is faced with the problem of integration and may lack coherence. Thus a "systems" approach provides a suitable general framework for encompassing the scope of human ecology in its relation to war and other military activities. The following assumptions are among those inherent in such an approach:

1. Human populations are organized into social systems that are more or less well adapted to a certain physical environment. Man's physical environment is partly determined by natural conditions and is partly built and determined by Man himself.

2. A social system interacts with the environment in order to extract food and materials for continued sustenance through the construction of tools and, through them, dwellings and other artefacts. The process of extraction, manipulation and distribution of food and materials (and the consequent division of labour) are regulated by means of social organization.

3. In order for a society to grow and develop it is necessary for the supply of raw materials to exceed current consumption. A surplus may be obtained by reducing current consumption, by reducing wastage, by increasing efficiency of production or by greater extraction. Once a surplus is attained it can be invested in improvements to the social system, in military activities or in other forms of consumption.

4. Outside stress on a social system induces structural strains that can result either in the deterioration of that system or in the strengthening of that system. The direction of the response depends not only upon the nature and magnitude of the external stress, but also upon a number of internal factors such as the size and complexity of the system as well as its flexibility and robustness.

5. Under wartime conditions the social system is called upon to face a variety of substantial worries, including: (a) a reduction in productive manpower; (b) an increase in number of dependants per supporter; (c) a destruction of tools and other artefacts necessary for production; (d) a debilitation or destruction of raw materials and other natural resources; and (e) a destruction of cultural artefacts, such as dwellings or communication systems.

6. In order to cope with wartime problems, a social system can adapt in a number of ways, among them by: (a) accepting lower standards of living; (b) drawing on surplus stocks for current consumption; (c) increasing productivity; (d) distributing resources more efficiently (e.g. by rationing); (e) adopting a more efficient division of labour (e.g. by employing more women or old people in factories); and (f) overcoming or capitulating to the enemy.

Ecological impact of modern armaments and techniques of warfare

In considering the dangers to Man and his environment inherent in modern armaments and techniques of warfare it becomes useful to distinguish among:

(a) incidental or indirect environmental effects of warfare; (b) direct or intentional environmental effects of warfare; and (c) environmental effects of non-hostile military activities. Each of these categories is examined in brief.

Incidental or indirect environmental effects of warfare

The use of force is accepted in international law in the case of legitimate self-defence, in so far as it is directed at the military forces of the enemy. However, when such attack is carried out with modern weapons and techniques it is likely to indiscriminately affect the civil population and to cause widespread, long-lasting and severe damage to the environment. Thus, in spite of the continuing efforts in international law and national regulations to circumscribe the effects of such attacks, it is clear that they will frequently result in substantial incidental environmental debilitation.

Nuclear and other weapons of mass destruction have been the object of most of the attention and research on actual or possible environmental effects of warfare. This focus has tended to obscure the need for further study of the destructiveness of such conventional weapons as high-explosive bombs. These can now be directed systematically in massive quantities at large areas, rather than at specific military targets. Indeed, there has been an exponential increase during this century in both the length and depth of battlefields and the conventional firepower available to combat troops. It is probably not generally appreciated that this increase in firepower continues to the present. Front-line troops of the major powers today have about 25 times the firepower of their predecessors in World War II. Some indications of the environmental impact of the massive employment of conventional firepower are provided by the Second Indochina War.

Coupled with the increasing trend towards greater area coverage by conventional weapons is the increasing exploitation of the time dimension by means of delayed-action weapons. These include a multiplicity of land mines as well as conventional munitions fitted with delayed-action fuses. One modern trend is towards the use of "scatterable" mines that can be disseminated in large numbers by aircraft, artillery or rockets. Huge quantities can be delivered either on the battlefield (in order to impede an advancing enemy) or in rear areas (in order to harass the enemy, a tactic that presents a grave danger to the civil population and to the environment). Environmental dangers of delayed-action munitions have been compounded
by the unreliability of the fuses used, with the result that they can remain a hazard for a long time into the future. Only recently has any systematic effort been made to begin to study the environmental problem of unexploded munitions.

Direct or intentional environmental effects of warfare

Some techniques of warfare seek to weaken the military forces of an enemy by intentionally destroying or denying their means of existence, usually including those of the civil population, which is thereby prevented from supporting the military forces. Included amongst these techniques of warfare are: blockade; the destruction of crops or water supplies; the destruction of forest sanctuary or cover; the driving of pastoral communities into inhospitable terrain lacking grazing land for their livestock; other forced relocation of populations; the destruction of housing, communication and health facilities; and - most recently - actions that result in the deterioration of the weather. In so far as the environment of the enemy nation rather than its military forces is the direct object of attack, such techniques are appropriately referred to as "environmental warfare".

Environmental effects of non-hostile military activities

A variety of military activities exists that are not in themselves intentionally directed either at an enemy force or at the environment, but which nevertheless cause injury to the environment. Impacts of this kind include: environmental pollution resulting from the production of munitions (both conventional and nuclear) and other military equipment; land use and the consumption of raw materials for military purposes; and damage to the environment resulting from the testing of conventional and nuclear weapons, from the training of troops and from accidents involving military forces.

Contents of the bibliography

The bibliography consists of 117 publications, listed alphabetically by author and all in some fashion pertaining to the relationship between warfare and the human environment. The intent has been to present a representative selection of relevant publications from the world literature. The cited items have originated in 13 nations and, although five languages are represented, all but seven of the cited items are in English. Most are of quite recent origin, with 73 having been published during the 1970s and another 27 during the 1960s. No comparable bibliography has been published, although a number of tangential ones should be noted, those by: O'Callaghan, 1973; Popper & Lybrand, 1960; Schultz, 1966; and Westing, 1974; q.v.

Of the military activities covered in the bibliography, descriptions or speculations on the use of nuclear weapons have been the most frequent, with those on conventional high-explosive bombs second. Of the habitats examined, tropical forest and the urban environment (especially European cities) have been the most common. Of the wars referred to, the Second Indochina War has been the most usual, followed by World War II. It has, of course, not been possible to provide references to the effects of all kinds of military activity on all kinds of ecosystems, for lack of cases or published information on them. For example, much more research has been devoted to military effects on the environments of major industrial powers than to effects on those of other societies. The frequency distribution of subject-matter in the bibliography is thus in part a reflection of the inequitable distribution of research facilities and funds.

Some 10 per cent of the productive land area of the Netherlands sustained severe military damage during World War II, including saltwater inundation, freshwater inundation, mine laying, and pre-emption for fortifications and airfields. The author provides a detailed analysis of these and other direct and indirect war damages to Dutch agriculture, horticulture and silviculture and discusses the problems of reconstruction. One of the most important studies of its kind.


