

CRISIS 21
Civilization's Crisis in the 21st Century

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Introduction

The aim of this book is to explore the links between the various problems facing civilization today. Although the problems are well known, it is useful to list them:

- **THREATS TO THE ENVIRONMENT:** The global environment is being destroyed by excessive consumption in the industrialized countries, combined with rapid population growth in developing nations. Climate change threatens to melt glaciers and polar ice. Complete melting of Greenland's inland ice would result in a 7 meter rise in sea level. Complete melting of the West Antarctic Ice Sheet would produce an additional 5 meters of rise.
- **GROWING POPULATION, VANISHING RESOURCES:** The fossil fuel era is ending. By 2050, oil and natural gas will be prohibitively expensive. They will no longer be used as fuels, but will be reserved as feedstocks for chemical synthesis. Within a hundred years, the same will be true of coal. The reserve indices for many metals are between 10 and 100 years. Reserve indices are defined as the size of the known reserves of metals divided by the current annual rates of production.
- **THE GLOBAL FOOD CRISIS:** It is predicted that by 2050, the world's population of humans will reach 9 billion. This is just the moment when the oil and natural gas, on which modern energy-intensive agriculture depend, will become so expensive that they will no longer be used as fuels. Climate change may also contribute to a global food crisis. Melting of Himalayan glaciers threatens the summer water supplies of both India and China. Rising sea levels threaten to inundate low-lying agricultural land, and aridity produced by climate change may reduce grain harvests. Furthermore, aquifers throughout the world are being

overdrawn, and water tables are falling. Topsoil is also being lost. These elements combine to produce a threat of widespread famine by the middle of the 21st century.

- **INTOLERABLE ECONOMIC INEQUALITY:** Today 2.7 billion people live on less than \$2 a day - 1.1 billion on less than \$1 per day. 18 million of our fellow humans die each year from poverty-related causes. Meanwhile, obesity is becoming a serious health problem in the rich part of the world. In 2006, 1.1 billion people lacked safe drinking water, and waterborne diseases killed an estimated 1.8 million people. The developing countries are also the scene of a resurgence of other infectious diseases, such as malaria, drug-resistant tuberculosis and HIV/AIDS.
- **THE THREAT OF NUCLEAR WAR:** Despite the end of the Cold War, the threat of a nuclear catastrophe remains severe. During the Cold War, the number and power of nuclear weapons reached insane heights - 50,000 nuclear weapons with a total explosive power equivalent to roughly a million Hiroshima bombs. Expressed differently, the total explosive power was equivalent to 20 billion tons of TNT, 4 tons for each person on earth. Today the total number of these weapons has been cut approximately in half, but there are still enough to destroy human civilization many times over. The danger of accidental nuclear war remains severe, since many nuclear missiles are on hair-trigger alert, ready to be fired within minutes of a warning being received. Continued over a long period of time, the threat of accident will grow to a near certainty. Meanwhile, the number of nations possessing nuclear weapons is growing, and there is a danger that if an unstable government is overthrown (for example, Pakistan's), the country's nuclear weapons will fall into the hands of subnational groups. Against nuclear terrorism there is no effective defense.
- **THE MILITARY-INDUSTRIAL COMPLEX:** In 2008, world military budgets reached a total of 1.47 trillion dollars (i.e. 1.47 million million dollars). This amount of money is almost too large to be imagined. The fact that it is being spent means that many people are making a living from the institution of war. Wealthy and powerful lobbies from the military-industrial complex are able to influence mass media and governments. Thus the institution of war persists, although we know

very well that it is a threat to civilization and that it responsible for much of the suffering that humans experience.

- LIMITS TO GROWTH: A “healthy” economic growth rate of 4% per year corresponds to an increase by a factor of 50 in a century, by a factor of 2,500 in two centuries and 125,000 in three centuries. No one can maintain that resource-using, waste-producing economic activities can continue to grow except by refusing to look more than a certain distance into the future. It seems likely that the boundaries for certain types of growth will be reached during the 21st century. (Culture can of course continue to grow.) We face a difficult period of transition from an economy that depends on growth for its health to a new economic system: steady-state economics.

The problems just mentioned are difficult and serious, but they all have solutions. The aim of this book is to show how the challenges facing civilization are interlinked and thus to throw some light on the remedies.

The present global economic recession should be seen as an advance warning of the limits to growth that will be reached by the middle of the 21st century. The recession offers an opportunity to take steps towards ecological sustainability and towards an economic system that does not depend on growth for its health - a steady-state economic system.

As the world economy reaches the limits of growth for resource-using activities, unemployment will become a threat; but public health work, reforestation, soil conservation, windmill construction, hydrogen technology research, and construction of energy-conserving buildings are all labor-intensive activities that will help to prevent unemployment while at the same time aiding the transition to sustainability.

Poverty causes overpopulation, and overpopulation causes poverty; war causes poverty, and poverty causes war; poverty causes disease, and disease causes poverty.

There is a reciprocal relationship between intolerable economic inequality and war. Military might is used by powerful industrialized nations to maintain economic hegemony over less developed countries. This is true today, even though the colonial era is supposed to be over (as has been amply documented by Professor Michael Klare in his books on “Resource Wars”). But, conversely, intolerable economic inequality is also a cause of war: Abolition of the institution of war will require the replacement of “might makes right”

by the rule international law. It will require development of effective global governance. But reform and strengthening of the United Nations is blocked by wealthy countries because they are afraid of losing their privileged positions. If global economic inequality were less enormous, the problem of unifying the world would be simplified.

Today's military spending of one and a half trillion US dollars per year would be more than enough to finance safe drinking water for the entire world, and to bring primary health care and family planning advice to all. If used constructively, the money now wasted (or worse than wasted) on the institution of war could also help the world to make the transition from fossil fuel use to renewable energy systems.

The dangers of nuclear weapons are linked to the problem of climate change because of the widespread (but false) belief that civilian nuclear power generation is carbon neutral. On the basis of this false premise, it is argued that nuclear power is an answer to the threat of global warming. But because it is almost impossible to distinguish between civilian and military nuclear programs, the widespread use of nuclear power throughout the world would carry with it serious dangers of nuclear proliferation.

We will attempt to explore these and other links between the problems facing civilization at the start of the 21st century.

The first chapter of this book is devoted to a history of economic ideas during the early phases of the Industrial Revolution, a development that was centered in England. It will be seen that the debate that took place at that time has great relevance to the 21st century. Adam Smith's ideas are dominant today, but deficiencies in the concept of a totally free market are becoming more and more apparent. The warning voice of Thomas Robert Malthus is given much space in the first chapter because of the light he throws on our present situation.

I must apologize for trying to treat such a broad panorama of problems. In doing so, one runs the risk of being superficial. However, I believe that insights into links between problems make this attempt worthwhile.

Finally, I would like to express my gratitude to Professor J.B. Opschoor, Ph.D. Stud. Christina Berg Johansen, Canadian Poet and Artist Heather Spears, and Lektor Birgit Schmidt for their careful reading of the book and for many extremely valuable suggestions.

Chapter 1

ECONOMICS, ETHICS AND ECOLOGY

“Like him who perverts the revenues of some pious foundation to profane purposes, he pays the wages of idleness with those funds which the frugality of his forefathers had, as it were, consecrated to the maintenance of industry.”

Adam Smith (describing an industrialist who fails to reinvest his profits)

Economics without ethics

The history of the epoch that immediately preceded the modern era can cast much light on the challenges facing us today, so we will begin by reviewing it. Until the start of the Industrial Revolution in the 18th and 19th centuries, human society maintained a more or less sustainable relationship with nature. However, with the beginning of the industrial era, traditional ways of life, containing both ethical and environmental elements, were replaced by the money-centered, growth-oriented life of today, from which these vital elements are missing.

According to the great classical economist Adam Smith (1723-1790), self-interest (even greed) is a sufficient guide to human economic actions. The passage of time has shown that Smith was right in many respects. The free market, which he advocated, has turned out to be the optimum prescription for economic growth. However, history has also shown that there is something horribly wrong or incomplete about the idea that individual self-interest alone, uninfluenced by ethical and ecological considerations, and totally free from governmental intervention, can be the main motivating force of a happy and just society. There has also proved to be something terribly wrong with the concept of unlimited economic growth. Here is what actually happened:

Industrialism in 18th and 19th centuries

Highland Clearances and Enclosure Acts

In pre-industrial Europe, peasant farmers held a low but nevertheless secure position, protected by a web of traditional rights and duties. Their low dirt-floored and thatched cottages were humble but safe refuges. If a peasant owned a cow, it could be pastured on common land.

With the invention of the steam engine and the introduction of spinning and weaving machines towards the end of the 18th Century, the pattern changed, at first in England, and afterwards in other European countries. Land-owners in Scotland and Northern England realized that sheep were more profitable to have on the land than “crofters” (i.e., small tenant farmers), and families that had farmed land for generations were violently driven from their homes with almost no warning. The cottages were afterwards burned to prevent the return of their owners.

Working conditions in 19th century England

According to the new rules by which industrial society began to be governed, traditions were forgotten and replaced by purely economic laws. Labor was



Figure 1.2: *A watercolor painting by Vincent van Gogh showing wives of Belgian miners carrying bags of coal.*



Figure 1.3: *London during the industrial revolution*

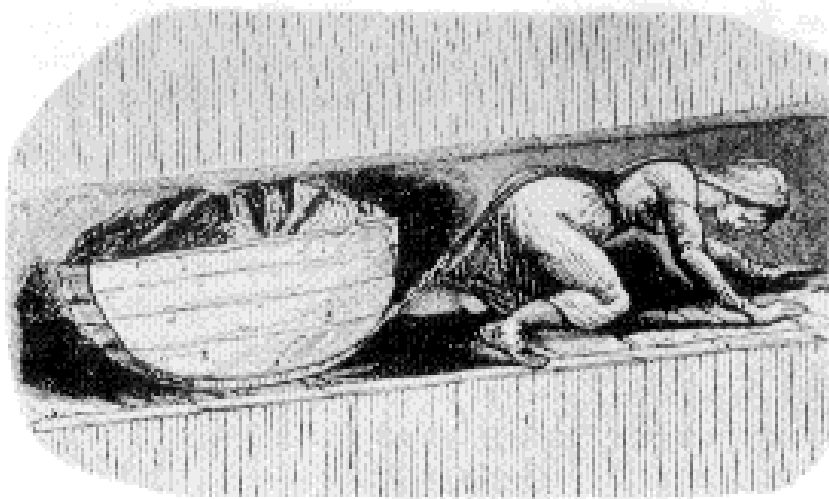


Figure 1.4: *A girl pulling a coaltub through the narrow space left by removal of coal from a seam.*

viewed as a commodity, like coal or grain, and wages were paid according to the laws of supply and demand, without regard for the needs of the workers. Wages fell to starvation levels, hours of work increased, and working conditions deteriorated.

John Fielden's book, "The Curse of the Factory System" was written in 1836, and it describes the condition of young children working in the cotton mills. "The small nimble fingers of children being by far the most in request, the custom instantly sprang up of procuring 'apprentices' from the different parish workhouses of London, Birmingham and elsewhere... Overseers were appointed to see to the works, whose interest it was to work the children to the utmost, because their pay was in proportion to the quantity of pay that they could exact."

"Cruelty was, of course, the consequence; and there is abundant evidence on record to show that in many of the manufacturing districts, the most heart-rending cruelties were practiced on the unoffending and friendless creatures... that they were flogged, fettered and tortured in the most exquisite refinements of cruelty, that they were in many cases starved to the bone while flogged to their work, and that they were even in some instances driven to commit suicide... The profits of manufacture were enormous, but this only whetted the appetite that it should have satisfied."

Dr. Peter Gaskell, writing in 1833, described the condition of the English mill workers as follows:

“The vast deterioration in personal form which has been brought about in the manufacturing population during the last thirty years... is singularly impressive, and fills the mind with contemplations of a very painful character... Their complexion is sallow and pallid, with a peculiar flatness of feature caused by the want of a proper quantity of adipose substance to cushion out the cheeks. Their stature is low - the average height of men being five feet, six inches... Great numbers of the girls and women walk lamely or awkwardly... Many of the men have but little beard, and that in patches of a few hairs... (They have) a spiritless and dejected air, a sprawling and wide action of the legs...”

“Rising at or before daybreak, between four and five o’clock the year round, they swallow a hasty meal or hurry to the mill without taking any food whatever... At twelve o’clock the engine stops, and an hour is given for dinner... Again they are closely immured from one o’clock till eight or nine, with the exception of twenty minutes, this being allowed for tea. During the whole of this long period, they are actively and unremittingly engaged in a crowded room at an elevated temperature.”

Dr. Gaskell described the housing of the workers as follows:

“One of the circumstances in which they are especially defective is that of drainage and water-closets. Whole ranges of these houses are either totally undrained, or very partially... The whole of the washings and filth from these consequently are thrown into the front or back street, which, often being unpaved and cut into deep ruts, allows them to collect into stinking and stagnant pools; while fifty, or even more than that number, having only a single convenience common to them all, it is in a very short time choked with excrementous matter. No alternative is left to the inhabitants but adding this to the already defiled street.”

“It frequently happens that one tenement is held by several families... The demoralizing effects of this utter absence of domestic privacy must be seen before they can be thoroughly appreciated. By laying bare all the wants and actions of the sexes, it strips them of outward regard for decency - modesty is annihilated - the father and the mother, the brother and the sister, the male and female lodger, do not scruple to commit acts in front of each other which even the savage keeps hid from his fellows.”

Adam Smith

The invisible hand

As everyone knows, Adam Smith invented the theory that individual self-interest is, and ought to be, the main motivating force of human economic activity, and that this, in effect, serves the wider social interest. He put forward a detailed description of this concept in an immense book, “The Wealth of Nations” (1776).

Adam Smith (1723-1790) had been Professor of Logic at the University of Glasgow, but in 1764 he withdrew from his position at the university to become the tutor of the young Duke of Buccleuch. In those days a Grand Tour of Europe was considered to be an important part of the education of a young nobleman, and Smith accompanied Buccleuch to the Continent. To while away the occasional dull intervals of the tour, Adam Smith began to write an enormous book on economics which he finally completed twelve years later. He began his “Inquiry into the Nature and Causes of the Wealth of Nations” by praising division of labor. As an example of its benefits, he cited a pin factory, where ten men, each a specialist in his own set of operations, could produce 48,000 pins in a day. In the most complex civilizations, Smith stated, division of labor has the greatest utility.

The second factor in prosperity, Adam Smith maintained, is a competitive market, free from monopolies and entirely free from governmental interference. In such a system, he tells us, the natural forces of competition are able to organize even the most complex economic operations, and are able also to maximize productivity. He expressed this idea in the following words:

“As every individual, therefore, endeavors as much as he can, both to employ his capital in support of domestic industry, and so to direct that industry that its produce may be of greatest value, each individual necessarily labours to render the annual revenue of the Society as great as he can.”

“He generally, indeed, neither intends to promote the public interest, nor knows how much he is promoting it. By preferring the support of domestic to that of foreign industry, he intends only his own security; and by directing that industry in such a manner as its produce may be of greatest value, he intends only his own gain; and he is in this, as in many other cases, led by an invisible hand to promote an end that was no part of his intention. Nor is it always the worse for Society that it was no part of it. By pursuing his own interest, he frequently promotes that of Society more effectively than when

he really intends to promote it.”

For example, a baker does not bake bread out of an unselfish desire to help his fellow humans; he does so in order to earn money; but if he were not performing a useful service, he would not be paid. Thus the “invisible hand” guides him to do something useful. Free competition also regulates prices: If the baker charges too much, he will be undersold. Finally, if there are too many bakers, the trade will become so unprofitable that some bakers will be forced into other trades. Thus highly complex operations are automatically regulated by the mechanisms of the free market. “Observe the accommodation of the most common artificer or day labourer in a civilized and thriving country”, Smith continues, “and you will perceive that the number of people of whose industry a part, though but a small part, has been employed in securing him this accommodation, exceeds all computation. The woolen coat, which covers the day-labourer, as coarse and rough as it may seem, is the joint labour of a great multitude of workmen. The shepherd, the sorter of wool, the wool-comber, the carder, the dyer, the scribbler, the spinner, the weaver, the fuller, the dresser, with many others, must all join their different arts to complete even the most homely production. How many merchants and carriers, besides, must have been employed... how much commerce and navigation... how many ship-builders, sailors, sail-makers, rope-makers...”

Reinvestment and growth

An important feature of Adam Smith’s economic model is that it is by no means static. The virtuous manufacturer does not purchase pearl necklaces for his wife; he reinvests his profits, buying more machinery or building new factories. An industrialist who ignores the commandment to reinvest is “...like him who perverts the revenues of some pious foundation to profane purposes; he pays the wages of idleness with those funds which the fragility of his forefathers had, as it were, consecrated to the maintenance of industry.”

The expansion of the system will not be slowed, Smith maintained, by shortages of labor, because “...the demand for men, like that for any other commodity, necessarily regulates the production of men.” Smith did not mean that more births would occur if the demand for workers became greater. He meant that if wages began to rise above the lowest level needed to maintain life, more children of the workers would survive. In those days, the rates of infant and child mortality were horrendous, particularly among the half-starved poor. “It is not uncommon”, Smith wrote, “in the Highlands of

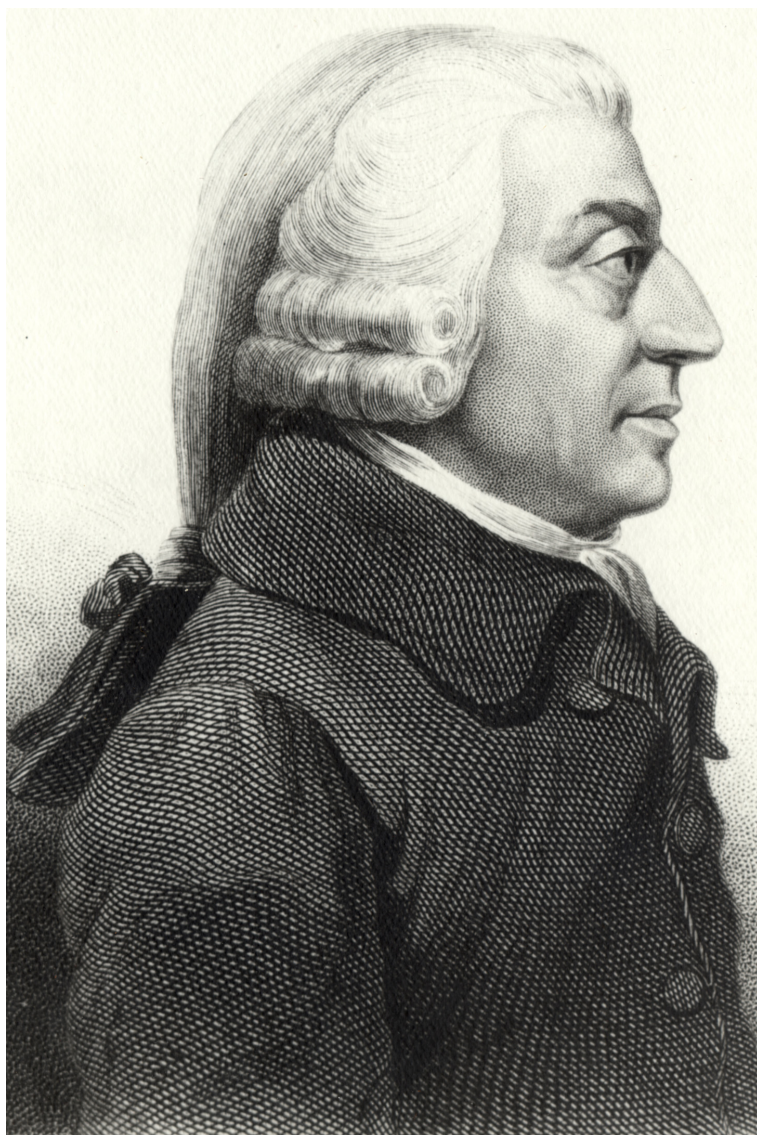


Figure 1.5: *Adam Smith (1723-1790)*

Scotland, for a mother who has borne twenty children not to have two alive.”

Adam Smith’s ideas were enthusiastically adopted by the rising class of manufacturers and by their representatives in government. The reverence shown to him can be illustrated by an event that occurred when he visited England’s Prime Minister, William Pitt, and his Cabinet. The whole gathering stood up when Smith entered. “Pray be seated, gentlemen”, Smith said. “Not until you first are seated Sir”, Pitt replied, “for we are all your scholars.”

History has shown that Adam Smith was right in many respects. The free market is indeed a dynamo that produces economic growth, and it is capable of organizing even the most complex economic endeavors. Through Adam Smith’s “invisible hand”, self interest is capable of guiding the economy so that it will maximize the production of wealth. However, history has also shown the shortcomings of a market that is totally free of governmental regulation.

The landowners of Scotland were unquestionably following self-interest as they burned the cottages of their crofters; and self-interest motivated overseers as they whipped half-starved child workers in England’s mills. Adam Smith’s “invisible hand” no doubt guided their actions in such a way as to maximize production. But whether a happy and just society was created in this way is questionable. Certainly it was a society with large areas of unhappiness and injustice. Self-interest alone was not enough. A society following purely economic laws - a society where selfishness is exalted as the main-spring for action - lacks both the ethical and ecological dimensions needed for social justice, widespread happiness, and sustainability¹.

Malthus

A debate between father and son

T.R. Malthus’ *Essay on The Principle of Population*, the first edition of which was published in 1798, was one of the the first systematic studies of

¹In fact, Adam Smith himself would have accepted this criticism of his enthronement of self-interest as the central principle of society. He believed that his “invisible hand” would not work for the betterment of society except within the context of a certain amount of governmental regulation. His modern Neoliberal admirers, however, forget this aspect of Smith’s philosophy, and maintain that market forces alone can achieve a desirable result.

the problem of population in relation to resources. Earlier discussions of the problem had been published by Botterro in Italy, Robert Wallace in England, and Benjamin Franklin in America. However Malthus' *Essay* was the first to stress the fact that, in general, powerful checks operate continuously to keep human populations from increasing beyond their available food supply. In a later edition, published in 1803, he buttressed this assertion with carefully collected demographic and sociological data from many societies at various periods of their histories.

The publication of Malthus' *Essay* coincided with a wave of disillusionment which followed the optimism of the Enlightenment. The utopian societies predicted by the philosophers of the Enlightenment were compared with reign of terror in Robespierre's France and with the miseries of industrial workers in England; and the discrepancy required an explanation. The optimism which preceded the French Revolution, and the disappointment which followed a few years later, closely paralleled the optimistic expectations of our own century, in the period after the Second World War, when it was thought that the transfer of technology to the less developed parts of the world would eliminate poverty, and the subsequent disappointment when poverty persisted. Science and technology developed rapidly in the second half of the twentieth century, but the benefits which they conferred were just as rapidly consumed by a global population which today is increasing at the rate of one billion people every fourteen years. Because of the close parallel between the optimism and disappointments of Malthus' time and those of our own, much light can be thrown on our present situation by rereading the debate between Malthus and his contemporaries.

Thomas Robert Malthus (1766-1834) came from an intellectual family: His father, Daniel Malthus, was a moderately well-to-do English country gentleman, an enthusiastic believer in the optimistic ideas of the Enlightenment, and a friend of the philosophers Henry Rousseau, David Hume and William Godwin. The famous book on population by the younger Malthus grew out of conversations with his father.

Daniel Malthus attended Oxford, but left without obtaining a degree. He later built a country home near Dorking, which he called "The Rookery". The house had Gothic battlements, and the land belonging to it contained a beech forest, an ice house, a corn mill, a large lake, and serpentine walks leading to "several romantic buildings with appropriate dedications".

Daniel Malthus was an ardent admirer of Rousseau; and when the French philosopher visited England with his mistress, Thérèse le Vasseur, Daniel



Figure 1.6: *The Rookery near Dorking in Surrey*

Malthus entertained him at the Rookery. Rousseau and Thérèse undoubtedly saw Daniel's baby son (who was always called Robert or Bob) and they must have noticed with pity that he had been born with a hare lip. This was later sutured, and apart from a slight scar which marked the operation, he became very handsome.

Robert Malthus was at first tutored at home; but in 1782, when he was 16 years old, he was sent to study at the famous Dissenting Academy at Warrington in Lancashire. Joseph Priestly had taught at Warrington, and he had completed his famous *History of Electricity* there, as well as his *Essay on Government*, which contains the phrase "the greatest good for the greatest number".

Robert's tutor at Warrington Academy was Gilbert Wakefield (who was later imprisoned for his radical ideas). When Robert was 18, Wakefield arranged for him to be admitted to Jesus College, Cambridge University, as a student of mathematics. Robert Malthus graduated from Cambridge in 1788 with a first-class degree in mathematics. He was Ninth Wrangler, which meant that he was the ninth-best mathematician in his graduating class. He also won prizes in declamation, both in English and in Latin, which is surprising in view of the speech defect from which he suffered all his life.

In 1793, Robert Malthus was elected a fellow of Jesus College, and he also took orders in the Anglican Church. He was assigned as Curate to Okewood Chapel in Surrey. This small chapel stood in a woodland region, and Malthus' illiterate parishioners were so poor that the women and children went without

shoes. They lived in low thatched huts made of woven branches plastered with mud. The floors of these huts were of dirt, and the only light came from tiny window openings. Malthus' parishioners diet consisted almost entirely of bread. The children of these cottagers developed late, and were stunted in growth. Nevertheless, in spite of the harsh conditions of his parishioners' lives, Malthus noticed that the number of births which he recorded in the parish register greatly exceeded the number of deaths. It was probably this fact which first turned his attention to the problem of population.

By this time, Daniel Malthus had sold the Rookery; and after a period of travel, he had settled with his family at Albury, about nine miles from Okewood Chapel. Robert Malthus lived with his parents at Albury, and it was here that the famous debates between father and son took place.

1793, the year when Robert Malthus took up his position at Okewood, was also the year in which Daniel Malthus friend, William Godwin, published his enormously optimistic book, *Political Justice* [6,14,21]. In this book, Godwin predicted a future society where scientific progress would liberate humans from material want. Godwin predicted that in the future, with the institution of war abolished, with a more equal distribution of property, and with the help of scientific improvements in agriculture and industry, much less labour would be needed to support life. Luxuries are at present used to maintain artificial distinctions between the classes of society, Godwin wrote, but in the future values will change; humans will live more simply, and their efforts will be devoted to self-fulfillment and to intellectual and moral improvement, rather than to material possessions. With the help of automated agriculture, the citizens of a future society will need only a few hours a day to earn their bread.

Godwin went on to say, "The spirit of oppression, the spirit of servility and the spirit of fraud - these are the immediate growth of the established administration of property. They are alike hostile to intellectual improvement. The other vices of envy, malice, and revenge are their inseparable companions. In a state of society where men lived in the midst of plenty, and where all shared alike the bounties of nature, these sentiments would inevitably expire. The narrow principle of selfishness would vanish. No man being obliged to guard his little store, or provide with anxiety and pain for his restless wants, each would lose his own individual existence in the thought of the general good. No man would be the enemy of his neighbor, for they would have nothing to contend; and of consequence philanthropy would resume the empire which reason assigns her. Mind would be delivered from her

perpetual anxiety about corporal support, and free to expatiate in the field of thought which is congenial to her. Each man would assist the inquiries of all.”

Godwin insisted that there is an indissoluble link between politics, ethics and knowledge. *Political Justice* is an enthusiastic vision of what humans could be like at some future period when the trend towards moral and intellectual improvement has lifted men and women above their present state of ignorance and vice. Much of the savage structure of the penal system would then be unnecessary, Godwin believed. (At the time when he was writing, there were more than a hundred capital offenses in England, and this number had soon increased to almost two hundred. The theft of any object of greater value than ten shillings was punishable by hanging.)

In its present state, Godwin wrote, society decrees that the majority of its citizens “should be kept in abject penury, rendered stupid with ignorance and disgustful with vice, perpetuated in nakedness and hunger, goaded to the commission of crimes, and made victims to the merciless laws which the rich have instituted to oppress them”. But human behavior is produced by environment and education, Godwin pointed out. If the conditions of upbringing were improved, behavior would also improve. In fact, Godwin believed that men and women are subject to natural laws no less than the planets of Newton’s solar system. “In the life of every human”, Godwin wrote, “there is a chain of causes, generated in that eternity which preceded his birth, and going on in regular procession through the whole period of his existence, in consequence of which it was impossible for him to act in any instance otherwise than he has acted.”

The chain of causality in human affairs implies that vice and crime should be regarded with the same attitude with which we regard disease. The causes of poverty, ignorance, vice and crime should be removed. Human failings should be cured rather than punished. With this in mind, Godwin wrote, “our disapprobation of vice will be of the same nature as our disapprobation of an infectious distemper.”

In France the Marquis de Condorcet had written an equally optimistic book, *Esquisse d’un Tableau Historique des Progrès de l’Esprit Humain*. Condorcet’s optimism was unaffected even by the fact that at the time when he was writing he was in hiding, under sentence of death by Robespierre’s government. Besides enthusiastically extolling Godwin’s ideas to his son, Daniel Malthus also told him of the views of Condorcet.

Condorcet’s *Esquisse*, is an enthusiastic endorsement of the idea of infinite



Figure 1.7: *Thomas Robert Malthus (1766-1834).*

human perfectibility which was current among the philosophers of the 18th century, and in this book, Condorcet anticipated many of the evolutionary ideas of Charles Darwin. He compared humans with animals, and found many common traits. Condorcet believed that animals are able to think, and even to think rationally, although their thoughts are extremely simple compared with those of humans. He also asserted that humans historically began their existence on the same level as animals and gradually developed to their present state. Since this evolution took place historically, he reasoned, it is probable, or even inevitable, that a similar evolution in the future will bring mankind to a level of physical, mental and moral development which will be as superior to our own present state as we are now superior to animals.

In his *Esquisse*, Condorcet called attention to the unusually long period of dependency which characterizes the growth and education of human offspring. This prolonged childhood is unique among living beings. It is needed for the high level of mental development of the human species; but it requires a stable family structure to protect the young during their long upbringing. Thus, according to Condorcet, biological evolution brought into existence a moral precept, the sanctity of the family.

Similarly, Condorcet maintained, larger associations of humans would have been impossible without some degree of altruism and sensitivity to the suffering of others incorporated into human behavior, either as instincts or as moral precepts or both; and thus the evolution of organized society entailed the development of sensibility and morality.

Condorcet believed that ignorance and error are responsible for vice; and he listed what he regarded as the main mistakes of civilization: hereditary transmission of power, inequality between men and women, religious bigotry, disease, war, slavery, economic inequality, and the division of humanity into mutually exclusive linguistic groups.

Condorcet believed the hereditary transmission of power to be the source of much of the tyranny under which humans suffer; and he looked forward to an era when republican governments would be established throughout the world. Turning to the inequality between men and women, Condorcet wrote that he could see no moral, physical or intellectual basis for it. He called for complete social, legal, and educational equality between the sexes.

Condorcet predicted that the progress of medical science would free humans from the worst ravages of disease. Furthermore, he maintained that since perfectibility (i.e. evolution) operates throughout the biological world, there is no reason why mankind's physical structure might not gradually im-

prove, with the result that human life in the remote future could be greatly prolonged. Condorcet believed that the intellectual and moral facilities of man are capable of continuous and steady improvement; and he thought that one of the most important results of this improvement will be the abolition of war.

As Daniel Malthus talked warmly about Godwin, Condorcet, and the idea of human progress, the mind of his son, Robert, turned to the unbalance between births and deaths which he had noticed among his parishioners at Okewood Chapel. He pointed out to his father that no matter what benefits science might be able to confer, they would soon be eaten up by population growth. Regardless of technical progress, the condition of the lowest social class would remain exactly the same: The poor would continue to live, as they always had, on the exact borderline between survival and famine, clinging desperately to the lower edge of existence. For them, change for the worse was impossible since it would loosen their precarious hold on life; their children would die and their numbers would diminish until they balanced the supply of food. But any change for the better was equally impossible, because if more nourishment should become available, more of the children of the poor would survive, and the share of food for each of them would again be reduced to the precise minimum required for life.

Observation of his parishioners at Okewood had convinced Robert Malthus that this sombre picture was a realistic description of the condition of the poor in England at the end of the 18th century. Techniques of agriculture and industry were indeed improving rapidly; but among the very poor, population was increasing equally fast, and the misery of society's lowest class remained unaltered.

Publication of the first essay in 1798

Daniel Malthus was so impressed with his son's arguments that he urged him to develop them into a small book. Robert Malthus' first essay on population, written in response to his father's urging, was only 50,000 words in length. It was published anonymously in 1798, and its full title was *An Essay on the Principle of Population, as it affects the future improvement of society, with remarks on the speculations of Mr. Godwin, M. Condorcet, and other writers*. Robert Malthus' *Essay* explored the consequences of his basic thesis: that "the power of population is indefinitely greater than the power in the earth to produce subsistence for man".

“That population cannot increase without the means of subsistence”, Robert Malthus wrote, “is a proposition so evident that it needs no illustration. That population does invariably increase, where there are means of subsistence, the history of every people who have ever existed will abundantly prove. And that the superior power cannot be checked without producing misery and vice, the ample portion of these two bitter ingredients in the cup of human life, and the continuance of the physical causes that seem to have produced them, bear too convincing a testimony.”

In order to illustrate the power of human populations to grow quickly to enormous numbers if left completely unchecked, Malthus turned to statistics from the United States, where the population had doubled every 25 years for a century and a half. Malthus called this type of growth “geometrical” (today we would call it “exponential”); and, drawing on his mathematical education, he illustrated it by the progression 1,2,4,8,16,32,64,128,256,...etc. In order to show that, in the long run, no improvement in agriculture could possibly keep pace with unchecked population growth, Malthus allowed that, in England, agricultural output might with great effort be doubled during the next quarter century; but during a subsequent 25-year period it could not again be doubled. The growth of agricultural output could at the very most follow an arithmetic (linear) progression, 1,2,3,4,5,6,...etc.

Because of the overpoweringly greater numbers which can potentially be generated by exponential population growth, as contrasted to the slow linear progression of sustenance, Malthus was convinced that at almost all stages of human history, population has not expanded freely, but has instead pressed painfully against the limits of its food supply. He maintained that human numbers are normally held in check either by “vice or misery”. (Malthus classified both war and birth control as a forms of vice.) Occasionally the food supply increases through some improvement in agriculture, or through the opening of new lands; but population then grows very rapidly, and soon a new equilibrium is established, with misery and vice once more holding the population in check.

Like Godwin’s *Political Justice*, Malthus’ *Essay on the Principle of Population* was published at exactly the right moment to capture the prevailing mood of England. In 1793, the mood had been optimistic; but by 1798, hopes for reform had been replaced by reaction and pessimism. Public opinion had been changed by Robespierre’s Reign of Terror and by the threat of a French invasion. Malthus’ clear and powerfully written essay caught the attention of readers not only because it appeared at the right moment, but also because

his two contrasting mathematical laws of growth were so striking.

One of Malthus' readers was William Godwin, who recognized the essay as the strongest challenge to his utopian ideas that had yet been published. Godwin several times invited Malthus to breakfast at his home to discuss social and economic problems. (After some years, however, the friendship between Godwin and Malthus cooled, the debate between them having become more acrimonious.)

In 1801, Godwin published a reply to his critics, among them his former friends James Mackintosh and Samuel Parr, by whom he recently had been attacked. His *Reply to Parr* also contained a reply to Malthus: Godwin granted that the problem of overpopulation raised by Malthus was an extremely serious one. However, Godwin wrote, all that is needed to solve the problem is a change of the attitudes of society. For example we need to abandon the belief "that it is the first duty of princes to watch for (i.e. encourage) the multiplication of their subjects, and that a man or woman who passes the term of life in a condition of celibacy is to be considered as having failed to discharge the principal obligations owed to the community".

"On the contrary", Godwin continued, "it now appears to be rather the man who rears a numerous family that has to some degree transgressed the consideration he owes to the public welfare". Godwin suggested that each marriage should be allowed only two or three children or whatever number might be needed to balance the current rates of mortality and celibacy. This duty to society, Godwin wrote, would surely not be too great a hardship to be endured, once the reasons for it were thoroughly understood.

The second essay, published in 1803

Malthus' small essay had captured public attention in England, and he was anxious to expand it with empirical data which would show his principle of population to be valid not only in England in his own day, but in all societies and all periods. He therefore traveled widely, collecting data. He also made use of the books of explorers, such as Cook and Vancouver.

Malthus second edition - more than three times the length of his original essay on population - was ready in 1803. Book I and Book II of the 1803 edition of Malthus' *Essay* are devoted to a study of the checks to population growth which have operated throughout history in all the countries of the world for which he possessed facts.

In his first chapter, Malthus stressed the potentially enormous power of

population growth contrasted the slow growth of the food supply. He concluded that strong checks to the increase of population must almost always be operating to keep human numbers within the bounds of sustenance. He classified the checks as either preventive or positive, the preventive checks being those which reduce fertility, while the positive checks are those which increase mortality. Among the positive checks, Malthus listed “unwholesome occupations, severe labour and exposure to the seasons, extreme poverty, bad nursing of children, great towns, excesses of all kinds, the whole train of common diseases and epidemics, wars, plague, and famine”.