A description of and justification for the United States air attacks in 1953 on the irrigation dams of North Korea during the Korean War. This article includes photographs and maps indicating the extent of damage caused by breaching the Toksan, Chasan and other dams. In addition to the tactical gain of destroying communications in the river valleys, the raids were intended to destroy thousands of hectares of growing rice as well as farms and irrigation canals, thereby turning North Korea from an exporter of rice to an importer at a time when intelligence reports indicated a serious rice famine in South China, a possible source of supplies. In addition to "inestimable" damage to the rice crops, the floods caused extensive damage to the capital city, Pyongyan. This report was prepared by a study group of and published by the United States Air Force.


This report considers the environmental impact of nuclear explosions on both the natural environment (Volume I) and agricultural ecosystems (Volume II). Volume III consists of a 25-page summary of Volumes I and II.


A description of the damage to the forests of north-eastern France still in evidence today that resulted from the destructive military activities of World War II and even of World War I. The study area included ca. 170 thousand hectares of managed forest (three-quarters of it deciduous). Most of the long-term damage was the result of artillery shells or machine gun bullets. A map of the area is included and the damage is quantified.


It was found that the major adverse effects of World War II on the avian and mammalian wildlife of Micronesia was via a decimation of the vegetation and other components of the animals' habitat. Islands included in the study were Peleliu (in the Carolines), Kwajalein (in the Marshalls), Guam and Saipan (in the Marianas) and Iwo Jima (slightly north of Micronesia). It was observed that the Marianas mallard (Anas oustaleti) had been extirpated from Guam by military activities and that the entire species was thereby placed in jeopardy. The introduced sambar deer (Rusa unicolor) increased in numbers on Guam presumably owing to reduced hunting pressures resulting from the war. (See also the articles by Donaghho, 1950 and by Fisher & Baldwin, 1946.)


Nuclear, chemical and biological weapons and their delivery systems are described and tabulated. Main emphasis is placed on their destructive abilities, increasing sophistication and continuing spread to additional nations. This is one of a group of articles edited by L. Kristoferson, 1975, q.v.


A review and assessment of environmental manipulations that have been employed for hostile military purposes or else have been suggested as future possibilities. Numerous potential techniques are presented in tabular form.
A brief survey of environmental manipulations for hostile purposes together with a summary of the environmental impact of United States operations during the Second Indochina War.


An analytical review of ozone depletion in the stratosphere brought about by the oxides of nitrogen generated by thermonuclear explosions. The analysis is based upon data from the United States and Soviet test series during 1961-1962, the French testing in 1970, a review of the literature (33 citations) and theoretical calculations. It is concluded that the depletion appears to be real enough, but only of the order of several per cent.


A compilation of 43 separately authored articles dealing with the impact of nuclear war on agriculture, divided into the following five groups: properties of radio-active fall-out (8 articles); effects on livestock (12 articles); effects on plants (9 articles); effects on agricultural and natural ecological communities (9 articles); and considerations in agricultural defence planning (5 articles). An additional amount of relevant materials is presented in two appendices. Considerable attention is given in this monograph not only to the effects of gamma radiation but also to those of beta radiation.


An account of the United States and British area bombing operations against German cities during World War II which puts more emphasis on the impact on the civilian population as such than do the official U.S. Strategic Bombing Survey Reports (for which see MacIsaac, 1976).


This paper analyses the "effectiveness" of the United States strategic and interdiction bombing during 1965-1968 of North Viet Nam in the Second Indochina War, doing so on the basis of the extensive documentation in the so-called Pentagon Papers. It was concluded one reason for the limited effectiveness of the bombing was that, as an agricultural country, North Viet Nam provided an "extremely poor target" for air attack. Nevertheless, by 1968 about half a million civilians, including women and children, were working to repair damage done by air attacks. The value of foreign aid received during the first period of bombing exceeded the value of the facilities destroyed. Societal adjustments to the bombing were sufficiently effective to maintain living standards, meet transportation requirements and improve military capabilities.


Data are presented from the World War II allied bombing of Germany which show that the decline in war production was not as great as had been expected by the British strategists. This book was published in the U.S.A. under the title of Fear, war and the bomb (New York: Whittlesey House, 249 pp., 1949). A Russian translation has also been published.


A collection of 15 separately authored chapters on various aspects of incendiary (including nuclear) bombing during World War II, with very detailed accounts of the impact on urban areas in both Germany and Japan. This is one of the most comprehensive sources available on the subject.


An extraordinarily moving series of first-person accounts in the form of brief essays and drawings by civilian primitive Laotian hill-tribesmen (montagnards) who had been subjected to repeated heavy bombing raids during the Second Indochina War.


A study of nearly 2,000 wild fires in the United States (including an analysis of the extent weather conditions in relation to fire spread), supported by some 30 interviews with fire experts and the review of 149 publications. Guidelines are presented for predicting the behaviour of mass fires following nuclear attack. A summary of this study has been published separately by the senior author as U.S. Forest Service Research Note No. PSW-22, 8 pp., 1963.


A description, inter alia, of the causes and demographic impact of the famine that resulted from the Bangladesh War of Independence of 1971 (a war that resulted in between one to three million Bengali fatalities and in the displacement of perhaps ten million). Several mutually reinforcing interactions between infection and malnutrition and among
A collection of eight separately authored investigations that describe the effects of World War II on about a dozen important fisheries on the Atlantic continental shelf of Europe. A comparison of the pre-war period (1937-1939) with the post-war period (1946) in most instances revealed an increased fish density (both in terms of numbers and individual sizes), presumably owing to reduced wartime fishing pressures. Substantial increases were reported especially for haddock (Melanogrammus aeglefinus), plaice (Pleuronectes platessa), ling (Molva molva) and hake (Merluccius merluccius).

The early fall-out from the 15 MT thermonuclear test device detonated at Bikini (in the Marshalls, Micronesia) on 1 March 1954 exposed well over 100 based on both published (177 citations) and unpublished materials. Appendix 3 (pp. 89-93), Dragon. Several deaths as well as a substantial Japanese on a passing fishing vessel, the Lucky from the blast wave (resulting in tree blow-down) are postulated. The major damage would be radio-actively contaminated. Both runoff and erosion would be increased to undesirably high levels. The water fires). Both runoff and erosion would be.

The major adverse impact of World War II on the birds of the Melanesian Solomon Islands of Guadalcanal and Tulagi was concluded to have been via vegetational and other habitat disturbance. Observations are presented on the successional recovery of war-torn jungle areas. (See also the articles by Baker, 1946 and by Fisher & Baldwin, 1946.)