In the following chapters of Books I, Malthus showed in detail the mechanisms by which population is held at the level of sustenance in various cultures. He first discussed primitive hunter-gatherer societies, such as the inhabitants of Tierra del Fuego, Van Diemens Land and New Holland, and those tribes of North American Indians living predominantly by hunting. In hunting societies, he pointed out, the population is inevitably very sparse: “The great extent of territory required for the support of the hunter has been repeatedly stated and acknowledged”, Malthus wrote, “...The tribes of hunters, like beasts of prey, whom they resemble in their mode of subsistence, will consequently be thinly scattered over the surface of the earth. Like beasts of prey, they must either drive away or fly from every rival, and be engaged in perpetual contests with each other...The neighboring nations live in a perpetual state of hostility with each other. The very act of increasing in one tribe must be an act of aggression against its neighbors, as a larger range of territory will be necessary to support its increased numbers. The contest will in this case continue, either till the equilibrium is restored by mutual losses, or till the weaker party is exterminated or driven from its country... Their object in battle is not conquest but destruction. The life of the victor depends on the death of the enemy”. Malthus concluded that among the American Indians of his time, war was the predominant check to population growth, although famine, disease and infanticide each played a part.

In the next chapter, Malthus quoted Captain Cook’s description of the natives of the region near Queen Charlotte’s Sound in New Zealand, whose way of life involved perpetual war. “If I had followed the advice of all our pretended friends”, Cook wrote, “I might have extirpated the whole race; for the people of each hamlet or village, by turns, applied to me to destroy the other”. According to Cook, the New Zealanders practiced both ceaseless war and cannibalism; and population pressure provided a motive for both

practices.

In later chapters on nomadic societies of the Near East and Asia, war again appears, not only as a consequence of the growth of human numbers, but also as one of the major mechanisms by which these numbers are reduced to the level of their food supply. The studies quoted by Malthus make it seem likely that the nomadic Tartar tribes of central Asia made no use of the preventive checks to population growth. In fact the Tartar tribes may have regarded growth of their own populations as useful in their wars with neighboring tribes.

Malthus also described the Germanic tribes of Northern Europe, whose population growth led them to the attacks which destroyed the Roman Empire. He quoted the following passage from Machiavelli's *History of Florence*: "The people who inhabit the northern parts that lie between the Rhine and the Danube, living in a healthful and prolific climate, often increase to such a degree that vast numbers of them are forced to leave their native country and go in search of new habitations. When any of those provinces begins to grow too populous and wants to disburden itself, the following method is observed. In the first place, it is divided into three parts, in each of which there is an equal portion of the nobility and commonality, the rich and the poor. After this they cast lots; and that division on which the lot falls quits the country and goes to seek its fortune, leaving the other two more room and liberty to enjoy their possessions at home. These emigrations proved the destruction of the Roman Empire". Regarding the Scandinavians in the early middle ages, Malthus wrote: "Mallet relates, what is probably true, that it was their common custom to hold an assembly every spring for the purpose of considering in what quarter they should make war".

In Book II, Malthus turned to the nations of Europe, as they appeared at the end of the 18th century, and here he presents us with a different picture. Although in these societies poverty, unsanitary housing, child labour, malnutrition and disease all took a heavy toll, war produced far less mortality than in hunting and pastoral societies, and the preventive checks, which lower fertility, played a much larger roll.

Malthus had visited Scandinavia during the summer of 1799, and he had made particularly detailed notes on Norway. He was thus able to present a description of Norwegian economics and demography based on his own studies. Norway was remarkable for having the lowest reliably-recorded death rate of any nation at that time: Only 1 person in 48 died each year in Norway. (By comparison, 1 person in 20 died each year in London.) The rate of

marriage was also remarkably low, with only 1 marriage each year for every 130 inhabitants; and thus in spite of the low death rate, Norway's population had increased only slightly from the 723,141 inhabitants recorded in 1769.

There were two reasons for late marriage in Norway: Firstly, every man born of a farmer or a labourer was compelled by law to be a soldier in the reserve army for a period of ten years; and during his military service, he could not marry without the permission of both his commanding officer and the parish priest. These permissions were granted only to those who were clearly in an economic position to support a family. Men could be inducted into the army at any age between 20 and 30, and since commanding officers preferred older recruits, Norwegian men were often in their 40's before they were free to marry. At the time when Malthus was writing, these rules had just been made less restrictive; but priests still refused to unite couples whose economic foundations they judged to be insufficient.

The second reason for late marriages was the structure of the farming community. In general, Norwegian farms were large; and the owner's household employed many young unmarried men and women as servants. These young people had no chance to marry unless a smaller house on the property became vacant, with its attached small parcel of land for the use of the "houseman"; but because of the low death rate, such vacancies were infrequent. Thus Norway's remarkably low death rate was balanced by a low birth rate. Other chapters in Book II are devoted to the checks to population growth in Sweden, Russia, Central Europe, Switzerland, France, England, Scotland and Ireland.

Malthus painted a very dark panorama of population pressure and its consequences in human societies throughout the world and throughout history: At the lowest stage of cultural development are the hunter-gatherer societies, where the density of population is extremely low. Nevertheless, the area required to support the hunters is so enormous that even their sparse and thinly scattered numbers press hard against the limits of sustenance. The resulting competition for territory produces merciless intertribal wars.

The domestication of animals makes higher population densities possible; and wherever this new mode of food production is adopted, human numbers rapidly increase; but very soon a new equilibrium is established, with the population of pastoral societies once more pressing painfully against the limits of the food supply, growing a little in good years, and being cut back in bad years by famine, disease and war.

Finally, agricultural societies can maintain extremely high densities of

population; but the time required to achieve a new equilibrium is very short. After a brief period of unrestricted growth, human numbers are once more crushed against the barrier of limited resources; and if excess lives are produced by overbreeding, they are soon extinguished by deaths among the children of the poor.

Malthus was conscious that he had drawn an extremely dark picture of the human condition. He excused himself by saying that he has not done it gratuitously, but because he was convinced that the dark shades really are there, and that they form an important part of the picture. He did allow one ray of light, however: By 1803, his own studies of Norway, together with personal conversations with Godwin and the arguments in Godwin's *Reply to Parr*, had convinced Malthus that "moral restraint" should be included among the possible checks to population growth. Thus he concluded Book II of his 1803 edition by saying that the checks which keep population down to the level of the means of subsistence can all be classified under the headings of "moral restraint, vice and misery". (In his first edition he had maintained that vice and misery are the only possibilities).

Systems of Equality

In the 1803 edition of Malthus' *Essay*, Books III and IV form a second volume. The ideas which he put forward in this second volume are much more open to dispute than are the solidly empirical demographic studies of Books I and II. Malthus excused himself at the beginning of the second volume, saying that he realized that the ideas which he was about to put forward were less solidly based than those in his first volume. However, he said that he wished to explore all the consequences of his principle of population: "...Even the errors into which I may have fallen", he wrote, "by affording a handle to argument, and an additional excitement to examination, may be subservient to the important end of bringing a subject so nearly connected with the happiness of society into more general notice".

Malthus began Book III by discussing the systems of equality proposed by Condorcet and Godwin; and he tried to show that such utopian societies would prove impossible in practice, because they would rapidly drown in a flood of excess population. Condorcet himself had recognized this difficulty. He realized that improved living conditions for the poor would lead to a rapid growth of population. "Must not a period then arrive", Condorcet had written, "... when the increase of the number of men surpassing their means

of subsistence, the necessary result must be either a continual diminution of happiness and population... or at least a kind of oscillation between good and evil?"

Condorcet believed the serious consequences of population pressure to be far in the future, but Malthus disagreed with him on exactly that point: "M. Condorcet's picture of what may be expected to happen when the number of men shall surpass subsistence is justly drawn... The only point in which I differ from M. Condorcet in this description is with regard to the period when it may be applied to the human race... This constantly subsisting cause of periodical misery has existed in most countries ever since we have had any histories of mankind, and continues to exist at the present moment."

"M. Condorcet, however, goes on to say", Malthus continued, "that should the period, which he conceives to be so distant, ever arrive, the human race, and the advocates of the perfectibility of man, need not be alarmed at it. He then proceeds to remove the difficulty in a manner which I profess not to understand. Having observed that the ridiculous prejudices of superstition would by that time have ceased to throw over morals a corrupt and degrading austerity, he alludes either to a promiscuous concubinage, which would prevent breeding, or to something else as unnatural. To remove the difficulty in this way will surely, in the opinion of most men, be to destroy that virtue and purity of manners which the advocates of equality and of the perfectibility of man profess to be the end and object of their views." When Malthus referred to "something else as unnatural", he of course meant birth control, some forms of which existed at the time when he was writing; and in this passage we see that he was opposed to the practice. He preferred late marriage or "moral restraint" as a means of limiting excessive population growth.

After his arguments against Condorcet, Malthus discussed William Godwin's egalitarian utopia, which, he said, would be extremely attractive if only it could be achieved: "The system of equality which Mr. Godwin proposes", Malthus wrote, "is, on the first view of it, the most beautiful and engaging which has yet appeared. A melioration of society to be produced merely by reason and conviction gives more promise of permanence than any change effected and maintained by force. The unlimited exercise of private judgement is a doctrine grand and captivating, and has a vast superiority over those systems where every individual is in a manner the slave of the public. The substitution of benevolence, as a master-spring and moving principle of society, instead of self-love, appears at first sight to be a consummation

devoutly to be wished. In short, it is impossible to contemplate the whole of this fair picture without emotions of delight and admiration, accompanied with an ardent longing for the period of its accomplishment.”

“But alas!” Malthus continued, “That moment can never arrive.... The great error under which Mr. Godwin labours throughout his whole work is the attributing of almost all the vices and misery that prevail in civil society to human institutions. Political regulations and the established administration of property are, with him, the fruitful sources of all evil, the hotbeds of all the crimes that degrade mankind. Were this really a true state of the case, it would not seem a completely hopeless task to remove evil completely from the world; and reason seems to be the proper and adequate instrument for effecting so great a purpose. But the truth is, that though human institutions appear to be, and indeed often are, the obvious and obtrusive causes of much misery in society, they are, in reality, light and superficial in comparison with those deeper-seated causes of evil which result from the laws of nature and the passions of mankind.”

The passions of mankind drive humans to reproduce, while the laws of nature set limits to the carrying capacity of the environment. Godwin’s utopia, if established, would be very favorable to the growth of population; and very soon the shortage of food would lead to its downfall: Because of the overpowering force of population growth, “Man cannot live in the midst of plenty. All cannot share alike the bounties of nature. Were there no established administration of property, every man would be obliged to guard with his force his little store. Selfishness would be triumphant. The subjects of contention would be perpetual. Every individual would be under constant anxiety about corporal support, and not a single intellect would be left free to expatiate in the field of thought.”

Malthus believed that all systems of equality are doomed to failure, not only because of the powerful pressure of population growth, but also because differences between the upper, middle, and lower classes serve the useful purpose of providing humans with an incentive for hard work. He thought that fear of falling to a lower social status, and hope of rising to a higher one, provide a strong incentive for constructive activity. However, he believed that happiness is most often found in the middle ranks of society, and that therefore the highest and lowest classes ought not to be large. Malthus advocated universal education and security of property as means by which the lowest classes of society could be induced to adopt more virtuous and prudent patterns of behavior.

The Poor Laws

Among the most controversial chapters of Malthus' second volume are those dealing with the Poor Laws. During the reign of Queen Elisabeth I, a law had been enacted according to which justices were authorized to collect taxes in order to set to work "...the children of all such, whose parents shall not by the said persons be thought able to keep and maintain their children; and also such persons, married or unmarried, as, having no means to maintain them, use no ordinary or daily trade to get their living by..". Malthus commented: "What is this but saying that the funds for the maintenance of labour in this country may be increased without limit by a *fiat* of government...? Strictly speaking, this clause is as arrogant and absurd as if it had enacted that two ears of wheat should in the future grow where one had grown before. Canute, when he commanded the waves not to wet his princely foot, did not assume a greater power over the laws of nature." Malthus pointed out that if we believe that every person has a right to have as many children as he or she wishes, and if we enact a law, according to which every person born has a right to sustenance, then we implicitly assume that the supply of food can be increased without limit, which of course is impossible.

During the first few years of the nineteenth century there was a severe shortage of food in England, partly because of war with France, and partly because of harvest failures. As a result, the price of wheat tripled, causing great distress among the poor. By 1803, 3,000,000 pounds sterling were being distributed to make up the difference between the wages of poor workers and the amount which they needed to pay for food. Malthus regarded the supply of grain as constant, i.e. independent of the price; and he therefore believed that distribution of money under the Poor Laws merely raised the price of grain still further in relation to wages, forcing a larger number of independent workers to seek help. He thought that the distributed money helped to relieve suffering in some cases, but that it spread the suffering over a wider area.

In some parishes, the amount of money distributed under the Poor Laws was proportional to the number of children in a family, and Malthus believed that this encouraged the growth of population, further aggravating the shortage of food. "A poor man may marry with little or no prospect of being able to support a family in independence", he wrote, "...and the Poor Laws may be said therefore in some measure to create the poor which they maintain; and as the provisions of the country must, in consequence of the increased population, be distributed to every man in smaller proportions, it is evident

that the labour of those who are not supported by parish assistance, will purchase a smaller quantity of provisions than before, and consequently more of them must be driven to ask for support.” Malthus advocated a very gradual abolition of the Poor Laws, and he believed that while this change was being brought about, the laws ought to be administered in such a way that the position of least well-off independent workers should not be worse than the position of those supported by parish assistance.

Replies to Malthus

The second edition of Malthus’ *Essay* was published in 1803. It provoked a storm of controversy, and a flood of rebuttals. In 1803 England’s political situation was sensitive. Revolutions had recently occurred both in America and in France; and in England there was much agitation for radical change, against which Malthus provided counter-arguments. Pitt and his government had taken Malthus’ first edition seriously, and had abandoned their plans for extending the Poor Laws. Also, as a consequence of Malthus’ ideas, England’s first census was taken in 1801. This census, and subsequent ones, taken in 1811, 1821 and 1831, showed that England’s population was indeed increasing rapidly, just as Malthus had feared. (The population of England and Wales more than doubled in 80 years, from an estimated 6.6 million in 1750 to almost 14 million in 1831.) In 1803, the issues of poverty and population were at the center of the political arena, and articles refuting Malthus began to stream from the pens of England’s authors.

William Coleridge planned to write an article against Malthus, and he made extensive notes in the margins of his copy of the *Essay*. In one place he wrote: “Are Lust and Hunger both alike Passions of physical Necessity, and the one equally with the other independent of the Reason and the Will? Shame upon our race that there lives an individual who dares to ask the Question.” In another place Coleridge wrote: “Vice and Virtue subsist in the agreement of the habits of a man with his Reason and Conscience, and these can have but one moral guide, Utility, or the virtue and Happiness of Rational Beings”. Although Coleridge never wrote his planned article, his close friend Robert Southey did so, using Coleridge’s notes almost verbatim. Some years later Coleridge remarked: “Is it not lamentable - is it not even marvelous - that the monstrous practical sophism of Malthus should now have gained complete possession of the leading men of the kingdom! Such an essential lie in morals - such a practical lie in fact it is too! I solemnly declare that I do

not believe that all the heresies and sects and factions which ignorance and the weakness and wickedness of man have ever given birth to, were altogether so disgraceful to man as a Christian, a philosopher, a statesman or citizen, as this abominable tenet.”

In 1812, Percy Bysshe Shelley, who was later to become William Godwin’s son-in-law, wrote: “Many well-meaning persons... would tell me not to make people happy for fear of over-stocking the world... War, vice and misery are undoubtedly bad; they embrace all that we can conceive of temporal and eternal evil. Are we to be told that these are remedyless, because the earth would in case of their remedy, be overstocked?” A year later, Shelley called Malthus a “priest, eunuch, and tyrant”, and accused him, in a pamphlet, of proposing that “.. after the poor have been stript naked by the tax-gatherer and reduced to bread and tea and fourteen hours of hard labour by their masters.. the last tie by which Nature holds them to benignant earth (whose plenty is garnered up in the strongholds of their tyrants) is to be divided... They are required to abstain from marrying under penalty of starvation... whilst the rich are permitted to add as many mouths to consume the products of the poor as they please”

Godwin himself wrote a long book (which was published in 1820) entitled *Of Population, An Enquiry Concerning the Power and Increase in the Number of Mankind, being an answer to Mr. Malthus*. One can also view many of the books of Charles Dickens as protests against Malthus’ point of view. For example, *Oliver Twist* gives us a picture of a workhouse “administered in such a way that the position of least well-off independent workers should not be worse than the position of those supported by parish assistance.”

Among the 19th century authors defending Malthus was Harriet Martineau, who wrote: “The desire of his heart and the aim of his work were that domestic virtue and happiness should be placed within the reach of all... He found that a portion of the people were underfed, and that one consequence of this was a fearful mortality among infants; and another consequence the growth of a recklessness among the destitute which caused infanticide, corruption of morals, and at best, marriage between pauper boys and girls; while multitudes of respectable men and women, who paid rates instead of consuming them, were unmarried at forty or never married at all. Prudence as to time of marriage and for making due provision for it was, one would think, a harmless recommendation enough, under the circumstances.”

At the end of the 19th century, the founders of neoclassical economic theory looked back on the problems raised by Malthus and concluded that they

had been overcome because of improvements in agriculture and transportation, and the opening up of new “unclaimed” lands in other parts of the world. However Alfred Marshall pointed out that in the very long run, the problems that Malthus raised would return. In his “Principles of Economics” (1890), Chapter IV, he wrote: “... it was not Malthus’ fault that he could not foresee the great developments of steam transport by land and by sea, which have enabled Englishmen of the present generation to obtain the products of the richest lands of the earth at comparatively small cost... But... [i]t remains true that unless the checks on the growth of population in force at the end of the nineteenth century are on the whole increased... it will be impossible for the habits of comfort prevailing in Western Europe to spread themselves over the whole world and maintain themselves for many hundred years”. Then there follows a footnote in which Malthus first extrapolates the then population size to find that before 2120 it will be 6 billion; he then assumes further innovation, but eventually says that: “... the pressure of population on the means of subsistence may be held in check for about two hundred years, but not longer.”

The Irish Potato Famine of 1845

Meanwhile, in Ireland, a dramatic series of events had occurred, confirming the ideas of Malthus. Anti-Catholic laws prevented the Irish cottagers from improving their social position; and instead they produced large families, fed almost exclusively on a diet of milk and potatoes. The potato and milk diet allowed a higher density of population to be supported in Ireland than would have been the case if the Irish diet had consisted primarily of wheat. As a result, the population of Ireland grew rapidly: In 1695 it had been approximately one million, but by 1821 it had reached 6,801,827. By 1845, the population of Ireland was more than eight million; and in that year the potato harvest failed because of blight. All who were able to do so fled from the country, many emigrating to the United States; but two million people died of starvation. As the result of this shock, Irish marriage habits changed, and late marriage became the norm, just as Malthus would have wished. After the Potato Famine of 1845, Ireland maintained a stable population of roughly four million.