A literature review (with 35 citations) of the ecological aspects of nuclear war. It is concluded that available information on the workings and interactions within ecosystems is insufficient to permit definitive conclusions. Concern is expressed over the possible consequences of nuclear war on weather and climate and over combined effects of radiation and disease.

A brief discussion of the human casualties that would result from the nuclear radiation resulting from nuclear weapons, including considerations of both close-in and distant casualties. This is one of a group of articles, edited by L. Kristoferson, 1975, q.v.

An examination of the postulated consequences of a 20 MT thermonuclear ground burst in the heart of Boston. The major focus of the article is on the medical and public health consequences of such an event, but ecological effects are also noted. (For a somewhat similar treatment of New York City, see the book by Stonier, 1964.)

The major theme of this perceptive, well-documented and thought-provoking treatise is that the global environment has deteriorated to such an extent that it has now become crucial that environmental considerations be given a dominant position in national and especially international affairs. The four dimensions of danger to the world ecology are concluded to be: the war system; the population explosion; an insufficiency of natural resources; and environmental (pollutional) overload. Subjects that receive major attention include the world order of today, the quest for world peace, attempts to bring about a new peaceful and environmentally sound world order and the prospects for attaining this elusive goal.

An analysis of the potential feasibility of various environmental manipulations suitable for hostile
military purposes. It is concluded that a number of sorts of significant climatic manipulations are indeed within the realm of possibility for the foreseeable future. It is urged that an international agreement be reached to ban such military activities while these forms of warfare have not as yet been developed. (This journal is also published in French, German, Russian and Esperanto.)


A detailed survey of the battle impact of World War II on the Hawaiian Island of Midway (in Polynesia) and thus an informative summary of the military impact on the specialized biota of islands. The most serious impact on the fauna is via the upheaval of the habitat, the authors having observed an almost linear relationship. The war-caused extinction of the Laysan rail (Porzanula palmeri) is reported here as is the probable extinction of the Laysan finch (Telespiza cantans) and the local extirpation of the brown booby (Sula leucogaster plotus). (See also the articles by Baker, 1946 and by Donaghho, 1950.)


Report of the medical consequences of the Nigerian Civil War of 1967-1970 by a member of the British paediatric relief team who spent ten weeks (November 1968-January 1969) in blockaded Biafra with its eight million inhabitants, half of whom were children. Some 21 months of siege resulted in the death by starvation of an estimated one-and-a-half million Ibos and other Biafrans. (See also the article by Mayer, 1969.)


This monograph examines in some detail one of the major United States strategies during the U.S. Civil War of 1861-1865 to subdue the rebellious southern Confederacy, that of starving the entire population. A combination of blockade and scorched-earth tactics was employed, including the systematic destruction of railroads, of crops and food stores and of farm machinery.


A detailed examination of the impact of war on public health, epidemics, nutrition and demography. Whereas much of the book is concerned with the impact of conventional wars over a fairly long historical period (with important statistical information particularly in regard to wars involving Imperial Russia and the Soviet Union), there are separate chapters examining the possible impact of nuclear, chemical and biological warfare on human populations and the biosphere. A valuable bibliography of relevant Soviet literature is included.


This is the basic technical source for the description of nuclear weapons and their divers effects. Separate treatments are included for air bursts (both low and high altitude), surface bursts on land and sea, underground bursts and underwater bursts. Detailed attention is given to the several important forms of energy release - including the blast wave, the thermal pulse, nuclear radiation and radio waves - and their effects on Man and his artefacts. Little attention is given to environmental damage per se, but the wealth of information given is presented in such a way that it lends itself to apropos extrapolation. The prior (1964) edition continues to be useful for its treatment of radiological warfare, its compilation of nuclear explosions, and other omissions of the new edition.


An analysis of the USSR/U.S.A. draft treaty of 21 August 1975 that would prevent those environmental manipulations for hostile purposes having widespread, long-lasting or severe effects. Serious shortcomings are pointed out. (A very similar treaty was opened for signature on 17 May 1977, analysed by J. Goldblat, 1977, q.v.) This is one of a group of articles edited by L. Kristoferson, 1975, q.v.


An analysis of the "Convention on the Prohibition of Military or any other Hostile Use of Environmental Modification Techniques" opened for signature by the United Nations on 18 May 1977. This treaty would prohibit any hostile use of environmental modification techniques having widespread, long-lasting or severe effects. The author concludes that the treaty is inadequate for the prevention of environmental warfare since it proscribes mainly imaginary techniques and condones those which are feasible. (See also the earlier article by Goldblat, 1975.)


An evaluation of numerous possible hostile environmental manipulations including, inter alia, those involving fog, rain, tropical cyclones, the polar ice caps, stratospheric ozone, earthquakes, tsunamis and electromagnetic radiation. Two case histories are provided as well, namely the hostile rain-making and rural wildfire operations carried out by the United States during the Second Indochina War.
The historical and biological aspects of the multifaceted long-term studies of ecological damage and recovery that were carried out by the University of Washington Radiation Biology Laboratory at the U.S. nuclear test sites in the Marshall Islands (in Micronesia) at Bikini and Enewetak (Eniwetok) are described at length.


The toxicology of several chemical anti-personnel and anti-plant agents is surveyed, including delayed effects. The environmental impact of chemical anti-plant agents is reviewed on the basis of the Second Indochina War experience. This is one of a group of articles edited by L. Kristoferson, 1975, q.v.


A review of weather-modification capabilities (with emphasis on Soviet advances in the field) as these pertain to applications to hostile military purposes. It is concluded that there is no present danger of the cold war becoming wet or windy, but that there is a vast potential for environmental catastrophe.


It is shown that today the world diverts annually to military use a quantity of resources representing about 6 per cent of total world output, equivalent to the combined gross national products of the 65 countries that comprise Latin America and Africa. The emphasis is on natural resource (raw material) consumption, which is considered a loss to the world community. This is one of a group of articles edited by L. Kristoferson, 1975, q.v.


A study of the sociological and demographical impacts of bomb destruction based upon the bombing of cities during World War II, primarily in Germany, Japan and Poland. The study is based upon data gathered by the author and on the U.S. Strategic Bombing Survey (cf. MacIssac, 1976). It is concluded that there is not a "one-to-one" relationship between the extent of physical destruction and social effects. For example, the policy of "dehousing" the civilian population by means of bombing did not produce a population exodus until some 25 per cent of the housing in German cities (or 10 per cent in Japanese cities) was destroyed. This was due to what the author describes as the "elasticity" of resources: resources - including accommodations - could be diverted from less important to more important tasks or uses. The war was seen to provoke a great deal of adaptive social behaviour, much of it carried out on a volunteer basis by individuals or organizations. The final chapter (Chapter 9, pp.203-232) deals with post-war problems of recovery and reconstruction. For a brief treatment of the subject, see the author's "Effect of war destruction upon the ecology of cities" in Social Forces 29, 1951: pp. 383-391.