Malthus continued a life of quiet scholarship, unperturbed by the heated public debate which he had caused. At the age of 38, he married a second cousin. The marriage produced only three children, which at that time was

considered to be a very small number. Thus he practiced the pattern of late marriage which he advocated. Although he was appointed rector of a church in Lincolnshire, he never preached there, hiring a curate to do this in his place. Instead of preaching, Malthus accepted an appointment as Professor of History and Political Economy at the East India Company's College at Haileybury. This appointment made him the first professor of economics in England, and probably also the first in the world. Among the important books which he wrote while he held this post was *Principles of Political Economy, Considered with a View to their Practical Application*. Malthus also published numerous revised and expanded editions of his *Essay on the Principle of Population*. The third edition was published in 1806, the fourth in 1807, the fifth in 1817, and the sixth in 1826.

In the societies that Malthus describes, we can see a clear link not only between population pressure and poverty, but also between population pressure and war. Undoubtedly this is why the suffering produced by poverty and war saturates so much of human history. Stabilization of population through birth control offers a key to eliminating this suffering.

We will return to the ideas of Malthus in Chapter 2, since they are extremely relevant to the problems of the 21st century.

Ricardo's theory of rent

. Among Malthus' closest friends was the financier David Ricardo (1772-1823). Ricardo had been born into a Jewish family that had moved to London from Portugal. However, at the age of 21 he had broken relations with his family and rejected his orthodox Jewish faith in order to marry a Quaker girl. Ricardo, who had worked with his father on the London Sock Exchange since the age of 14, then proceeded to become a financier in his own right, amassing a fortune worth over a million pounds, in those days an immense sum.

Having read a copy of Adam Smith's *Wealth of Nations*, Ricardo became interested in theoretical economics, and at the age of 37 he began to write about this subject. His articles and books were admired by Malthus, and the two became close friends, although they disagreed on many issues.

Malthus had been brought up as a member of the British landowning class. He valued the beauty of the countryside, and was disturbed by the growth of industrialism. By contrast, Ricardo's sympathies lay with the rising and vigorous class of industrialists. The theory of rent, developed by

Ricardo, showed that there is an inevitable conflict between these two classes.

Ricardo's theory of rent dealt with the effect of economic growth on prices, wages and profits. He and Malthus both agreed with Adam Smith's picture of growth: The virtuous industrialist does not spend his profits on luxuries, but instead reinvests them. New factories are built, the demand for workers increases, wages rise, and more workers are "produced" in response to the demand, i.e., more of the worker's children survive, and their numbers grow.

With each turn of the spiral of economic growth, there is an increased demand for food, since the population of workers increases. The most fertile land is already in use, but to meet the larger demand for food, marginal land is tilled, for example land on steep hillside slopes. It costs more to grow grain on marginal land, and therefore grain prices rise. According to Ricardo, the only people who benefit from economic growth are the owners of especially fertile land. The factory owners do not benefit, because they must pay higher wages to meet the increased price of food for their workers, and their profits remain the same. The workers do not benefit, because regardless of the price of grain, each of them is given only enough food to survive. The true beneficiaries of economic growth, according to Ricardo, are the owners of the most fertile land, i.e., the landowning aristocracy.

Ricardo defines "rent" to be the difference, per acre, between the cost of growing grain on good land, and the cost on marginal land. This difference is pocketed by the owners of good land. They do not really deserve it because ownership of fertile land is something that they inherited, rather than something that they produced by their own efforts.

The Corn Laws

At the time when Ricardo was writing, imports of cheap foreign grain were effectively blocked by the Corn Laws, a series of acts of Parliament which were in force between 1815 and 1846. These laws imposed prohibitively high tariffs on the import of foreign grain. Ricardo's theory of rents showed that the Corn Laws benefited the landowning aristocracy at the expense of the industrialists. His sympathies were with the industrialists, because he felt that the Corn Laws were forcing England back into feudalism and economic stagnation. By contrast, Malthus favored the Corn laws because he felt that it was dangerous for England to become dependent on imports of foreign grain. What would the country do in case of war?, Malthus asked. What would England do if it lost its industrial edge and became unable to export its

manufactured products? How would the country then support its overgrown population?

In the end, the aristocracy lost its control of Parliament, the Corn Laws were repealed, and the population of England continued to grow. It has grown from 8.3 million in 1801, the year of the first census, to 50.7 million in 2006. Today, England could not possibly support its population on home-grown food. Like the Netherlands and Japan, Britain is dependent on exports of manufactured goods and imports of grain.

The Iron Law of Wages

Ricardo believed that the “natural price” of any commodity is the lowest possible cost of its production, and that in the long run, prices of any commodity would approach this natural value. When he applied this idea to labor, the result was his “Iron Law of Wages”. Since the lowest cost of “producing” workers is the cost of keeping them alive at the subsistence level, he reasoned, the natural price of labor is determined by the lowest possible cost of sustenance. If workers are paid less than this, they will die, their numbers will decrease, the demand for workers will increase, and the price of labor will rise. If they are paid more, a greater number of their children will survive, the number of workers will increase above demand, and wages will fall. According to this argument, starvation wages are inevitable.

Ricardo’s reasoning assumes industrialists to be completely without social conscience or governmental regulation; it fails to anticipate the development of trade unionism; and it assumes that the working population will multiply without restraint as soon as their wages rise above the starvation level. This was an accurate description of what was happening in England during Ricardo’s lifetime, but it obviously does not hold for all times and all places.

The Reform Movement

The slow acceptance of birth control in England

With the gradual acceptance of birth control in England, the growth of trade unions, the passage of laws against child labor and finally minimum wage laws, conditions of workers gradually improved, and the benefits of industrialization began to spread to the whole of society.

One of the arguments which was used to justify the abuse of labor was that the alternative was starvation. The population of Europe had begun to grow rapidly for a variety of reasons: - because of the application of scientific knowledge to the prevention of disease; because the potato had been introduced into the diet of the poor; and because bubonic plague had become less frequent after the black rat had been replaced by the brown rat, accidentally imported from Asia.

It was argued that the excess population could not be supported unless workers were employed in the mills and factories to produce manufactured goods, which could be exchanged for imported food. In order for the manufactured goods to be competitive, the labor which produced them had to be cheap: hence the abuses. (At least, this is what was argued).

Industrialization benefited England, but in a very uneven way, producing great wealth for some parts of society, but also extreme misery in other social classes. For many, technical progress by no means led to an increase of happiness. The persistence of terrible poverty in 19th-century England, and the combined pessimism of Ricardo and Malthus, caused Thomas Carlyle to call economics "the Dismal Science".

Among the changes which were needed to insure that the effects of technical progress became beneficial rather than harmful, the most important were the abolition of child labor, the development of unions, the minimum wage law, and the introduction of birth control.

Francis Place (1771-1854), a close friend of William Godwin and James Mill, was one of the earliest and most courageous pioneers of these needed changes. Place had known extreme poverty as a child, but he had risen to become a successful businessman and a leader of the trade union movement.

Place and Mill were Utilitarians, and like other members of this movement they accepted the demographic studies of Malthus while disagreeing with Malthus' rejection of birth control. They reasoned that since abortion and infanticide were already widely used by the poor to limit the size of their families, it was an indication that reliable and humane methods of birth control would be welcome. If marriage could be freed from the miseries which resulted from excessive numbers of children, the Utilitarians believed, prostitution would become less common, and the health and happiness of women would be improved.

Francis Place and James Mill decided that educational efforts would be needed to make the available methods of birth control more widely known and accepted. In 1818, Mill cautiously wrote "The great problem of a real



Figure 1.8: *The Utilitarian philosopher and economist James Mill (1773-1836) was an early advocate of birth control. (He was the father of John Stuart Mill.)*

check to population growth has been miserably evaded by all those who have meddled with the subject... And yet, if the superstitions of the nursery were discarded, and the principle of utility kept steadily in view, a solution might not be very difficult to be found.”

A few years later, Mill dared to be slightly more explicit: “The result to be aimed at”, he wrote in his *Elements of Political Economy* (1821), “is to secure to the great body of the people all the happiness which is capable of being derived from the matrimonial union, (while) preventing the evils which the too rapid increase of their numbers would entail. The progress of legislation, the improvement of the education of the people, and the decay of superstition will, in time, it may be hoped, accomplish the difficult task of reconciling these important objects.”

In 1822, Francis Place took the considerable risk of publishing a four-page pamphlet entitled *To the Married of Both Sexes of the Working People*, which contained the following passages:

“It is a great truth, often told and never denied, that when there are too many working people in any trade or manufacture, they are worse paid than they ought to be paid, and are compelled to work more hours than

they ought to work. When the number of working people in any trade or manufacture has for some years been too great, wages are reduced very low, and the working people become little better than slaves.”

“When wages have thus been reduced to a very small sum, working people can no longer maintain their children as all good and respectable people wish to maintain their children, but are compelled to neglect them; - to send them to different employments; - to Mills and Manufactories, at a very early age. The miseries of these poor children cannot be described, and need not be described to you, who witness them and deplore them every day of your lives.”

“The sickness of yourselves and your children, the privation and pain and premature death of those you love but cannot cherish as you wish, need only be alluded to. You know all these evils too well.”

“And what, you will ask, is the remedy? How are we to avoid these miseries? The answer is short and plain: the means are easy. Do as other people do, to avoid having more children than they wish to have, and can easily maintain.”

“What is to be done is this. A piece of soft sponge is tied by a bobbin or penny ribbon, and inserted just before the sexual intercourse takes place, and is withdrawn again as soon as it has taken place. Many tie a sponge to each end of the ribbon, and they take care not to use the same sponge again until it has been washed. If the sponge be large enough, that is, as large as a green walnut, or a small apple, it will prevent conception... without diminishing the pleasures of married life...”

“You cannot fail to see that this address is intended solely for your good. It is quite impossible that those who address you can receive any benefit from it, beyond the satisfaction which every benevolent person and true Christian, must feel, at seeing you comfortable, healthy and happy.”

The publication of Place’s pamphlet in 1822 was a landmark in the battle for the acceptance of birth control in England. Another important step was taken in 1832, when a small book entitled *The Fruits of Philosophy or, the Private Companion of Young Married People* was published by a Boston physician named Dr. Charles Knowlton. The book contained simple contraceptive advice. It reviewed the various methods of birth control available at the time. In order for the sponge method to be reliable, Knowlton’s book pointed out, use of a saline douching solution was necessary.

The battle for these social reforms was not easily won. For example, in 1876, “The Fruits of Philosophy” was ruled by an English court to be obscene,

and a bookseller was sentenced to two years imprisonment for distributing it. The liberal politician Charles Bradlaugh and his friend, the feminist author Annie Besant then decided to provoke a new trial by selling the book themselves. They wrote polite letters to the Chief Clerk of the Magistrates, the Detective Department, and the City Solicitor announcing the time and the place at which they intended to sell the book, and they asked to be arrested. The result was a famous trial in which the two reformers were acquitted, but the jury again ruled “The Fruits of Philosophy” to be obscene.

As the nineteenth century progressed, birth control gradually came to be accepted in England, and the average number of children per marriage fell from 6.16 in 1860 to 4.13 in 1890. By 1915 this figure had fallen to 2.43. Because of lowered population pressure, combined with the growth of trade unions and better social legislation, the condition of England’s industrial workers improved; and under the new conditions, Ricardo’s Iron Law of Wages fortunately no longer seemed to hold.

Trade unions and child labor laws

Nor was the battle to establish trade unions easily won. At the start of the 19th century, many countries had laws prohibiting organizing unions, and these invoked penalties up to and including death. In England, the Reform Act of 1832 made unions legal, but nevertheless in 1834, six men from Dorset who had formed the “Friendly Society of Agricultural Workers” were arrested and sentenced to a seven years’ transportation to Australia. An obscure law from 1797 was invoked, which prohibited swearing secret oaths. This they had in fact done, but their main crime seems to have been refusing to work for less than 10 shillings a week. Despite bitter opposition, trade unions gradually developed both in England and in other industrial countries.

One of the important influences for reform was the Fabian Society, founded in London in 1884. The group advocated gradual rather than revolutionary reform (and took its name from Quintus Fabius Maximus, the Roman general who defeated Hannibal’s Carthaginian army by using harassment and attrition rather than head-on battles). The Fabian Society came to include a number of famous people, including Sydney and Beatrice Webb, George Bernard Shaw, H.G. Wells, Annie Besant, Leonard Woolf, Emaline Pankhurst, Bertrand Russell, John Maynard Keynes, Harold Laski, Ramsay MacDonald, Clement Attlee, Tony Benn and Harold Wilson. Jawaharlal Nehru, India’s first Prime Minister, was greatly influenced by Fabian eco-



Figure 1.9: *Beatrice Webb (1858-1943). Together with her husband Sidney Webb, Graham Wallace and George Bernard Shaw, she founded the London School of Economics using money left to the Fabian Society by Henry Hutchinson. The Fabians also founded the British Labour Party, and they lobbied for a minimum wage law and National Health Service.*

nomic ideas.

The group was instrumental in founding the British Labour Party (1900), the London School of Economics and the New Statesman. In 1906, Fabians lobbied for a minimum wage law, and in 1911 they lobbied for the establishment of a National Health Service.

Adam Smith had praised division of labor as one of the main elements in industrial efficiency, but precisely this aspect of industrialism was criticized by Thomas Carlyle (1795-1891), John Ruskin (1819-1900) and William Morris (1834-1896). They considered the numbingly repetitive work of factory laborers to be degrading, and they rightly pointed out that important traditions of design were being lost and replaced by ugly mass produced artifacts. The Arts and Crafts movement founded by Ruskin and Morris advocated cooperative workshops, where creative freedom and warm human relationships would make work rewarding and pleasant. In several Scandinavian countries, whose industrialization came later than England's, efforts were made to preserve traditions of design. Hence the present artistic excellence of Scandinavian furniture and household articles.

Through the influence of reformers, the more brutal aspects of Adam Smith's economic model began to be moderated. Society was learning that

free market mechanisms alone do not lead to a happy and just society. In addition, ethical and ecological considerations and some degree of governmental regulation are also needed.

The Reform Movement aimed at social goals, but left ecological problems untreated. Thus our economic system still does not reflect the true price to society of environmentally damaging activities. For example, the price of coal does not reflect the cost of the environmental damage done by burning it. This being so, our growth-worshipping economic system of today thunders ahead towards an environmental mega-catastrophe, as we will see in the next chapter.

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Chapter 2

THREATS TO THE ENVIRONMENT

“Some of the potential risks could be irreversible and could accelerate the process of global warming. Melting of permafrost in the Arctic could lead to the release of huge quantities of methane. Dieback of the Amazon forest could mean that the region starts to emit rather than to absorb greenhouse gases. These feedbacks could lead to warming that is at least twice as fast as current high-emission projections, leading to temperatures higher than seen in the last 50 million years. There are still uncertainties about how much warming would be needed to trigger these abrupt changes. Nevertheless, the consequences would be catastrophic if they do occur.”

Stern Report Discussion Paper, January 31, 2006.

Malthus revisited

Avoiding the grim Malthusian forces

Malthus died in Bath in 1834, but debate on his ideas continued to rage, both in his own century and our own. Each year he is refuted, and each year revived. Despite impressive scientific progress since his time, the frightful Malthusian forces - poverty, famine, disease, and war - cast as dark a shadow in our own times as they did in the nineteenth century. Indeed, the enormous power of modern weapons has greatly intensified the dangers posed by war; and the rapid growth of global population has given new dimensions to the problems of poverty and famine.

Looking at the world today, we can see regions where Malthus seems to be a truer prophet than Condorcet and Godwin. In most developing countries, poverty and disease are still major problems. In other parts of the world, the optimistic prophecies of Condorcet and Godwin have been at least partially fulfilled. In the industrialized nations, Godwin's prophecy of automated agriculture has certainly come true. In the nations of the North, only a small percentage of the population is engaged in agriculture, while most of the citizens are free to pursue other goals than food production.

Scandinavia is an example of an area where poverty and war have both been eliminated locally, and where death from infectious disease is a rarity. These achievements would have been impossible without the low birth rates which also characterize the region. In Scandinavia, and in other similar regions, low birth rates and death rates, a stable population, high educational levels, control of infectious disease, equal status for women, democratic governments, and elimination of poverty and war are linked together in a mutually re-enforcing circle of cause and effect. By contrast, in many large third-world cities, overcrowding, contaminated water, polluted air, dense population without adequate sanitation, low status of women, high birth rates, rapidly increasing population, high unemployment levels, poverty, crime, ethnic conflicts, and resurgence of infectious disease are also linked in a self-perpetuating causal loop - in this case a vicious circle.

Population stabilization and sustainability

Does the contrast between the regions of our contemporary world mean that Malthus has been "proved wrong" in some regions and "proved right" in

others? To answer this question, let us re-examine the basic assertion which Malthus puts forward in Books I and II of the 1803 version of his *Essay*. His basic thesis is that the maximum natural fertility of human populations is greatly in excess of replacement fertility. This being so, Malthus points out, human populations would always increase exponentially if they were not prevented from doing so by powerful and obvious checks.

In general, Malthus tells us, populations cannot increase exponentially because the food supply increases slowly, or is constant. Therefore, he concludes, in most societies and almost all periods of history, checks to population growth are operating. These checks may be positive, or they may be preventive, the positive checks being those which raise the death rate, while the preventive checks lower the birth rate. There are, however, Malthus says, exceptional periods of history when the populations of certain societies do actually increase exponentially because of the opening of new lands or because of the introduction of new methods of food production. As an example, he cites the growth of the population of the United States, which doubled every 25 years over a period of 150 years.

We can see, from this review of Malthus' basic thesis, that his demographic model is flexible enough to describe all of the regions of our contemporary world: If Malthus were living today, he would say that in countries with low birth and death rates and stable populations, the checks to population growth are primarily preventive, while in countries with high death rates, the positive checks are important. Finally, Malthus would describe our rapidly-growing global population as the natural result of the introduction of improved methods of food production in the developing countries. We should notice, however, that the flexibility of Malthus' demographic model first appears in the 1803 version of his *Essay*: In the 1798 version, he maintained "...that population does invariably increase, where there are means of subsistence.." and "that the superior power (of population) cannot be checked without producing misery and vice.." This narrower model of population did not agree with Malthus' own observations in Norway in 1799, and therefore in his 1803 *Essay* he allowed more scope for preventive checks, which included late marriage and moral restraint as well as birth control (which he classified under the heading of "vice").