This mimeographed report - which argues that human beings are the single most important

A detailed account of the background to and actual World War II allied air raid of February 1945 on Dresden. Prior to the war Dresden had been a cultural centre and one of the world's most beautiful cities. The raid destroyed much of the city. Moreover, with about 135,000 fatalities, this was perhaps the most destructive bombing raid in history in terms of human life.


A discussion of the psychological impact of air attacks on human populations, drawn primarily from the experience of the British and German civil populations during World War II.


An exposition of the basic meteorological and other geophysical processes that must be understood and mastered before environmental manipulations for hostile purposes become feasible. Among the processes examined for possible manipulation are rain, fog, lightning, hurricanes, electro-magnetic radiation, earthquakes and tsunamis. The feasibility of most sorts of suggested means of environmental warfare is doubted. This is one of a group of articles edited by L. Kristoferson, 1975 q.v.


A detailed technical analysis of the effect on stratospheric ozone level of oxides of nitrogen injected into the atmosphere by nuclear explosions. The level and extent of such injection resulting from the United States and Soviet test explosions during 1961-1962 were inferred from the recorded levels of 90 Sr. An examination of global ozone levels recorded for 1960-1970 suggests that the explosions had resulted in a temporary 5 per cent reduction in stratospheric ozone.


The most recent and one of the most extensive reports prepared for the U.S. Senate subcommittee on the human impact of the Second Indochina War. (Earlier reports go back over a ten-year period.) This is undoubtedly among the most detailed sources available on the social impact of that war. In particular it reproduces in full reports of the World Health Organization and United Nations missions to Indochina, reports that otherwise received only limited distribution. It also contains details of the aid programmes of international organizations as well as a selection of press reports on conditions in the countries of Indochina and Thailand following the conclusion of hostilities. This publication does not describe the ecological destruction resulting from the war in Indochina (for which see SIPRI, 1976), but it does describe the results of that destruction: the problems of moving back millions of peasant refugees from overcrowded cities with no economic basis to an extensively destroyed countryside; the problems of nutrition; an increase in diseases such as malaria; and so on. This publication goes a long way towards making up for the general dearth of information on the effects of war on developing countries. It makes it clear that one of the effects of war on a developing country may be to magnify the underlying problems of underdevelopment: rapid urbanization, disease, unemployment, inflation and a great many other social problems.


This is a group of ten articles - and an appendix (pp. 234-244) that reprints legal and political documents - all pertaining to the interaction between war and the environment. The articles, each of which has a separate entry in the present bibliography, are by: F. Barnaby, K. Edvarson, J. Goldblat, B. Holmberg, R.H. Huiskens, B.M. Jasani, M. Lumsden, I. Thorsson, A.H. Westing and H. York. This special double issue of Ambio was prepared in collaboration with SIPRI. Major portions of five of the articles (those by J. Goldblat, R.H. Huiskens, B.M. Jasani, M. Lumsden and A.H. Westing) have appeared in SIPRI Yearbook 1976: pp. 72-101 (Chapter 4).


A catalogue of cathedrals, museums, monuments, statues, paintings and similar priceless art treasures that were destroyed by bombing and other military activities in Europe during World War II. The book, profusely illustrated by pre-war photographs, demonstrates very well the effect modern war can have on the cultural heritage of Man.
A vivid, subjective first-person account of the human consequences of the heavy-handed U.S. tactics during the Second Indochina War against the land and people of rural South Vietnam. The effects of bombing, of spraying chemical anti-plant agents and of landclearing with Rome-plough tractors are described as well as those of forced population relocation.

An in-depth analysis of the massive and sophisticated employment of aircraft by the United States during the Second Indochina War. Separate chapters are devoted to the air wars waged against North Vietnam, South Vietnam, southern Laos, northern Laos and Cambodia. Other chapters examine the monetary costs, legal aspects and moral questions of this aspect of that war. A separate chapter (Chapter 8, pp. 91-96) and appendix (Appendix E, pp. 241-263) examine the ecological impact of the air war, including the effects of the air-delivered high-explosive munitions and of the chemical anti-plant agents (herbicides). This monograph constitutes an important study of the strategy of war in which a wealthy developed nation attempts to crush a poor underdeveloped adversary through lavish expenditures of remotely delivered munitions over wide areas.

This article points out that the origins of "ecological warfare" can be traced back to the efforts of colonial powers to "pacify" human populations in colonized territories. Drawing upon data from World War II and the Second Indochina War the author argues that, in spite of the enormous destructive capability of modern conventional weapon systems, human societies demonstrate a remarkable capacity to adapt to war. The data indicate, however, that a modern industrial society can rebuild its pre-war industrial capacity quicker than a poor agricultural society can regenerate its productive capacity. In the latter case the problem of wartime destruction is compounded by the underlying problem of underdevelopment. In so far as most recent wars have taken place in developing countries, this means that they are most detrimental to the very societies that can least afford them. This is one of a group of articles edited by L. Kristoferson, 1975, q.v.

This article describes the early post-war reconstruction efforts. It was written by the Director of the Office of Reconstruction of Finnmark County (the major zone of devastation). This case history demonstrates well the enormous effort required to restore a society that has been drastically disrupted by war.

A review and analysis of rainfall manipulations for hostile purposes, including a review of the operations carried out by the United States during the Second Indochina War and an examination of the future potential and political implications of such activities.

Toward the close of World War II the United States instituted a massive study of the effects of the allied strategic bombing in Europe and the Pacific. The effects of high-explosive, incendiary and nuclear bombs were each examined in detail. Primary emphasis was placed upon the military, political, economic and social consequences of bombing cities and industrial centres, mostly in Germany and Japan. Some 850 military personnel and over 300 civilians under the leadership of F. O'Doier prepared six major reports, and more than 300 additional formal reports and several thousand background papers. Of the formal reports, published during 1945-1947, about 210 dealt with Europe and about 110 with Japan. Only about 80 of these were made generally available at the time and all have been out of print for several decades. In the present partial reprinting 20 reports deal with Europe (Volumes 1-6), including two of the three European summary reports; and 11 reports deal with the Pacific (Volumes 7-10), including the Pacific summary report. (Not included here, however, is the 317-page index volume to all of the several thousand reports that had been published by the USSBS in 1947.) A companion volume (Strategic Bombing in World War II: the story of the United States Strategic Bombing Survey) provides a history of this monumental and unique undertaking. (For the official British account of the strategic bombing of World War II, see Webster & Frankland, 1961.)

An introduction to the modern historical study of the impact of war on society, based upon World Wars I and II. Four themes are focused upon: the destructive aspects of war; the extent to which war serves to test the effectiveness of a particular form of social organization; the impact of war on the degree of participation of the population in social processes; and the psychological aspects of the impact of war on society. Although the book is largely historical in concept, the author identifies remaining behind. This article describes the early post-war reconstruction efforts. It was written by the Director of the Office of Reconstruction of Finnmark County (the major zone of devastation). This case history demonstrates well the enormous effort required to restore a society that has been drastically disrupted by war.
himself in part with a more modern, sociological approach. An annotated bibliography of modern historical studies of war and society is included as well as a useful appendix on the use of archive film material.


Summary of the report of a mission to study nutritional problems in the Nigerian Civil War of 1967-1970. The situation is characterized as one of the great nutritional disasters of modern times. It is estimated that between one and two million Biafrans (primarily Ibos) died of starvation or malnutrition brought about by blockade and by the bombing of airfields and distribution centres through which relief supplies were brought in. The fatalities alone represent perhaps one-fifth of the Biafran population. The full study mission report is to be found in U.S. Congressional Record 115:4371-4382, 1969. (See also the article by Gans, 1969.)


A very moving, powerful first-person account of the tragic human sequelae to the nuclear bomb dropped by the United States during World War II on Nagasaki on 9 August 1945.


The Second Indochina War will go down in military history as the one in which the United States introduced the massive and long-sustained employment of chemical anti-plant agents (herbicides) as a means of depriving a largely guerrilla enemy in South Viet Nam of forest concealment on the one hand and of food crops on the other. This report provides a lengthy though disjointed, uneven and poorly edited report of the forest destruction aspects of the programme. Part A (one volume of 398 pp.) presents the summary and conclusions of this several-year study and Part B (19 volumes) presents a series of working papers. Seven of the 19 working papers deal with lowland mangrove forest destruction and the remainder with upland (inland) forest destruction. It is concluded, inter alia, that it will take at least 100-120 years for the destroyed mangrove forests to recover. The report was prepared by A. Lang and 17 colleagues. The summary of the report has been reprinted in the U.S. Congressional Record 120: pp. 4,615-4,632; 1974.


Chapters 1 and 2 (by Neilands and Vennema, respectively) describe the use, toxicology and effects of the chemical anti-personnel agents employed by the United States in South Viet Nam during the Second Indochina War. Chapters 3 and 4 (by Pfeiffer and Orians and by Westing, respectively) describe the history, use and ecological effects of the chemical anti-plant agents, the former in South Viet Nam and the latter in Democratic Kampuchea. Numerous relevant documents are reprinted in an appendix. Chapter 4 (pp. 177-205) by Westing on "Herbicidal Damage to Cambodia" describes in some detail the extent of damage caused by herbicidal attack on rubber plantations, fruit trees, agricultural plants, livestock and humans. It thus provides one of the few descriptions of such attack on Man and nature in a rural, agricultural society.


The report contains a chapter on the physical effects of attacks using thermo-nuclear weapons and then attempts to draw up detailed guidelines for research on the possible societal, group and individual responses to such attack with a view to aiding civil defence planning. Thus the report is not merely descriptive of the effects of nuclear attack, and it is far from being a "handbook" for practising civil defence workers, rather it indicates the enormity of the research effort required to explore great areas of uncertainty with regard to the human effects of nuclear attack.
This booklet provides a useful overview of individual, social psychological and societal responses to disasters comparable with a nuclear attack. The aim of the study was to concentrate attention upon the interaction of physical and social effects and in particular upon the problem of "social damage assessment." Such assessment requires not only an inventory of damage, but also the tracing out of the ramifications of social disruption in order to attain the continued survival and recovery of society. This descriptive report was prepared for the U.S. Air Force.

A bibliography with 519 citations arranged in alphabetical order, published primarily in the past decade or so. A limited subject index is appended.

A compilation of 17 separately authored review articles dealing with the long-term medical consequences of the World War II nuclear bombing by the United States of Hiroshima and Nagasaki in August 1945, grouped into the following three sections: dosimetry (6 articles); biological effects (9 articles); and future research and health surveillance (2 articles). This collection provides the most comprehensive overview of the subject currently available.

A detailed recording during 1939-1945 of the number and severity of dust storms occurring at a location about half way between El Alamein and Alexandria, Egypt, during World War II. Dust storms increased in number and severity as a result of military and related activities in the area including, inter alia, the Battle of El Alamein of October-November 1942. These activities had severely disrupted large surface areas and destroyed much of the vegetation, primarily the shrub Thymelaea hirsuta. The disturbed areas gave rise to dust storms with only half the wind velocity usually needed, thereby increasing their annual frequency by an order of magnitude. The problem persisted for the several years that it took for the re-establishment of a soil-stabilizing vegetative cover. It might be added that the presence of extensive mine fields contributed to the recovery of the vegetation by denying human access to large areas.

An authoritative description of the 900-day World War II siege of Leningrad by the Germans during 1941-1942. The author, who was in charge of both military and civilian food supplies in this besieged city of three million inhabitants, describes primarily the extraordinary problems of maintaining life under the conditions of the blockade. The author includes discussions of the administrative measures dealing with rationing, supplies, health and sanitation which - together with the co-operation of the population - limited deaths from starvation and disease to an estimated 632,000. This case study shows that ecological warfare can be carried out by means other than, for example, strategic bombing. Further, it illustrates the thesis that human beings and human societies are dependent upon an ecological relationship with their environment, but that when this environment is disrupted they are able to take partially compensatory adaptive measures.
social dimensions of a possible nuclear attack. The present work is divided into three sections: various aspects of a projected thermo-nuclear attack, including the post-attack recovery period; societal, group or individual reactions to World War II bombings; as well as to other large-scale disasters; and the development of analytical models and methods having potential utility in the further study of nuclear attack.


Various weapons having indiscriminate effects - including blast, fragmentation, time-delay and incendiary ones - are described with special emphasis on their medical effects. Brief descriptions of environmental impact are included. This report was prepared by the expert representatives of 19 nations.