Today we are able to estimate the population of the world at various periods in history, and we can also make estimates of global population in prehistoric times. Looking at the data, we can see that the global population of humans has not followed an exponential curve as a function of time, but

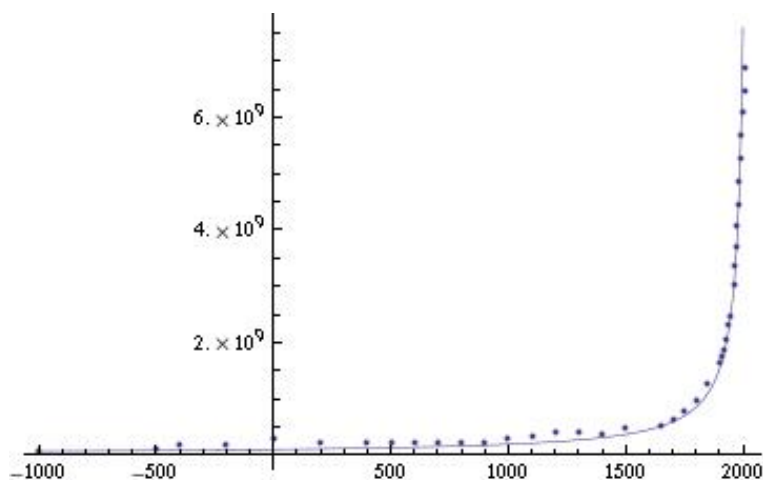


Figure 2.1: *The hyperbola $C/(2025-t)$ compared with global population estimates from the U.S. Census Bureau. Here we choose $C = 190,000,000,000$.*

has instead followed a hyperbolic trajectory. At the time of Christ, the population of the world is believed to have been approximately 220 million. By 1500, the earth contained 450 million people, and by 1750, the global population exceeded 700 million. As the industrial and scientific revolution has accelerated, global population has responded by increasing at a break-neck speed: In 1930, the population of the world reached two billion; in 1958 three billion; in 1974 four billion; in 1988 five billion, and in 1999, six billion. Today, roughly a billion people are being added to the world's population every fourteen years.

As the physicist Murry Gell-Mann has pointed out, a simple mathematical curve which closely approximates the global population of humans over a period of several thousand years is an hyperbola of the form

$$P = \frac{190,000,000,000}{2025 - t}$$

Here P is the population and t is the year. How are we to explain the fact that the population curve is not an exponential? We can turn to Malthus for an answer: According to his model, population does not increase exponentially, except under special circumstances, when the food supply is so ample that the increase of population is entirely unchecked. Malthus gives us a model of culturally-driven population growth. He tells us that population increase

tends to press against the limits of the food supply, and since these limits are culturally determined, population density is also culturally-determined. Hunter-gatherer societies need large tracts of land for their support; and in such societies, the population density is necessarily low. Pastoral methods of food production can support populations of a higher density. Finally, extremely high densities of population can be supported by modern agriculture. Thus, the hyperbolic curve, $P=C/(2025-t)$, where C is a constant, should be seen as describing the rapidly-accelerating growth of human culture, this being understood to include methods of food production.

If we look at the curve, $P=C/(2025-t)$, it is obvious that human culture has reached a period of crisis. The curve predicts that the world's population will rise to infinity in the year 2025, which of course is impossible. Somehow the actual trajectory of global population as a function of time must deviate from the hyperbolic curve, and in fact, the trajectory has already begun to fall away from the hyperbola. Because of the great amount of human suffering which may be involved, and the potentially catastrophic damage to the earth's environment, the question of how the actual trajectory of human population will come to deviate from the hyperbola is a matter of enormous importance. Will population overshoot the sustainable limit, and crash? Or will it gradually approach a maximum? In the case of the second alternative, will the checks which slow population growth be later marriage and family planning? Or will the grim Malthusian forces - famine, disease and war - act to hold the number of humans within the carrying capacity of their environment?

We can anticipate that as the earth's human population approaches 10 billion, severe famines will occur in many developing countries. The beginnings of this tragedy can already be seen. It is estimated that roughly 40,000 children now die every day from starvation, or from a combination of disease and malnutrition.

An analysis of the global ratio of population to cropland shows that we have probably already exceeded the sustainable limit of population through our dependence on petroleum: Between 1950 and 1982, the use of cheap synthetic fertilizers increased by a factor of 8. Much of our present agricultural output depends on their use, but their production is expensive in terms of energy. Furthermore, petroleum-derived synthetic fibers have reduced the amount of cropland needed for growing natural fibers, and petroleum-driven tractors have replaced draft animals which required cropland for pasturage. Also, petroleum fuels have replaced fuelwood and other fuels derived for

biomass. The reverse transition, from fossil fuels back to renewable energy sources, will require a considerable diversion of land from food production to energy production. For example, 1.1 hectares are needed to grow the sugar-cane required for each alcohol-driven Brazilian automobile. This figure may be compared with the steadily falling average area of cropland available to each person in the world: .24 hectares in 1950, .16 hectares in 1982.

As population increases, the cropland per person will continue to fall, and we will be forced to make still heavier use of fertilizers to increase output per hectare. Also marginal land will be used in agriculture, with the probable result that much land will be degraded through erosion and salination. Climate change will reduce agricultural output. The Hubbert peaks for oil and natural gas will occur within one or two decades, and the fossil fuel era will be over by the end of 21st century. Thus there is a danger that just as global population reaches the unprecedented level of 10 billion or more, the agricultural base for supporting it may suddenly collapse. Ecological catastrophe, possibly compounded by war and other disorders, could produce famine and death on a scale unprecedented in history - a disaster of unimaginable proportions, involving billions rather than millions of people, as will be discussed in Chapter 4.

The resources of the earth and the techniques of modern science can support a global population of moderate size in comfort and security; but the optimum size is undoubtedly smaller than the world's present population (see Chapter 4). Given a sufficiently small global population, renewable sources of energy can be found to replace disappearing fossil fuels. Technology may also be able to find renewable substitutes for many disappearing mineral resources for a global population of a moderate size. What technology cannot do, however, is to give a global population of 10 billion people the standard of living which the industrialized countries enjoy today.

What would Malthus tell us if he were alive today? Certainly he would say that we have reached a period of human history where it is vital to stabilize the world's population if catastrophic environmental degradation and famine are to be avoided. He would applaud efforts to reduce suffering by eliminating poverty, widespread disease, and war; but he would point out that, since it is necessary to stop the rapid increase of human numbers, it follows that whenever the positive checks to population growth are removed, it is absolutely necessary to replace them by preventive checks. Malthus' point of view became more broad in the successive editions of his *Essay*; and if he were alive today, he would probably agree that family planning is the

most humane of the preventive checks.

In Malthus' *Essay on the Principle of Population*, population pressure appears as one of the main causes of war; and Malthus also discusses many societies in which war is one of the the principle means by which population is reduced to the level of the food supply. Thus, his *Essay* contains another important message for our own times: If he were alive today, Malthus would also say that there is a close link between the two most urgent tasks which history has given to the 21st century - stabilization of the global population, and abolition of the institution of war.

In most of the societies which Malthus described, a clear causal link can be seen, not only between population pressure and poverty, but also between population pressure and war. As one reads his *Essay*, it becomes clear why both these terrible sources of human anguish saturate so much of history, and why efforts to eradicate them have so often met with failure: The only possible way to eliminate poverty and war is to reduce the pressure of population by preventive checks, since the increased food supply produced by occasional cultural advances can give only very temporary relief. Today, the links between population pressure, poverty, and war are even more pronounced than they were in the past, because the growth of human population has brought us to the absolute limits imposed by ecological constraints.

Biology and economics

Classical economists like Smith and Ricardo pictured the world as largely empty of human activities. According to the "empty-world" picture of economics, the limiting factors in the production of food and goods are shortages of capital and labor. The land, forests, fossil fuels, minerals, oceans filled with fish, and other natural resources upon which human labor and capital operate, are assumed to be present in such large quantities that they are not limiting factors. In this picture, there is no naturally-determined upper limit to the total size of the human economy. It can continue to grow as long as new capital is accumulated, as long as new labor is provided by population growth, and as long as new technology replaces labor by automation.

Biology, on the other hand, presents us with a very different picture. Biologists remind us that if any species, including our own, makes demands on its environment which exceed the environment's carrying capacity, the result is a catastrophic collapse both of the environment and of the population which

it supports. Only demands which are within the carrying capacity are sustainable. For example, there is a limit to regenerative powers of a forest. It is possible to continue to cut trees in excess of this limit, but only at the cost of a loss of forest size, and ultimately the collapse and degradation of the forest. Similarly, cattle populations may for some time exceed the carrying capacity of grasslands, but the ultimate penalty for overgrazing will be degradation or desertification of the land. Thus, in biology, the concept of the carrying capacity of an environment is extremely important; but in economic theory this concept has not yet been given the weight that it deserves.

The terminology of economics can be applied to natural resources: For example, a forest can be thought of as natural capital, and the sustainable yield from the forest as interest. Exceeding the biological carrying capacity then corresponds, in economic terms, to spending one's capital.

If it is to be prevented from producing unacceptable contrasts of affluence and misery within a society, the free market advocated by Adam Smith needs the additional restraints of ethical principles, as well as a certain amount of governmental regulation. Furthermore, in the absence of these restraints, it will destroy the natural environment of our planet.

There is much evidence to indicate that the total size of the human economy is rapidly approaching the absolute limits imposed by the carrying capacity of the global environment. For example, a recent study by Vitousek et. al. showed that 40 percent of the net primary product of landbased photosynthesis is appropriated, directly or indirectly, for human use. (The net primary product of photosynthesis is defined as the total quantity of solar energy converted into chemical energy by plants, minus the energy used by the plants themselves). Thus we are only a single doubling time away from 80 percent appropriation, which would imply a disastrous environmental degradation.

Another indication of our rapid approach to the absolute limits of environmental carrying capacity can be found in the present rate of loss of biodiversity. Biologists estimate that between 10,000 and 50,000 species are being driven into extinction each year as the earth's rainforests are destroyed.

The burning of fossil fuels and the burning of tropical rain forests have released so much carbon dioxide that the atmospheric concentration of this greenhouse gas has increased from a preindustrial value of 260 ppm to its present value: 380 ppm. Most scientists agree that unless steps are taken to halt the burning of rain forests and to reduce the use of fossil fuels, the earth's temperature will steadily rise during the coming centuries. This

gradual long-term climate change will threaten future agricultural output by changing patterns of rainfall. Furthermore, the total melting of the Arctic and Antarctic icecaps, combined with the thermal expansion of the oceans, threatens to produce a sea level rise of up to 12 meters. Although these are slow, long-term effects, we owe it to future generations to take steps now to halt global warming.

The switch from fossil fuels to renewable energy sources is vital not only because of the need to reduce global warming, but also because the earth's supply of fossil fuels is limited. A peak in the production and consumption of conventional petroleum is predicted within one or two decades. Such a peak in the use of any non-renewable natural resource is called a "Hubbert peak" after the oil expert Dr. M. King Hubbert. It occurs when reserves of the resource are approximately half exhausted. After that point, the resource does not disappear entirely, but its price increases steadily because supply fails to meet demand, and because of rising extraction costs. It is predicted that the Hubbert peak for both oil and natural gas will also occur within a few decades. The peak for oil may occur within the present decade. Thus, halfway through the 21st Century, oil and natural gas will become very expensive - perhaps so expensive that they will not be burned but will instead be reserved as starting points for chemical synthesis.

The reserves of coal are much larger, and at the present rate of use they would last for slightly more than two centuries. However, it seems likely that as petroleum is exhausted, coal will be converted into liquid fuels, as was done in Germany during World War II, and in South Africa during the oil embargo. Thus, in predicting a date for the end of the fossil fuel era, we ought to lump oil, natural gas and coal together. If we do so, we find the total supply has an energy content of 1260 terawatt-years. (1 terawatt is equal to 1,000,000,000,000 Watts). One finds in this way that if they are used at the present rate of 13 terawatts, fossil fuels will last about 100 years.

Resolute government intervention is needed to promote energy conservation measures and to bring about the switch from fossil fuels to renewable energy sources, such as biomass, photovoltaics, solar thermal power, wind and wave power, and hydropower. Both subsidies for renewable energy technologies, to help them get started, and taxes on fossil fuels will be needed. Changes in tax structure could also encourage smaller families, encourage resource conservation, or diminish pollution. In general, taxation should be used, not merely to raise money, but, more importantly, to guide the evolution of society towards humane and sustainable goals.

Fossil fuel use and climate change

Melting of the polar ice caps

At present the amount of carbon in the atmosphere is increasing by about 6 gigatons per year because of human activities; and projections estimate that the CO_2 concentration will reach about 600 ppm by 2050 (more than double the preindustrial concentration). In addition to CO_2 , methane, CH_4 , and nitrous oxide, NO_2 , are also released into the atmosphere by human activities. Anthropogenic methane comes from the production and transportation of coal, natural gas and oil, decomposition of organic wastes in municipal landfills, cultivation of rice paddies, and the raising of livestock.

The greenhouse gasses (which include water vapor, carbon dioxide, methane, ozone, nitrous oxide, sulfur hexafluoride, hydrofluorocarbons, perfluorocarbons and many other gasses) absorb a part of the infrared radiation from the earth's surface, which otherwise would have been sent directly into outer space. Part of this energy is re-radiated into space, but a part is sent downward to the earth, where it is absorbed. The result is that the earth's surface is much warmer than it otherwise would be. The mechanism is much the same as that of a greenhouse, where the glass absorbs and re-radiates infrared radiation. A moderate greenhouse effect on earth is helpful to life, but climatologists believe that anthropogenic CO_2 and CH_4 emissions may produce a dangerous amount of global warming during the next few centuries.

According to the Intergovernmental Panel on Climate Change the percentages of greenhouse gas emissions contributed by various human activities are as follows:

Energy use	{	Transportation	13.5%
		Electricity and heat	24.6%
		Other fuel combustion	9.0%
		Industry	10.4%
		Fugitive emissions	3.9%

Other sources	{	Industrial processes	3.4%
		Land use change (deforestation)	18.2%
		Agriculture	13.5%
		Waste	3.6%

In thinking about global warming, it is important to remember that it is a very slow and long-term phenomenon. Stephen H. Schneider and Janica Lane of Stanford University, in an article entitled *An Overview of 'Dangerous' Climate Change* include a figure that emphasizes the long-term nature of global warming. The figure presupposes that CO_2 emissions will peak within 50 years and will thereafter be reduced. According to the figure, it will still take more than a century for the level of CO_2 in the atmosphere to stabilize. The establishment of temperature equilibrium will require several centuries. Sea level rises due to thermal expansion of ocean water will not be complete before the end of the millennium, while sea level rises due to melting of the polar icecaps might not be complete for several millennia!

It is worrying to think that total melting of the Greenland ice cap, which some authors think might begin in earnest during the 22nd century, would result in a sea level rise of up to 7 meters. Of course, society would have some time to adjust to this event. But a glance at maps and elevations makes one realize the extent of such a catastrophe and the importance of preventing it.

The IPCC and Stern reports

Models put forward by the Intergovernmental Panel on Climate Change (IPCC, 2007 Report) suggest that if no steps are taken to reduce carbon emissions, a temperature increase of 1.4-5.6 degrees C will occur by 2100¹. Global warming may have some desirable effects, such as increased possibilities for agriculture in Canada, Sweden and Siberia. However, most of the expected effects of global warming will be damaging. These unwanted effects include ocean level rises, extreme weather conditions (such as heat waves, hurricanes and tropical cyclones), changes in the patterns of ocean currents,

¹relative to 1990 temperatures.

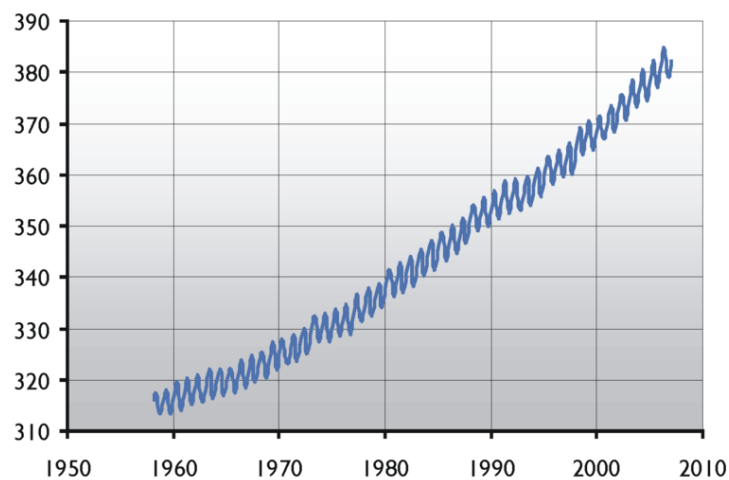


Figure 2.2: *Atmospheric CO₂ concentrations measured at Mount Loa, Hawaii*

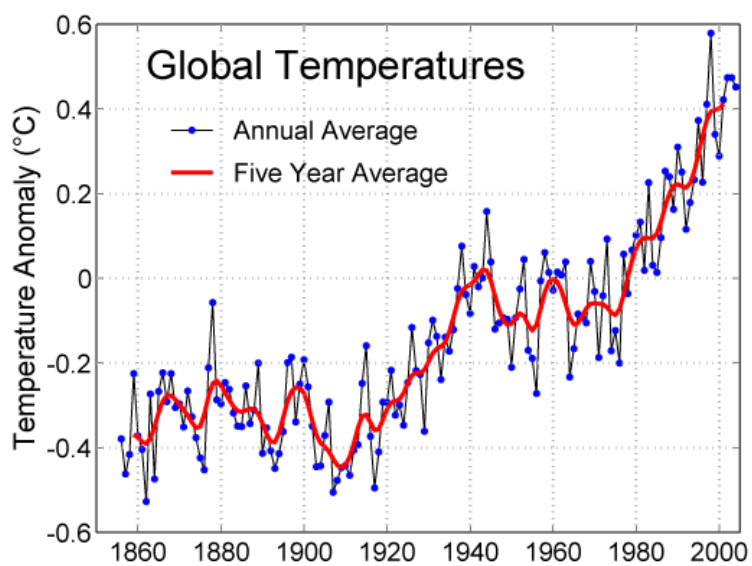


Figure 2.3: *Global temperatures during the last two centuries*

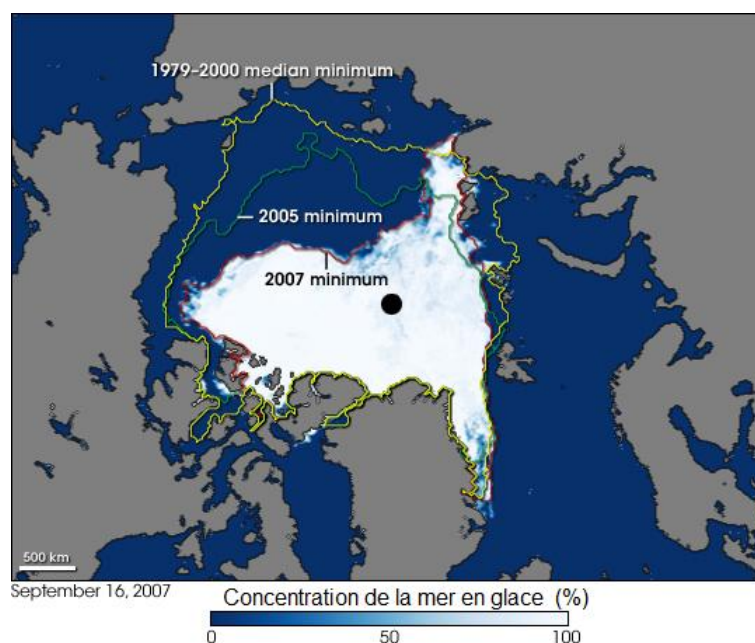


Figure 2.4: *Recent loss of Arctic ice, as measured by NASA's Aqua satellite*

melting of polar ice and glaciers, abnormal spread of diseases, extinctions of plant and animal species, together with aridity and crop failures in some areas of the world which are now able to produce and export large quantities of grain.