This study constitutes a portion (Appendix III B) of a major "environmental impact statement" prepared for the U.S. Air Force regarding its plans to develop a large military base on the Micronesian island of Tinian. An historical introduction indicates some of the major ecological and social disturbances that have been inflicted upon the island and its population by a succession of occupying powers: the population was deported by the Spanish military authorities in the seventeenth century; it was enticed back by the Germans to work the copra plantations; the copra plantations were destroyed by the Japanese and replaced by sugar plantations; the island, like others in the Marianas, was severely damaged during World War II. At present it is inhabited by about 750 people. This study goes on to examine the economic and social impact on this small and young community if plans are realized to locate some 10,000 military and associated personnel on the island. Although peace-time as well as wartime military activities having had major environmental impacts have been the object of studies in the past, the present one is rare both in its depth and because it was made in advance of a potential military insult to the environment. As such it forms a commendable precedent for other national and international bodies. This study was prepared by M.W. Caulfield, L. Kelley and colleagues.


An account of the effects of allied bombing on Germany during World War II by one of the officials in charge of fire-fighting operations. Tables with damage estimates are included. The author has also published an earlier similar work: Hochrote Hahn /Crimson rooster/ (Darmstadt: E.S. Mittler, 167 pp. 1952).


A compilation of the following six separately authored chapters: I. The nature of military impacts on the environment (by R.B. Russell); II. Indochina: prototype of ecocide (by A.H. Westing); III. Nuclear explosives: potential for ecological catastrophe (by H. Scoville Jr.); IV. Environmental effects of chemical weapons (by S. Zolla & M. McClintock); V. Weather as a weapon (by E.B. Weiss); and VI. Humanitarianism and human survival (by R.B. Russell). The book also has a foreword by A. Myrdal.


A review of environmental manipulations for hostile military purposes together with an examination of the international negotiations aimed at proscribing them, the aims of which the author supports.


A bibliography with 161 citations dealing with the ecological research carried out at the atomic bomb test site in the Mohave (Great Basin) Desert of Nevada, U.S.A. (37°N 116°W). All of the references are to articles in the open literature, but some are of only limited circulation.


An examination of the extent of destruction and damage and of the rate of recovery following low-altitude aerial bursts of low-yield (mostly ca. 10 KT) in the Mohave (Great Basin) Desert at Yucca Flat, Nevada, U.S.A. (37°N 116°W). The extent of initial vegetational annihilation was of the order of 70-200 ha and that of damage, 400-1,400 ha. Reinvasion by pioneer species occurred within three to four years and full ecological recovery was expected to take many decades. This article should be read in conjunction with the one by Shields et al., 1963.


The annotation for this article is covered by the one for Shields & Wells, 1962, q.v. supra.

A basic reference source on anti-personnel weapons (small arms, grenades, conventional artillery and bombs, anti-personnel fragmentation bombs, mines and so on) so that the background of recent efforts at the intergovernmental level to restrict or prohibit the use of the more inhumane and indiscriminate of these weapons. Although the study is not primarily ecological in focus, the historical overview emphasizes the exponential increase in the firepower available to front-line combat troops of the major powers and the trend towards increased area coverage. Ecological considerations are emphasized in the chapter on delayed-action munitions, including mines. It is pointed out that unexploded munitions result in a major, long-term environmental hazard and data are presented on the percentage of duds amongst various categories of munitions. The book contains a unique set of tables listing the quantities of cluster bombs and other anti-personnel munitions authorized for procurement for use in the Second Indochina War. This monograph was prepared by M. Lumsden.


Dioxin or TCDD (2-, 3-, 7-, 8-tetrachlorodibenzo-p-dioxin), one of the most poisonous substances known to Man, is considered to be suited as a chemical-warfare agent for long-term area denial and other hostile purposes. The history and toxicology of this agent are reviewed. The behaviour of dioxin in the environment and its ecological consequences are examined on the basis of four episodes of contamination: in South Viet Nam during the Second Indochina War during 1961-1970; in north-western Florida, U.S.A., while testing chemical anti-plant warfare agents during 1962-1964; in eastern Missouri, U.S.A., during 1971; and in northern Italy during 1976. It is concluded that the adverse ecological consequences would be drastic in the light of the extreme toxicity, ecological mobility and great environmental persistence of dioxin. The social consequences would be drastic as well owing to the potential medical effects and to the long-lasting inability to utilize contaminated areas for agricultural or other civil pursuits. This chapter was prepared by A.H. Westing and K. Lohs.


Viet Nam, Democratic Kampuchea and Laos sustained enormous levels of environmental disruption during the Second Indochina War. The major instruments of destruction were bombs, chemical anti-plant agents and land-clearing tractors (Rome ploughs). Both the methods and extent of environmental damage from these sources are described and analysed in detail. There are also briefer treatments of the use for hostile purposes of rural fires and of cloud-seeding (rain-making) agents. A discussion of ecological recovery from war damage is included. Very little attention is paid to the human consequences of the environmental damage described. This monograph was prepared by A.H. Westing. Excerpts appear in SIPRI Yearbook 1976: pp. 48-53; a summary appears in SIPRI Yearbook 1977: pp. 198-200. A Japanese translation is in the press (Tokyo: Iwanami Shoten Publishers).


Based on five articles that had originally appeared in a group of articles edited by L. Kristoferson, 1975, q.v. The articles, each of which has a separate entry in the present bibliography, were by: J. Goldblat, R.H. Huisken, B.M. Jasani, M. Lumsden and A.H. Westing.


The basic source on incendiary weapons and their effects. Included are a history of the use of fire in warfare from antiquity to the present, with emphasis on the period during and since World War II, including especially the Korean War and the Second Indochina War. Modern incendiary weapons are described in detail as are thermal effects on human beings. Little attention is paid to the environment per se. This monograph was prepared by M. Lumsden.


This analysis begins with brief descriptions of the environmental impacts of several categories of warfare: conventional, nuclear, chemical, biological, and geophysical. The bulk of the chapter outlines the environmental impacts of warfare on the several major global habitats: temperate, tropical, desert, arctic, island and oceanic. It is concluded that the military abuses of the environment have the potential of reaching very substantial, not to say spectacular, proportions. Moreover, hostile environmental disruption is open to a priori criticism since its effect is unavoidably indiscriminate, uncontrollable, and long-lasting. The first portion of the article is based upon the 1977 SIPRI monograph on Weapons of Mass Destruction and the Environment (q.v.); and the second upon the SIPRI monograph on Warfare in a Fragile World, to appear in late 1978 or early 1979. This chapter was prepared by A.H. Westing.


A brief examination of the voracious military requirements for oil is included. This monograph was prepared by B. Heinebück.


The definitive source for a wide range of technical information on chemical and biological weapons and warfare of the twentieth century. Little attention
is paid to the environment per se. The titles of the separate volumes indicate the range of topics covered:


These monographs were prepared by various researchers: I. by J.P. Robinson; II. by J.P. Robinson and colleagues; III. by A. Boserup; IV. by J. Goldblat; V. by A. Boserup and colleagues; and VI. by C-G Hedén.


Efforts by the United Nations and the International Committee of the Red Cross to prohibit or restrict the use of certain inhumane or indiscriminate weapons are described. Particular attention is paid to incendiary weapons and data are presented on the use of incendiaries as strategic and tactical area weapons. Estimates are included of quantities used, areas destroyed and civilian casualties produced for World War II, the Korean War and the Second Indochina War. This chapter was prepared by M. Lumsden.


The extent and duration of environmental damage to be expected from nuclear, chemical, biological and selected environmental weapons are examined. Nuclear weapons are analysed in terms of their blast wave, thermal pulse and nuclear radiation and how these affect the geosphere, atmosphere and biosphere. The chemical and biological weapons examined include CS, VX, botulinum toxin, the anthrax bacillus and the yellow fever virus. Environmental weapons are illustrated by the use and effects of fire and of rain-making agents. This monograph was prepared by A.H. Westing.


This monograph treats the problem of social recovery after nuclear attack as a special case of the general problem of social change. A number of general theories of short-term and long-term socially disintegrative processes are examined as well as theories of socially reconstructive and integrative processes. An attempt is made to integrate these theories within a framework that sees human societies as equilibrium systems which may be closed or opened with respect to outside influences. This integrated framework is then applied within the perspective of a nuclear attack. The theoretical analysis is of considerable interest in itself and has wider applications than that of a nuclear attack.


This sociological study describes the typical effects of war, famine, pestilence and other calamities upon the human mind and socio-cultural life. It is concluded that these disasters contribute to an increase in the incidence of mental disturbances and emotional disorders which act as an additional burden on the afflicted society in the post-disaster period. This classic work has been republished by the Greenwood Press, New York, 1968.


A detailed account of the geography and history of Saipan and of the anthropology of the indigenous population. The devastation caused by World War II is described in brief (pp. 91-95) and this is followed by a more detailed account of the post-war recovery of the population and its economy (pp. 98-215).


A massively documented account of the long-term (permanent) physical and mental damage brought about by sustained substandard nutrition in human foetuses and infants. The study finds its basis in the effects of the food embargo that Germany imposed upon portions of the Netherlands in 1944-1945, during its occupation of that country during World War II. During the period of privation, population fertility declined and perinatal and infant mortality increased substantially. The major focus of the study is on adult males, surviving in 1971-1972, who had been in utero during 1944-1945, comparing such survivors from the famine city of Amsterdam with a control city in the south. For this group of survivors it was found that substandard prenatal nutrition had increased the frequency of central nervous system disorders although mental performance appeared to be essentially unaffected. For a preliminary report of this investigation, see Science 178: pp. 708-713; 180: pp. 133-136, 1972-1973.


An examination of the postulated consequences of a 20 MT thermonuclear bomb detonated over the heart of New York City. Both short-term and long-term consequences are explored. Two chapters deal with anticipated ecological upsets: Chapter 11 (pp. 121-135) focuses upon plants, insects and other animals whereas Chapter 12 (pp. 136-152) focuses upon climate and erosion. A preliminary version of this book appeared in the Annals of the New York Academy of Sciences 105: pp. 281-364; 1963. (For a somewhat similar treatment of Boston, see the article by Ervin et al., 1962.)

A description by the chief Swedish delegate to the Geneva Conference of the Committee on Disarmament (CCD) of those negotiations that have pertained to the protection of the human environment. This is one of a group of articles edited by L. Kristoferson, 1975 q.v.


An excellent brief treatment of the subject suggested by the title. Human ecology is well covered, although the impact on the environment per se is only indicated in passing. This monograph was prepared by M.A. Vellodi and colleagues.


An exceptionally useful summary of a variety of known and presumed chemical and biological agents. Included are descriptions of representative anti-personnel (both lethal and harassing), anti-animal and anti-plant agents, how they might be used in war and their effects on both the intended target and its environment. Medical, agricultural and ecological impacts are all covered in greater or lesser detail. This monograph was prepared by W. Epstein and colleagues. This book makes an excellent companion volume to the one by the World Health Organization, 1970 q.v.


A brief consideration is included of the effects of world-wide arms and other military expenditures on natural resources (raw materials). This monograph was prepared by G. Dolgu and colleagues.


An excellent brief treatment of the use of fire in war. Emphasis is on the weapons and their medical effects. Succinct descriptions are included of the effects of incendiary attack on cities and of the use of such weapons on the battlefield and against environmental targets. This monograph was prepared by R. Björnerstedt and colleagues.


This authoritative reference work provides detailed quantitative information on the sources of ionizing radiation (nuclear-weapon use, testing and accidents among them) and the effects of such radiation on man (both somatic and genetic). Volume I is devoted to levels and Volume II to effects. Many tables and an extensive bibliography are included. A lengthy section (paragraphs 147-268) deals with atmospheric and surface nuclear explosions (including discussions of the transport of radio-active debris within the atmosphere, of internal radiation, of external radiation and of dose commitments). Another section (paragraphs 269-311) deals with underground and cratering nuclear explosions (including discussions of the sources of radio-activity, of contained experiments, of cratering experiments and of doses). This report was prepared by the scientific representatives of 15 nations.


This book contains extensive tabulations of the loss of human life (both military and civilian, both battle and non-battle) as a result of the direct and indirect effects of war and, as a consequence, of the influence of war on population dynamics. The data are drawn from a very wide variety of sources - for historical periods up to and including especially World Wars I and II - though mainly with reference to Europe during the last three-and-a-half centuries; there is brief reference to losses in some of the major post-World War II wars, but the available sources here are inadequate. In recent wars civilian losses have often exceeded losses of military personnel. In addition, excess mortality and a decline in birth rates may affect the age and sex composition of the population for decades. Although birth rates may be high in the post-war period, the proportion of the dependent fraction of the population (children, old people, invalids, etc.) increases relative to the productive fraction.


Taking as its point of departure the question as to why the massive United States bombing of North Vietnam during the Second Indochina War failed to "bring that country to its knees", this book examines the impact of the bombing and the societal response to it. Extensive use is made of translated Vietnamese documents as well as of U.S. material. Although the human costs of the bombing were high, their impact was minimized through great efforts by the government and the population. A number of relatively straightforward measures were successfully instituted, such as evacuation of people and dispersal of industrial machinery, digging of simple shelters in large numbers, the decentralization of administration, the providing of grass-roots health services and the rationing of food and cloth.