According to a report presented to the Oxford Institute of Economic Policy by Sir Nicholas Stern on 31 January, 2006, areas likely to lose up to 30% of their rainfall by the 2050's because of climate change include much of the United States, Brazil, the Mediterranean region, Eastern Russia and Belarus, the Middle East, Southern Africa and Southern Australia. Meanwhile rainfall is predicted to increase up to 30% in Central Africa, Pakistan, India, Bangladesh, Siberia, and much of China.

Stern and his team point out that "We can... expect to see changes in the Indian monsoon, which could have a huge impact on the lives of hundreds of millions of people in India, Pakistan and Bangladesh. Most climate models suggest that the monsoon will change, although there is still uncertainty about exactly how. Nevertheless, small changes in the monsoon could have a huge impact. Today, a fluctuation of just 10% in either direction from average monsoon rainfall is known to cause either severe flooding or drought.

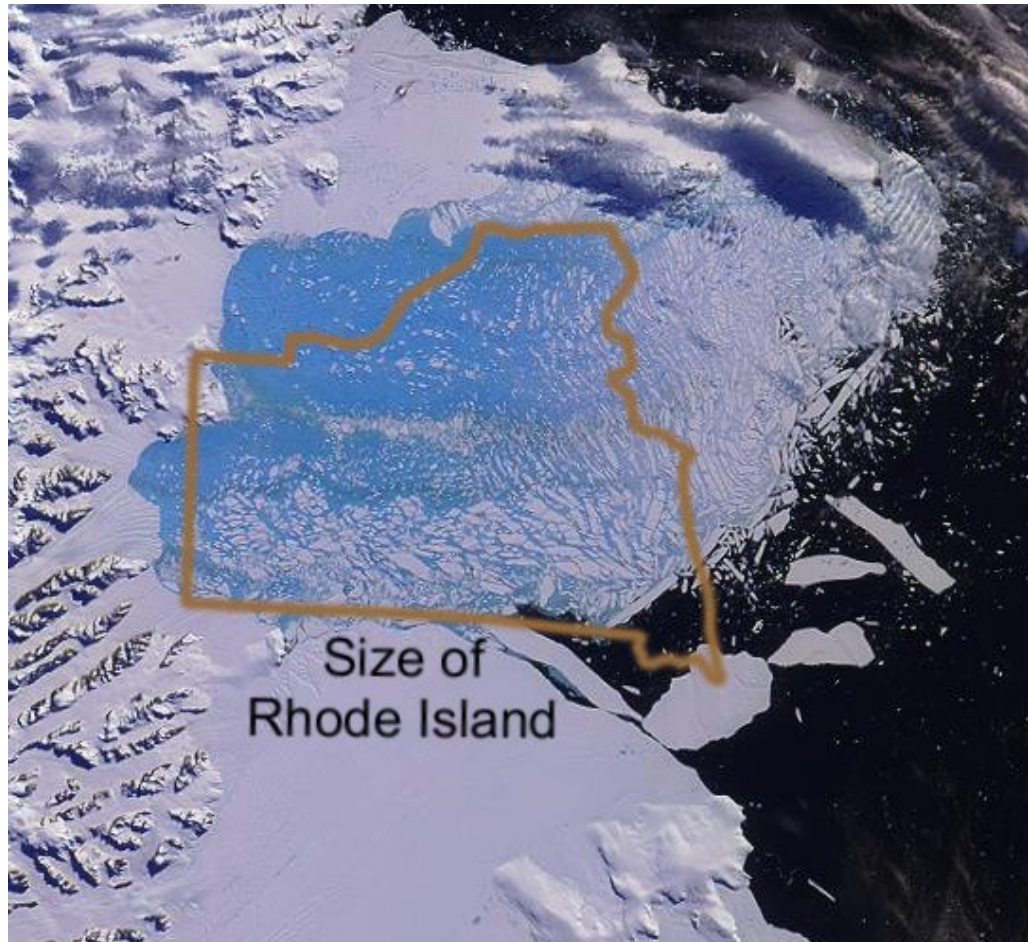


Figure 2.5: *The collapsing Larsen-B iceshelf in the Antarctic is similar in size to the US state of Rhode Island*

A weak summer monsoon, for example, can lead to poor harvests and food shortages among the rural population - two-thirds of India's almost 1.1 billion people. Heavier-than-usual monsoon downpours can also have devastating consequences..."

In some regions, melting of glaciers can be serious from the standpoint of dry-season water supplies. For example, melts from glaciers in the Hindu Kush and the Himalayas now supply much of Asia, including China and India, with a dry-season water supply. Complete melting of these glacial systems would cause an exaggerated runoff for a few decades, after which there would be a drying out of some of the most densely populated regions of the world.

The threat of feed-back loops

The Discussion Paper presented by Stern on January 31, 2006, also notes that "Some of the potential risks could be irreversible and accelerate the process of global warming. Melting of permafrost in the Arctic could lead to the release of huge quantities of methane. Dieback of the Amazon forest could mean that the region starts to emit rather than absorb greenhouse gases. These feedbacks could lead to warming that is at least twice as fast as current high-emissions projections, leading to temperatures higher than seen in the past 50 million years. There are still uncertainties about how much warming would be needed to trigger these abrupt changes. Nevertheless, the consequences would be catastrophic if they do occur."

The much larger (700 page) Stern Report was made public on October 30, 2006. It explores not only the scientific basis for predictions of global warming but also the possible economic consequences. Unless we act promptly to prevent it, the Stern Report states, global warming could render swaths of the planet uninhabitable, and do economic damage equal to that inflicted by the two world wars.

A large United Nations Climate Conference (COP15) took place in Copenhagen from December 7 to December 18, 2009. In order to make the latest results of researchers available to the 15,000 expected participants, a preliminary meeting of scientists was held at the University of Copenhagen in March, 2009. 2,500 delegates from 80 countries attended the meeting. Among the conclusions of this international congress of scientists were the following:

- **Climatic trends:** "Recent observations confirm that, given the high

rates of observed emissions, the worst-case IPCC scenario trajectories (or even worse) are being realized. For many key parameters, the climate system is already moving beyond the patterns of natural variability within which our society and economy developed and thrived. These parameters include global mean surface temperature, sea-level rise, ocean and ice sheet dynamics, ocean acidification and extreme climate events. There is a significant risk that many of the trends will accelerate, leading to an increasing risk of abrupt or irreversible climatic shifts.”

- **Social disruption:** “Recent observations show that societies are highly vulnerable to even modest levels of climate change, with poor nations and communities particularly at risk. Temperature rises above 2° C will be very difficult for contemporary societies to cope with, and will increase the level of climate disruption through the rest of the century.”

To avoid temperature increases of more than 2° C, the scientists say that it will be necessary for the world to reduce its CO₂ emissions by 90% by 2050. In other words if dangerous climate change is to be avoided, the fossil fuel era must essentially end by that date.

Despite these clear and essentially unanimous warnings from the scientific community, the United Nations climate conference in Copenhagen failed to reach an agreement sufficiently strong to avoid dangerous climate change. The problem encountered by the conference was a deep disagreement between developed and developing countries. The developing countries correctly maintained that historically, they have not been to blame for emission of greenhouse gases. Meanwhile, the industrialized countries pointed to the future, saying (also correctly) that unless the developing countries accepted their future responsibilities, there would be no hope of avoiding disaster.

At the last moment, the United States, China, India, Brazil and South Africa hammered out a weak agreement, the *Copenhagen Accord*, which the other nations at the conference agreed to “take note of”. The Copenhagen Accord recognizes the aim of limiting global warming to 2° C. However, it does not provide mechanisms sufficiently strong to reach that goal. Another UN climate conference will be held in Mexico in November, 2010, and it is to be hoped that during the intervening months, negotiators will be able to build on the very modest results of COP15 and put together an adequate and legally binding treaty.

Table 2.1: *This table shows the 2006 CO₂ emissions from burning of fossil fuels, by country as percentages of the global total and in terms of metric tons per capita. The eight countries with greatest emissions are shown. China is still classified as a developing country, and its per capita emissions are still relatively low (although rapidly increasing). However, because of its large population, China now puts more CO₂ into the atmosphere per year than any other country. Similarly, despite India's low per capita emissions, it is now in 4th place.*

Country	Percentage of global total	Per capita in metric tons
China	21.5%	4.57
United States	20.2%	18.67
Russia	5.5%	11.03
India	5.3%	1.29
Japan	4.6%	10.14
Germany	2.8%	9.82
United Kingdom	2.0%	9.26
Canada	1.9%	16.08

Loss of biodiversity

Agricultural monocultures

In modern agriculture it has become common to plant large regions with a single crop variety. For example, it is common to plant large regions with a single high-yield wheat variety. Monocultures of this kind offer farmers advantages of efficiency in the timing of planting and harvesting. With regard to pest and disease control, there may be short-term advantages, but these have to be weighed against the threat of long-term disasters. In the great Irish Potato Famine of 1845-1849, the potato monoculture which had sustained Ireland's growing population was suddenly devastated by *Phytophthora infestans*, commonly called "potato blight". The result was a catastrophic famine that resulted in the death or emigration of much of Ireland's population.

In general, monocultures are vulnerable to plant disease. Thus the replacement of traditional varieties with the high-yield crops developed by the "Green Revolution" carries serious risks. Adjustment to climate change also requires genetic diversity. In general, a genetically diverse population is far better to adjust to environmental changes than a genetically homogeneous population. This being so, it is vital to preserve civilization's heritage of genetically diverse crops.

Deforestation and loss of biodiversity

The earth's tropical rain forests are rapidly being destroyed for the sake of new agricultural land. Tropical rain forests are thought to be the habitat of more than half of the world's species of plants, animals and insects; and their destruction is accompanied by an alarming rate of extinction of species. The Harvard biologist, E.O. Wilson, estimates that the rate of extinction resulting from deforestation in the tropics may now exceed 4,000 species per year - 10,000 times the natural background rate (*Scientific American*, September, 1989).

The enormous biological diversity of tropical rain forests has resulted from their stability. Unlike northern forests, which have been affected by glacial epochs, tropical forests have existed undisturbed for millions of years. As a result, complex and fragile ecological systems have had a chance to develop. Professor Wilson expresses this in the following words:

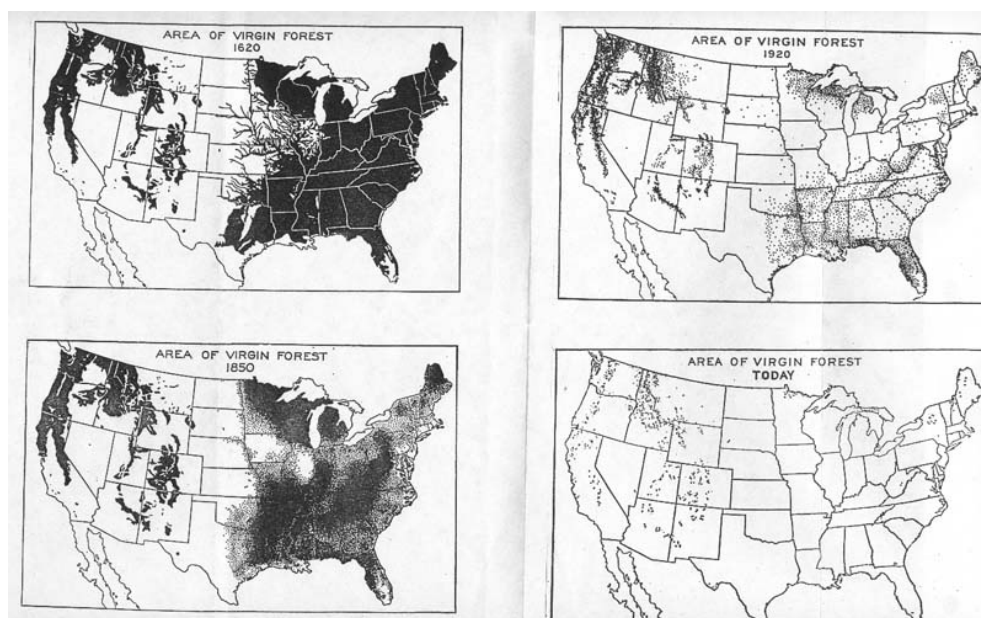


Figure 2.6: *Deforestation in the United States between 1620 and the present.*

“Fragile superstructures of species build up when the environment remains stable enough to support their evolution during long periods of time. Biologists now know that biotas, like houses of cards, can be brought tumbling down by relatively small perturbations in the physical environment. They are not robust at all.”

The number of species which we have until now domesticated or used in medicine is very small compared with the number of potentially useful species still waiting in the world’s tropical rain forests. When we destroy them, we damage our future. But we ought to regard the annual loss of thousands of species as a tragedy, not only because biological diversity is potential wealth for human society, but also because every form of life deserves our respect and protection.

Economics without growth

According to Adam Smith, the free market is the dynamo of economic growth. The true entrepreneur does not indulge in luxuries for himself and his family, but reinvests his profits, with the result that his business or fac-



Figure 2.7: *Jungle burned for agriculture in southern Mexico.*

tory grows larger, producing still more profits, which he again reinvests, and so on. This is indeed the formula for exponential economic growth.

Economists (with a few notable exceptions such as Aurelio Pecci and Herman Daly) have long behaved as though growth were synonymous with economic health. If the gross national product of a country increases steadily by 4% per year, most economists express approval and say that the economy is healthy. If the economy could be made to grow still faster (they maintain), it would be still more healthy. If the growth rate should fall, economic illness would be diagnosed. However, the basic idea of Malthus is applicable to exponential increase of any kind. It is obvious that on a finite Earth, neither population growth nor resource-using and pollution-generating economic growth can continue indefinitely.

A “healthy” economic growth rate of 4% per year corresponds to an increase by a factor of 50 in a century. (The reader is invited to calculate the factor of increase in five centuries. The answer is $50^5 = 312,500,000$.) No one can maintain that this type of growth is sustainable except by refusing to look more than a short distance into the future. Sooner or later (perhaps

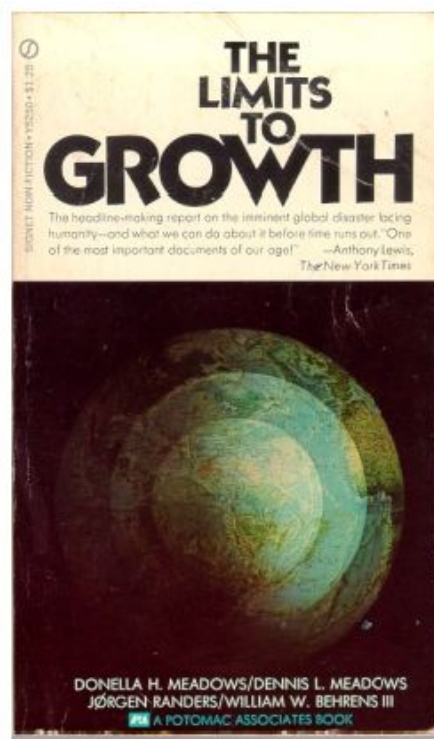


Figure 2.8: In 1968 Aurelio Pecci, Thorkil Kristensen and others founded the Club of Rome, an organization of economists and scientists devoted to studying the predicament of human society. One of the first acts of the organization was to commission an MIT study of future trends using computer models. The result was a book entitled “Limits to Growth”, published in 1972. From the outset the book was controversial, but it became a best-seller. It was translated into many languages and sold 30 million copies. The book made use of an exponential index for resources, i.e. the number of years that a resource would last if used at an exponentially increasing rate. Today the more accurate Hubbert Peak model is used instead to predict rate of use of a scarce resource as a function of time. Although the specific predictions of resource availability in “Limits to Growth” lacked accuracy, its basic thesis - that unlimited economic growth on a finite planet is impossible - was indisputably correct. Nevertheless the book was greeted with anger and disbelief by the community of economists, and these emotions still surface when it is mentioned. Perhaps part of this collective blindness was and is due to the polarization of opinion produced by the Cold War. In any case, the myth of unlimited growth has remained the central dogma of western economics.

surprisingly soon) an entirely new form of economics will be needed - not the empty-world economics of Adam Smith, but what might be called “full-world economics”, or “steady-state economics”.

Economic activity is usually divided into two categories, 1) production of goods and 2) provision of services. It is the rate of production of goods that will be limited by the carrying capacity of the global environment. Services that have no environmental impact will not be constrained in this way. Thus a smooth transition to a sustainable economy will involve a shift of a large fraction the work force from the production of goods to the provision of services.

In his recent popular book *The Rise of the Creative Class*, the economist Richard Florida points out that in a number of prosperous cities - for example Stockholm - a large fraction of the population is already engaged in what might be called creative work - a type of work that uses few resources, and produces few waste products - work which develops knowledge and culture rather than producing material goods. For example, producing computer software requires few resources and results in few waste products. Thus it is an activity with a very small ecological footprint. Similarly, education, research, music, literature and art are all activities that do not weigh heavily on the carrying capacity of the global environment. Furthermore, cultural activities lead in a natural way to global cooperation and internationalism. Florida sees this as a pattern for the future, and maintains that everyone is capable of creativity. He visualizes the transition to a sustainable future economy as one in which a large fraction of the work force moves from industrial jobs to information-related work. Meanwhile, as Florida acknowledges, industrial workers feel uneasy and threatened by such trends.

The present use of resources by the industrialized countries is extremely wasteful. A growing national economy must, at some point, exceed the real needs of the citizens. It has been the habit of the developed countries to create artificial needs by means of advertising, in order to allow economies to grow beyond the point where all real needs have been met; but this extra growth is wasteful, and in the future it will be important not to waste the earth's diminishing supply of non-renewable resources.

Thus, the times in which we live present a challenge: We need a revolution in economic thought. We must develop a new form of economics, taking into account the realities of the world's present situation - an economics based on real needs and on a sustainable equilibrium with the environment, not on the thoughtless assumption that growth can continue forever.