Part I of this work deals with chemical riot-control (harassing) agents, including their nature and
toxicity; and Part II deals with chemical anti-plant agents (herbicides), including their nature, toxicity and environmental impact. Parts I and II draw heavily upon the Second Indochina War experience. Part III deals with the polemological (politicio-military) aspects of the possession and use of these two classes of agents; and Part IV deals with the legal aspects. The major strength of the work lies in Part IV (Chapters 12-15, pp. 205-304).


A compilation of five separately authored papers that is intended to provide planning and operating officials with information about possible patterns of social effects and societal vulnerabilities that would result from a nuclear attack on the United States. Among the subjects covered are demographic aspects, economic dimensions, political-administrative problems at the local governmental level and methodological issues with regard to the analysis of the social effects. There is a separate 40-page summary.


The official British account of the allied strategic bombing offensive against Germany during World War II. Volume I is entitled "Preparation", Volume II "Endeavour", Volume III "Victory", and Volume IV "Anxieties and Appendices". Among those items of environmental concern are the appendices that summarize the findings of the British and U.S. Strategic Bombing Surveys, calculations of the tonnage of bombs required to inflict "decisive damage" on a populated city (for example, 3 tonnes per square kilometre or 1 tonne per 800 people at 50 per cent efficiency) and references to abortive plans and attempts to burn agricultural fields and forests. (For the official U.S. account of the strategic bombing of World War II, see MacIsaac, 1976.)


A collection of a dozen separately authored articles, most of them previously published, all dealing with social and ecological aspects of the Second Indochina War. They are divided into the following five groups: Introduction (1 article); Overview (4 articles); Earth below: destruction of the living landscape (6 articles); Destruction of a culture (9 articles); and From the other side (4 articles).


A brief review of weather- (rain, fog) manipulation capabilities, their application to hostile military purposes and the legal and diplomatic implications of such actions.


One of the continuing strategies of the United States during the Second Indochina War was to deny food to its largely guerrilla enemy in South Viet Nam. One of the important means by which it was attempted to accomplish this was through the aerial application of chemical anti-plant agents, often the herbicide dimethyl arsenic acid (code name, Agent Blue). The present article approximates the amount of food destroyed by this means alone during 1961-1971, largely in the Central Highlands of South Viet Nam: a very conservative calculation suggests that sufficient upland rice and other field crops were thus destroyed to provide the total diet for almost 900,000 people for a period of one year. Virtually all of the destroyed crops had been destined for civilian consumption. A briefer preliminary version of this article appeared in the New York Times, 12 July 1971, p. 27.


A bibliography with 294 citations that covers the world literature on the military use for hostile purposes of chemical anti-plant agents (herbicides). By far the greatest number deal with the Second Indochina War. Included in the compilation are 45 items of limited circulation by the U.S. Department of Defense.


An analysis is made of the traditional approaches to arms control and disarmament with reference to prohibiting environmental damage of the sort that occurred during the Second Indochina War. It is concluded that the traditional approaches - those focusing on Man per se, on geographical regions, or on the weapons themselves - have only limited applicability. It is suggested that a new approach is required to prevent serious ecological debilitation (so-called ecocide) by military means, one that focuses on the target rather than the technique, on the effect rather than the means.


It is shown that limited warfare can result in widespread, long-lasting and severe environmental damage. This has been demonstrated by a study of the effects of high-explosive munitions (bombs and shells), chemical anti-plant agents (herbicides) and heavy land-clearing tractors (so-called Rome ploughs).
as employed by the United States in South Viet Nam during the Second Indochina War, largely for the purpose of extended large-scale area denial. The ecological lesson to be learned is that the vegetation can be severely damaged or even destroyed with relative ease over extensive areas; that natural, agricultural and industrial-crop plant communities are all similarly vulnerable; and that the ecological impact of such actions is likely to be of long duration. Although the ecological damage to South Viet Nam was severe, the area-denial techniques used were of doubtful military success. It is therefore concluded that should a similar strategy be pursued in some future war, then the ecological damage can be expected to be far worse owing to the military necessity for a greatly expanded application of such techniques. This is one of a group of articles edited by L. Kristoferson, 1975, q.v.

This article examines the impact on the world ocean of military activities, both hostile and non-hostile, in relation to those of civil origin. Among the military abuses singled out for quantitative examination are underwater explosions, both conventional and nuclear, and contamination of the ocean with radio-active isotopes, chemical-warfare agents and oil. It is concluded that anthropogenic abuses of the world ocean are approaching a danger level and it is suggested that the military contribution to these abuses is one of the prime candidates for curtailment.

A corroboration of the concerns expressed by Hampson, 1974, q.v., and an extension of his calculations to include low-altitude nuclear explosions.

A group of five articles: "Physical damage from nuclear explosions" (by C.F. Miller); "Effects of fire on major ecosystems" (by A. Broido); "Effects of ionizing radiation on ecological systems" (by G.M. Woodwell and A.H. Sparrow); "Ionizing radiation and homeostasis of ecosystems" (by R.B. Platt); and "Biological interactions associated with spruce budworm infestations" (by D.R. MacDonald). There is also a "Summary" (by E.P. Odum). This collection of papers is useful not only in clarifying the complex ecological problems involved in a nuclear holocaust, but also in defining the normal patterns of structure, function and development characteristic of natural ecosystems. Fire and nuclear radiation - two of the major effects of nuclear weapons - are especially well covered.

The consequences of employing the various major chemical and biological warfare agents are analysed with special reference to the public health, medical and psychosocial consequences. Included are descriptions of lethal, incapacitating, harassing, anti-plant and other chemical agents as well as viral, rickettsial, bacterial and fungal biological agents. The danger of epidemics, casualty estimates and the contamination of water supplies are among the topics singled out. This monograph was prepared by M. Kaplan and colleagues. This book makes an excellent companion volume to the one by the United Nations, 1969, q.v.

An exhaustive treatise on the theory, history, causes and prevention of war; the classic study in its field. Although the effects of war (aside from casualties) are essentially not covered, the book is nevertheless useful in the present context because of its extensive statistical information, much of it in tabular form.

A scenario of a nuclear war in western Europe between the NATO and Warsaw Pact nations. In short, Europe could be totally destroyed by such a war. Less than 600 Soviet missiles could eliminate virtually the entire urban population (by blast) and most of the suburban and rural population (by nuclear fall-out) of western Europe, plus a million more elsewhere in the world. This is one of a group of articles edited by L. Kristoferson, 1975 q.v.
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