Adam Smith was perfectly correct in saying that the free market is the dynamo of economic growth; but rapid growth of human population and economic activity have brought us, in a surprisingly short time, from the empty-world situation in which he lived to a full-world situation. In today's world, we are pressing against the absolute limits of the earth's carrying capacity, and further growth carries with it the danger of future collapse. Full-world economics, the economics of the future, will no longer be able to rely on growth to give profits to stockbrokers or to solve problems of unemployment or to alleviate poverty. In the long run, growth of any kind is not sustainable (except perhaps growth of culture and knowledge); and we are now nearing the environmentally-imposed limits.

Transition to a sustainable economy

Like a speeding bus headed for a brick wall, the earth's rapidly-growing population of humans and its rapidly-growing resource-using and pollution-generating economic activity are headed for a collision with a very solid barrier - the carrying capacity of the global environment. As in the case of the bus and the wall, the correct response to the situation is to apply the brakes in time - but fear prevents us from doing this. What will happen if we slow down very suddenly? Will not many of the passengers be injured? Undoubtedly. But what will happen if we hit the wall at full speed? Perhaps it would be wise, after all, to apply the brakes!

The memory of the great depression of 1929 makes us fear the consequences of an economic slowdown, especially since unemployment is already a serious problem in many parts of the world. Although the history of the 1929 depression is frightening, it may nevertheless be useful to look at the measures which were used then to bring the global economy back to its feet. A similar level of governmental responsibility may help us to avoid some of the more painful consequences of the necessary transition from the economics of growth to steady-state economics.

In the United States, President Franklin D. Roosevelt was faced with the difficult problems of the depression during his first few years in office. Roosevelt introduced a number of special governmental programs, such as the WPA, the Civilian Construction Corps and the Tennessee Valley Authority, which were designed to create new jobs on projects directed towards socially useful goals - building highways, airfields, auditoriums, harbors, housing projects, schools and dams. The English economist John Maynard Keynes,

(1883-1946), provided an analysis of the factors that had caused the 1929 depression, and a theoretical justification of Roosevelt's policies.

The transition to a sustainable global society will require a similar level of governmental responsibility, although the measures needed are not the same as those which Roosevelt used to end the great depression. Despite the burst of faith in the free market which has followed the end of the Cold War, it seems unlikely that market mechanisms alone will be sufficient to solve problems of unemployment in the long-range future, or to achieve conservation of land, natural resources and environment.

The Worldwatch Institute, Washington D.C., lists the following steps as necessary for the transition to sustainability²:

1. Stabilizing population
2. Shifting to renewable energy
3. Increasing energy efficiency
4. Recycling resources
5. Reforestation
6. Soil Conservation

All of these steps are labor-intensive; and thus, wholehearted governmental commitment to the transition to sustainability can help to solve the problem of unemployment.

In much the same spirit that Roosevelt (with Keynes' approval) used governmental powers to end the great depression, we must now urge our governments to use their powers to promote sustainability and to reduce the trauma of the transition to a steady-state economy. For example, an increase in the taxes on fossil fuels could make a number of renewable energy technologies economically competitive; and higher taxes on motor fuels would be especially useful in promoting the necessary transition from private automobiles to bicycles and public transportation. Tax changes could also be helpful in motivating smaller families.

The present economic recession offers us an opportunity to take steps towards the creation of a sustainable steady-state economic system. Government measures to avoid unemployment could at the same time shift the work force to jobs that promote sustainability, i.e., jobs in the areas listed by the Worldwatch Institute.

²L.R. Brown and P. Shaw, 1982.



Figure 2.9: *Lester R. Brown, founder of the Worldwatch Institute, and for many years its President. He is now the leader of the Earth Policy Institute. His recent book, “Plan B”, gives important information about the ecological crisis now facing the world. It may be downloaded free of charge from the website of the Earth Policy Institute.*

Governments already recognize their responsibility for education. In the future, they must also recognize their responsibility for helping young people to make a smooth transition from education to secure jobs. If jobs are scarce, work must be shared, in a spirit of solidarity, among those seeking employment; hours of work (and if necessary, living standards) must be reduced to insure a fair distribution of jobs. Market forces alone cannot achieve this. The powers of government are needed.

Population and goods per capita

In the distant future, the finite carrying capacity of the global environment will impose limits on the amount of resource-using and waste-generating economic activity that it will be possible for the world to sustain. The consumption of goods per capita will be equal to this limited total economic activity divided by the number of people alive at that time. Thus, our descendants will have to choose whether they want to be very numerous and very poor, or less numerous and more comfortable, or very few and very rich. Perhaps the middle way will prove to be the best.

Given the fact that environmental carrying capacity will limit the sustainable level of resource-using economic activity to a fixed amount, average wealth in the distant future will be approximately inversely proportional to population over a certain range of population values. Obviously, if the number of people is reduced to such an extent that it approaches zero, the average wealth will not approach infinity, since a certain level of population is needed to maintain a modern economy. However, if the global population becomes extremely large, the average wealth will indeed approach zero.

In the 1970's the equation $I = P \times A \times T$ was introduced in the course of a debate between Barry Commoner, Paul R. Ehrlich and John P. Holdren. Here I represents environmental impact, P is population, while A represents goods per capita, and T is an adjustable factor that depends on the technology used to produce the goods. The assertion of the previous paragraph can be expressed by solving for A and setting I equal to a constant: $A = I/(P \times T)$. In the distant future, the environmental impact I will not be allowed to increase, and therefore for a given value of T , A will be inversely proportional to P .

If the environmental impact I is broken up into several components, a few of them have historically fallen with increasing values of $A \times P$ because of diminishing T (thus exhibiting the *environmental Kuznets curve*). However,

most components of I , such as energy, land and resource use, have historically increased with increasing $A \times P$.

Suggestions for further reading

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Chapter 3

GROWING POPULATION, VANISHING RESOURCES

“Let us try to translate pollution and ruthless exploitation of the environment into economic language: Both of these mean that we are spending our capital, i.e., we are spending the earth’s riches of coal, oil and raw materials, as well as our inheritance of clean air, clean water, and places where one can be free from noise pollution. It is clear that economic growth, as we experience it today, means that we are spending more and more of humankind’s natural wealth. This cannot continue indefinitely.”

Professor Thorkil Kristensen, former Secretary General of the OECD

Fossil fuels: a long-term view

In Chapter 2 we saw that in order to avoid dangerous climate change, the world will have to reduce its CO_2 emissions by 90% by 2050. Thus the fossil fuel era will have to end by the middle of the 21st century in order to avoid disastrous climate change. But even if it were not for these considerations, the fossil fuel era would end within a century because of vanishing resources.

As oil becomes scarce, it is likely that coal will be converted to liquid fuels, as was done in Germany during World War II, and in South Africa during the oil embargo. In this process, coal is gasified to form syngas, which is a mixture of CO and H_2 . These two gasses are then converted to light hydrocarbons by means of Fischer-Tropsch catalysts. Both gasoline and diesel fuel can be made in this way.

If coal is converted to liquid fuels on a large scale, the rate of use of coal will increase. Thus the projected date for the exhaustion of coal reserves based on the present consumption of coal is unrealistic. It is more accurate to lump all fossil fuels together and to predict a future date for their exhaustion based on the lumped consumption of coal, natural gas and oil. Doing so gives a figure of 95 years; but the true figure is likely to be less because of increased rates of consumption. We must remember also that the conversion of coal to liquid fuels requires energy. Of course, neither coal, nor oil, nor natural gas will disappear entirely, but they will become so expensive that their use as fuels will seem inappropriate, and they will be reserved as starting materials for synthesis.

The date at which the possibility for nuclear energy will end is more controversial and difficult to predict. However, it seems likely that if nuclear reactors are used as an energy source despite their great dangers, finite reserves of uranium and thorium will be exhausted by the end of the 21st century.

Optimists point to the possibility of using fusion of light elements, such as hydrogen, to generate power. However, although this can be done on a very small scale (and at great expense) in laboratory experiments, the practical generation of energy by means of thermonuclear reactions remains a mirage rather than a realistic prospect on which planners can rely. The reason for this is the enormous temperature required to produce thermonuclear reactions. This temperature is comparable to that existing in the interior of the sun, and it is sufficient to melt any ordinary container. Elaborate “magnetic bottles” have been constructed to contain thermonuclear reactions, and these

have been used in successful very small scale experiments. However, despite 50 years of heavily-financed research, there has been absolutely no success in producing thermonuclear energy on a large scale, or at anything remotely approaching commercially competitive prices.

Thus, after the end of the fossil fuel era, our industrial civilization will probably have to rely on renewable sources to supply our energy needs. These sources include hydropower, wind and tidal power, biomass, geothermal energy and solar energy. Let us try to survey how much energy these sources can be expected to produce.

Before the start of the industrial era, human society relied exclusively on renewable energy sources - but can we do so again, with our greatly increased population and greatly increased demands? Will we ultimately be forced to reduce the global population or our per capita use of energy, or both? Let us now try to examine these questions.

Global energy resources

The total ultimately recoverable resources of fossil fuels amount to roughly 1260 terawatt-years of energy (1 terawatt-year $\equiv 10^{12}$ Watt-years $\equiv 1$ TWy is equivalent to 5 billion barrels of oil or 1 billion tons of coal). Of this total amount, 760 TWy is coal, while oil and natural gas each constitute roughly 250 TWy.¹ In 1890, the rate of global consumption of energy was 1 terawatt, but by 1990 this figure had grown to 13.2 TW, distributed as follows: oil, 4.6; coal, 3.2; natural gas, 2.4; hydropower, 0.8; nuclear, 0.7; fuelwood, 0.9; crop wastes, 0.4; and dung, 0.2. By 2005, the rate of oil, natural gas and coal consumption had risen to 6.0 TW, 3.7 TW and 3.5 TW respectively. Thus, if we continue to use oil at the 2005 rate, it will last for 42 years, while natural gas will last for 68 years. The reserves of coal are much larger; and used at the 2005 rate, coal would last for 217 years. However, it seems likely that as oil and natural gas become depleted, coal will be converted to liquid and gaseous fuels, and its rate of use will increase. Also, the total global energy consumption is likely to increase because of increasing population and rising standards of living in the developing countries.

The industrialized countries use much more than their fair share of global resources. For example, with only a quarter of world's population they use more than two thirds of its energy; and in the U.S.A. and Canada the average

¹British Petroleum, "B.P. Statistical Review of World Energy", London, 1991

per capita energy consumption is 12 kilowatts, compared with 0.2 kilowatts in Bangladesh. If we are to avoid severe damage to the global environment, the industrialized countries must rethink some of their economic ideas, especially the assumption that growth can continue forever.

Hubbert peaks for oil and gas

One can predict that as the reserves of oil become exhausted, the price will rise to such an extent that production and consumption will diminish. Thus oil experts do not visualize a special date in the future after which oil will totally disappear, but rather a date at which the production and consumption of oil will reach a maximum and afterward diminish because of scarcity of the resource and increase in price. Such a peak in the production of any nonrenewable resource is called a *Hubbert peak*, after Dr. M. King Hubbert, who applied the idea to oil reserves.

Most experts agree that the Hubbert peak for oil will occur within a decade or two. Thus the era of cheap petroleum is rapidly approaching its end, and we must be prepared for the serious economic and political impacts of rising oil prices, as well as great changes in lifestyle in the industrialized countries. Halfway through the present century, petroleum will become too expensive and rare to be used as a fuel. It will be reserved almost exclusively for lubrication and as a starting material for the manufacture of plastics, paint, fertilizers and pharmaceuticals.

The United States uses petroleum at the rate of more than 7 billion barrels (7 Gb) per year, while that country's estimated reserves and undiscovered resources are respectively 50.7 Gb and 49.0 Gb. Thus if the United States were to rely only on its own resources for petroleum, then, at the 2001 rate of use, these would be exhausted within 14 years. In fact, the United States already imports more than half of its oil. According to the "National Energy Policy" report (sometimes called the "Cheney Report" after its chief author) US domestic oil production will decline from 3.1 Gb/y in 2002 to 2.6 Gb/y in 2020, while US consumption will rise from 7.2 Gb/y to 9.3 Gb/y. Thus the United States today imports 57% of its oil, but the report predicts that by 2020 this will rise to 72%. The predicted increment in US imports of oil between 2002 and 2020 is greater than the present oil consumption of China.

It is clear from these figures that if the United States wishes to maintain its enormous rate of petroleum use, it will have to rely on imported oil, much of it coming from regions of the world that are politically unstable, or else

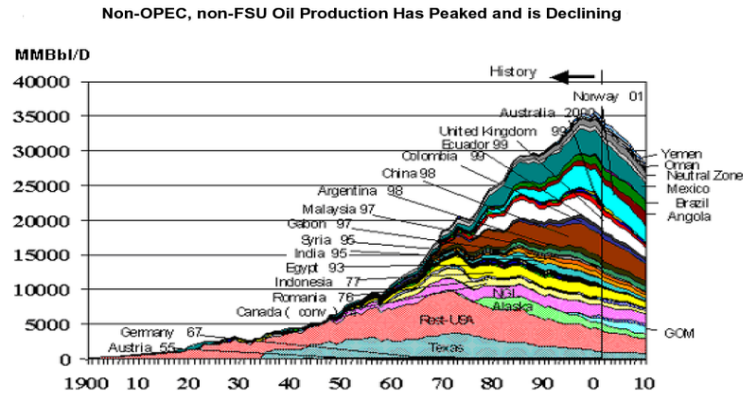


Figure 3.1: *The Hubbert Peak for non-OPEC non-FSU oil.*

unfriendly to America, or both.

As the per-capita oil consumption of India and China increases, global production will fail to meet demand. For example, if the consumption in these two countries were to increase to 12 barrels per person per year (half the North American level), it would amount to 27 billion barrels per year - roughly the same amount of oil that the whole world uses today. Even a smaller increase in petroleum use by China and India may soon produce an energy crisis. One can anticipate that many voices will then be raised favoring widespread use of nuclear energy. However there would be great dangers associated with such a development.

Oilsands, tarsands and heavy oil

When the Hubbert peak for conventional oil has been passed, the price of oil will steadily increase, and this will make the extraction of oil from unconventional sources more economically feasible. For example, very large deposits of oilsands and tarsands exist in northern Alberta, Canada, a few miles north of Fort McMurray. These deposits, known as the Athabasca oil sands, consist of sand layers near to the surface. Each grain of sand in these deposits is surrounded by a thin film of water, outside of which there is a coating of oil. During the extraction process, the sand is transported to tanks where oil is stripped away from the grains by a hot water flotation process. The oil recovered in this way is too viscous to be pumped, but it can be upgraded to a pumpable fluid by the addition of naphtha. Besides the Athabasca deposit,

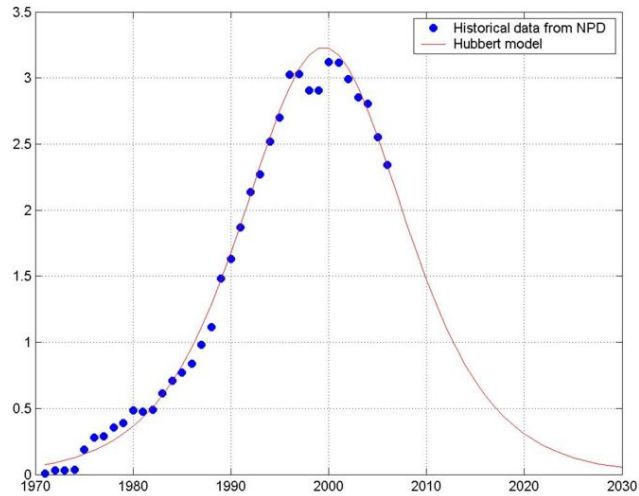


Figure 3.2: *The data for oil production by Norway closely follow the Hubbert model. The Hubbert Peak occurred slightly before 2000.*

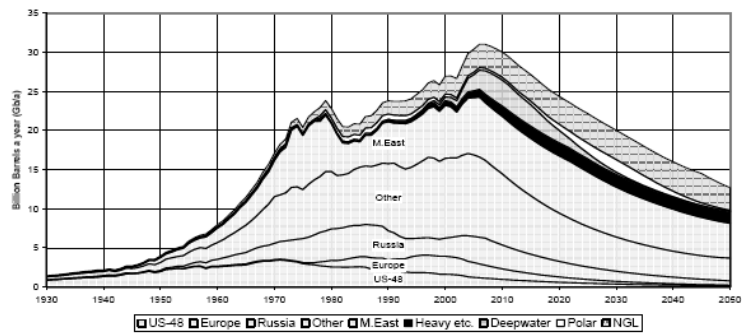


Figure 3.3: *Global oil production between 1930 and 2050, showing both historical and projected figures. According to the Hubbert model, production of any non-renewable resource peaks when the reserves are approximately half exhausted.*

whose area is twice the size of Lake Ontario, Alberta also has three other smaller oilsand deposits.

The energy inputs for extraction of oil from oilsands are high. It has been estimated that three barrels of oil in the sands can produce only one net barrel of output oil, because the other two barrels are needed to supply energy for the extraction process.

The world's largest deposit of superheavy oil is the "cinturon de la brea" (belt of tar) in Venezuela. This semi-solid material can be made more fluid by the addition of hydrogen. Alternatively it can be emulsified, and the emulsion can be burned in power plants.

The extremely large deposits of unconventional oil in Canada and Venezuela will to some extent cushion the economic shocks produced by scarcity of conventional oil. Nevertheless, because of the high extraction costs of unconventional oil, we must still anticipate that the price of oil will rise steadily after the Hubbert peak has been reached.

Coal

The remaining reserves of coal in the world amount to about 1 exagram, i.e. 10^{18} grams or 10^{12} metric tons. The average energy density of coal is 760 Watt-years/ton, and therefore the world's coal reserves correspond to 760 TWy. If coal continues to be consumed at the present rate of 3.5 TW, the global reserves will last a little more than two centuries. However, it seems likely that as petroleum becomes prohibitively expensive, coal will be converted into liquid fuels, so that the rate of use of coal will increase. Therefore it is more realistic to lump all fossil fuels together and to divide the total supply (1260 TWy) by the the total rate of use (13.2 TW). The result is a prediction that the era of inexpensive fossil fuels will end in less than a century, as is shown in Table 7.4.

67% of the world recoverable reserves of coal are located in four countries:

1. United States, 27%
2. Russia, 17%
3. China, 13%
4. India, 10%

The present rate of use of coal by China and India is 1.5 billion metric tons per year which is equal to 1.1 TW. However, the rate of coal use by China and India is expected to double by 2030.

Renewable energy

Solar energy

Biomass, wind energy, hydropower and wave power derive their energy indirectly from the sun, but in addition, various methods are available for utilizing the power of sunlight directly. These include photovoltaic panels, solar designs in architecture, solar systems for heating water and cooking, concentrating photovoltaic systems, and solar thermal power plants.

Photovoltaic cells and concentrating photovoltaic systems

Solar photovoltaic cells are thin coated wafers of a semiconducting material (usually silicon). The coatings on the two sides are respectively charge donors and charge acceptors. Cells of this type are capable of trapping solar energy and converting it into direct-current electricity. The electricity generated in this way can be used directly (as it is, for example, in pocket calculators) or it can be fed into a general power grid. Alternatively it can be used to split water into hydrogen and oxygen. The gases can then be compressed and stored, or exported for later use in fuel cells. In the future, we may see solar photovoltaic arrays in sun-rich desert areas producing hydrogen as an export product. As their petroleum reserves become exhausted, the countries of the Middle East and Africa may be able to shift to this new technology and still remain energy exporters.

The cost of manufacturing photovoltaic cells is currently falling at the rate of 3%-5% per year. The cost in 2006 was \$4.50 per peak Watt. Usually photovoltaic panels are warranted for a life of 20 years, but they are commonly still operational after 30 years or more. The cost of photovoltaic electricity is today 2-5 times the cost of electricity generated from fossil fuels, but photovoltaic costs are falling rapidly, while the costs of fossil fuels are rising equally rapidly.

Concentrating photovoltaic systems are able to lower costs still further by combining silicon solar cells with reflectors that concentrate the sun's rays. The most inexpensive type of concentrating reflector consists of a flat piece of aluminum-covered plastic material bent into a curved shape along one of its dimensions, forming a trough-shaped surface. (Something like this shape results when we hold a piece of paper at the top and bottom with our two

hands, allowing the center to sag.) The axis of the reflector can be oriented so that it points towards the North Star. A photovoltaic array placed along the focal line will then receive concentrated sunlight throughout the day.

Photovoltaic efficiency is defined as the ratio of the electrical power produced by a cell to the solar power striking its surface. For commercially available cells today, this ratio is between 9% and 14%. If we assume 5 hours of bright sunlight per day, this means that a photocell in a desert area near to the equator (where 1 kW/m^2 of peak solar power reaches the earth's surface) can produce electrical energy at the average rate of $20\text{--}30 \text{ W}_e/\text{m}^2$, the average being taken over an entire day and night. (The subscript e means “in the form of electricity”. Energy in the form of heat is denoted by the subscript t , meaning “thermal”.) Thus the potential power per unit area for photovoltaic systems is far greater than for biomass. However, the mix of renewable energy sources most suitable for a particular country depends on many factors. We saw above that biomass is a promising future source of energy for Sweden, because of Sweden's low population density and high rainfall. By contrast, despite the high initial investment required, photovoltaics are undoubtedly a more promising future energy source for southerly countries with clear skies.

In comparing photovoltaics with biomass, we should be aware of the difference between electrical energy and energy contained in the chemical bonds of a primary fuel such as wood or rapeseed oil. If Sweden (for example) were to supply all its energy needs from biomass, part of the biomass would have to be burned to generate electricity. The efficiency of energy conversion in electricity generation from fuel is 20%–35%. Of course, in dual use power plants, part of the left-over heat from electrical power generation can be used to heat homes or greenhouses. However, hydropower, wind power and photovoltaics have an advantage in generating electrical power, since they do so directly and without loss, whereas generation of electricity from biomass involves a loss from the inefficiency of the conversion from fuel energy to electrical energy. Thus a rational renewable energy program for Sweden should involve a mixture of biomass for heating and direct fuel use, with hydropower and wind power for generation of electricity. Perhaps photovoltaics will also play a role in Sweden's future electricity generation, despite the country's northerly location and frequently cloudy skies.

The global market for photovoltaics is expanding at the rate of 30% per year. This development is driven by rising energy prices, subsidies to photovoltaics by governments, and the realization of the risks associated with global warming and consequent international commitments to reduce carbon



Figure 3.4: *A row of 7 meter diameter stamped sheet metal solar concentrators in Georgia USA. The metal is covered with special high-reflection foil.*

emissions. The rapidly expanding markets have resulted in lowered photovoltaic production costs, and hence further expansion, still lower costs, etc. - a virtuous feedback loop.

Solar thermal power plants

Solar Parabolic Troughs can be used to heat a fluid, typically oil, in a pipe running along the focal axis. The heated fluid can then be used to generate electrical power. The liquid that is heated in this way need not be oil. In a solar thermal power plant in California, reflectors move in a manner that follows the sun's position and they concentrate solar energy onto a tower, where molten salt is heated to a temperature of 1050 degrees F (566 degrees C). The molten salt stores the heat, so that electricity can be generated even when the sun is not shining. The California plant, now in a three-year operating and testing phase, generates 10 MW_e.

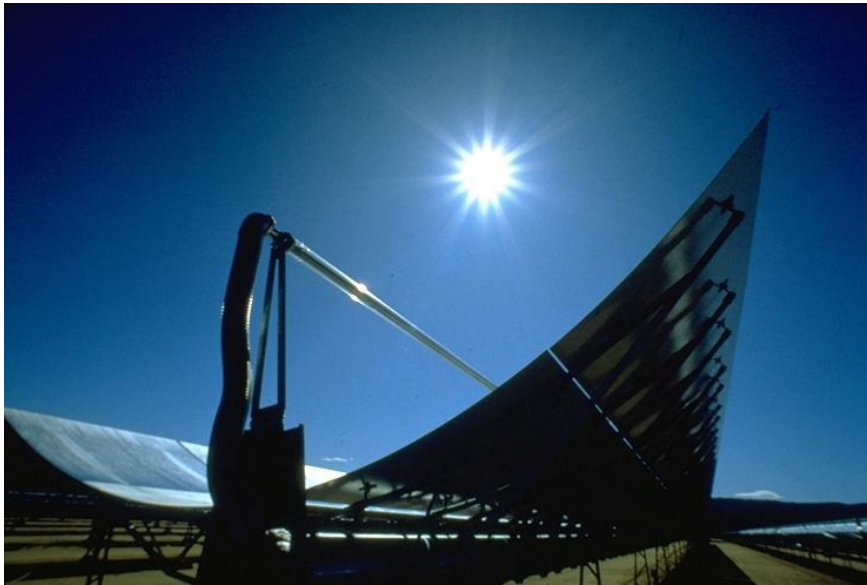


Figure 3.5: *A solar trough, one of the most cost-effective and widely-deployed solar devices.*



Figure 3.6: *The 11 megawatt Serpa photovoltaic installation in Portugal.*



Figure 3.7: *A woman in Ghana pasturising water using a solar cooker.*

Solar designs in architecture

At present, the average global rate of use of primary energy is roughly 2 kW_t per person. In North America, the rate is 12 kW_t per capita, while in Europe, the figure is 6 kW_t. In Bangladesh, it is only 0.2 kW_t. This wide variation implies that considerable energy savings are possible, through changes in lifestyle, and through energy efficiency.

Wind energy

Wind parks in favorable locations, using modern wind turbines, are able to generate 10 MW_e/km² or 10 W_e/m². Often wind farms are placed in offshore locations. When they are on land, the area between the turbines can be utilized for other purposes, for example for pasturage. For a country like Denmark, with good wind potential but cloudy skies, wind turbines can be expected to play a more important future role than photovoltaics. Denmark is already a world leader both in manufacturing and in using wind turbines. Today, 23% of all electricity used in Denmark is generated by wind power, and the export of wind turbines makes a major contribution to the Danish economy.

Globally, only 1.5% of all electricity generated comes from wind power. This corresponds to 121 GW_e or 0.121 TW_e. However, the use of wind power is currently growing at the rate of 38% per year. In the United States, it is the fastest-growing form of electricity generation.

The location of wind parks is important, since the energy obtainable from wind is proportional to the cube of the wind velocity. We can understand this cubic relationship by remembering that the kinetic energy of a moving object is proportional to the square of its velocity multiplied by the mass. Since the mass of air moving past a wind turbine is proportional to the wind velocity, the result is the cubic relationship just mentioned.

Before the decision is made to locate a wind park in a particular place, the wind velocity is usually carefully measured and recorded over an entire year. For locations on land, mountain passes are often very favorable locations, since wind velocities increase with altitude, and since the wind is concentrated in the passes by the mountain barrier. Other favorable locations include shorelines and offshore locations on sand bars. This is because onshore winds result when warm air rising from land heated by the sun is replaced by cool marine air. Depending on the season, the situation may



Figure 3.8: *A geothermal power plant at Nesjavellir in Iceland.*

be reversed at night, and an offshore wind may be produced if the water is warmer than the land.

The cost of wind-generated electrical power is currently about 5 US cents per kilowatt hour, i.e., lower than the cost of electricity generated by burning fossil fuels.

The “energy payback ratio” of a power installation is defined as the ratio of the energy produced by the installation over its lifetime, divided by the energy required to manufacture, construct, operate and decommission the installation. For wind turbines, this ratio is 17-39, compared with 11 for coal-burning plants. The construction energy of a wind turbine is usually paid back within three months.

Besides the propeller-like design for wind turbines there are also designs where the rotors turn about a vertical shaft. One such design was patented in 1927 by the French aeronautical engineer Georges Jean Marie Darrieus. The blades of a Darrieus wind turbine are airfoils similar to the wings of an aircraft. As the rotor turns in the wind, the stream of air striking the airfoils produces a force similar to the “lift” of an airplane wing. This force pushes the rotor in the direction that it is already moving. The Darrieus design has some advantages over conventional wind turbine design, since the generator

can be placed at the bottom of the vertical shaft, where it may be more easily serviced. Furthermore, the vertical shaft can be lighter than the shaft needed to support a conventional wind turbine.

One problem with wind power is that it comes intermittently, and demand for electrical power does not necessarily come at times when the wind is blowing most strongly. To deal with the problem of intermittency, wind power can be combined with other electrical power sources in a grid. Alternatively, the energy generated can be stored, for example by pumped hydroelectric storage or by using hydrogen technology, as will be discussed below.

Bird lovers complain that birds are sometimes killed by rotor blades. This is true, but the number killed is small. For example, in the United States, about 70,000 birds per year are killed by turbines, but this must be compared with 57 million birds killed by automobiles and 97.5 million killed by collisions with plate glass.

The aesthetic aspects of wind turbines also come into the debate. Perhaps in the future, as wind power becomes more and more a necessity and less a matter of choice, this will be seen as a “luxury argument”.

The case of Samsø.

The Danish island of Samsø is only 112 square kilometers in size, and its population numbers only 4,300. Nevertheless, it has a unique distinction. Samsø was the first closed land area to declare its intention of relying entirely on renewable energy, and it has now achieved this aim, provided that one stretches the definitions slightly.

In 1997, the Danish Ministry of Environment and Energy decided to sponsor a renewable-energy contest. In order to enter, communities had to submit plans for how they could make a transition from fossil fuels to renewable energy. An engineer (who didn’t live there) thought he knew how the island could do this, and together with the island’s mayor he submitted a plan which won the contest. As a result, the islanders became interested in renewable energy. They switched from furnaces to heat pumps, and formed cooperatives for the construction of windmill parks in the sea near to the island. By 2005, Samsø was producing, from renewable sources, more energy than it was using. The islanders still had gasoline-driven automobiles, but they exported from their windmill parks an amount of electrical energy that balanced the fossil fuel energy that they imported. This is a story that can give us hope for the future, although a farming community like Samsø cannot



Figure 3.9: *Erection of an Enercon E70-4 in Germany*



Figure 3.10: *An offshore wind farm near the Danish island of Samsø.*

serve as a model for the world.

Biomass

Biomass is defined as any energy source based on biological materials produced by photosynthesis - for example wood, sugar beets, rapeseed oil², crop wastes, dung, urban organic wastes, processed sewage, etc. Using biomass for energy does not result in the net emission of CO₂, since the CO₂ released by burning the material had previously been absorbed from the atmosphere during photosynthesis. If the biological material had decayed instead of being burned, it would have released the same amount of CO₂ as in the burning process.

The solar constant has the value 1.4 kilowatts/m². It represents the amount of solar energy per unit area³ that reaches the earth, before the sunlight has entered the atmosphere. Because the atmosphere reflects 6% and absorbs 16%, the peak power at sea level is reduced to 1.0 kW/m². Clouds also absorb and reflect sunlight. Average cloud cover reduces the energy of sunlight a further 36%. Also, we must take into account the fact that the sun's rays do not fall perpendicularly onto the earth's surface. The angle that they make with the surface depends on the time of day, the season and the latitude.

²canola, a cultivar of *Brassica napus* or *Brassica rapa*

³The area is assumed to be perpendicular to the sun's rays.

In Sweden, which lies at a northerly latitude, the solar energy per unit of horizontal area is less than for countries nearer the equator. Nevertheless, Göran Persson, the Prime Minister of Sweden, recently announced that his government intends to make the country independent of imported oil by 2020 through a program that includes energy from biomass.

In his thesis, *Biomass in a Sustainable Energy System*, the Swedish researcher Pål Börjesson states that of various crops grown as biomass, the largest energy yields come from short-rotation forests (*Salix viminalis*, a species of willow) and sugar beet plantations. These have an energy yield of from 160 to 170 GJ_t per hectare-year. One can calculate that this is equivalent to about 0.5 MW_t/km², or 0.5 W_t/m². Thus, although 1.0 kW/m² of solar energy reaches the earth at noon at the equator, the trees growing in northerly Sweden can harvest a day-and-night and seasonal average of only 0.5 Watts of thermal energy per horizontal square meter⁴. Since Sweden's present primary energy use is approximately 0.04 TW_t, it follows that if no other sources of energy were used, a square area of *Salix* forest 290 kilometers on each side would supply Sweden's present energy needs. This corresponds to an area of 84,000 km², about 19% of Sweden's total area⁵. Of course, Sweden's renewable energy program will not rely exclusively on energy crops, but on a mixture of sources, including biomass from municipal and agricultural wastes, hydropower, wind energy and solar energy.

At present, both Sweden and Finland derive about 30% of their electricity from biomass, which is largely in the form of waste from the forestry and paper industries of these two countries.

Despite their northerly location, the countries of Scandinavia have good potentialities for developing biomass as an energy source, since they have small population densities and adequate rainfall. In Denmark, biodiesel oil derived from rapeseed (canola) has been used as fuel for experimental buses. Rapeseed fields produce oil at the rate of between 1,000 and 1,300 liters per hectare-crop. The energy yield is 3.2 units of fuel product energy for every unit of fuel energy used to plant the rapeseed, and to harvest and process the oil. After the oil has been pressed from rapeseed, two-thirds of the seed remains as a protein-rich residue which can be fed to cattle.

Miscanthus is a grassy plant found in Asia and Africa. Some forms will

⁴In tropical regions, the rate of biomass production can be more than double this amount.

⁵Additional land area would be needed to supply the energy required for planting, harvesting, transportation and utilization of the wood.

also grow in Northern Europe, and it is being considered as an energy crop in the United Kingdom. *Miscanthus* can produce up to 18 dry tonnes per hectare-year, and it has the great advantage that it can be cultivated using ordinary farm machinery. The woody stems are very suitable for burning, since their water content is low (20-30%).

Jatropha is a fast-growing woody shrub about 4 feet in height, whose seeds can be used to produce diesel oil at the cost of about \$43 per barrel. The advantage of *Jatropha* is that it is a hardy plant, requiring very little fertilizer and water. It has a life of roughly 50 years, and can grow on wasteland that is unsuitable for other crops. The Indian State Railway has planted 7.5 million *Jatropha* shrubs beside its right of way. The oil harvested from these plants is used to fuel the trains.

For some southerly countries, honge oil, derived from the plant *Pongamia pinnata* may prove to be a promising source of biomass energy. Studies conducted by Dr. Udishi Shrinivasa at the Indian Institute of Sciences in Bangalore indicate that honge oil can be produced at the cost of \$150 per ton. This price is quite competitive when compared with other potential fuel oils.

Recent studies have also focused on a species of algae that has an oil content of up to 50%. Algae can be grown in desert areas, where cloud cover is minimal. Farm waste and excess CO₂ from factories can be used to speed the growth of the algae.

It is possible that in the future, scientists will be able to create new species of algae that use the sun's energy to generate hydrogen gas. If this proves to be possible, the hydrogen gas may then be used to generate electricity in fuel cells, as will be discussed below in the section on hydrogen technology. Promising research along this line is already in progress at the University of California, Berkeley.

Biogas is defined as the mixture of gases produced by the anaerobic digestion of organic matter. This gas, which is rich in methane (CH₄), is produced in swamps and landfills, and in the treatment of organic wastes from farms and cities. The use of biogas as a fuel is important not only because it is a valuable energy source, but also because methane is a potent greenhouse gas, which should not be allowed to reach the atmosphere. Biogas produced from farm wastes can be used locally on the farm, for cooking and heating, etc. When biogas has been sufficiently cleaned so that it can be distributed in a pipeline, it is known as "renewable natural gas". It may then be distributed in the natural gas grid, or it can be compressed and used in internal

combustion engines. Renewable natural gas can also be used in fuel cells, as will be discussed below in the section on Hydrogen Technology.

Biofuels are often classified according to their generation. Those that can be used alternatively as food are called first-generation biofuels. By contrast, biofuels of the second generation are those that make use of crop residues or other cellulose-rich materials. Cellulose molecules are long chains of sugars, and by breaking the inter-sugar bonds in the chain using enzymes or other methods, the sugars can be freed for use in fermentation. In this way lignocellulosic ethanol is produced. The oil-producing and hydrogen-producing algae mentioned above are examples of third-generation biofuels.

We should notice that growing biofuels locally (even first-generation ones) may be of great benefit to smallholders in developing countries, since they can achieve local energy self-reliance in this way.

Competition between food and biofuels

Although it is largely a future problem rather than a present one, we can see today the start of a competition between food production and first-generation biofuels. In 2007, 27% of the US corn (maize) crop was used to produce ethanol for motor fuel, an increase by a factor of more than 5 from 1996. In 1996, none of the soybean oil produced in the US was used for biodiesel, while in 2007, more than 17% of the crop was used for fuel. South American soybean oil is also used for biodiesel. In Europe, biodiesel comes mainly from rapeseed (canola) oil, but this can also be used for food. Brazilian ethanol comes from sugar cane produced on land that alternatively could be used for food production. Biodiesel from South East Asia is mainly edible palm oil. Thus, many (but not all!) of the major biofuels are produced from feedstocks that could be used to produce food, or are grown on land that could be used for food production.

There is a danger that a food-versus-fuel competition will develop between the world's 860 million automobiles and its 2 billion poorest people. As Lester Brown puts it in his book *Plan B*, "Suddenly the world is faced by a moral and political issue for which there is no precedent: Should we use grain to fuel cars or to feed people? The average income of the world's automobile owners is roughly \$30,000 a year; the 2 billion poorest people earn on average less than \$3,000 a year. The market says, 'Let's fuel the cars'." It is up to the world's collective conscience to overrule the market on this point.

Future food output will also be decreased because, as petroleum prices

become prohibitively high, synthetic fibers based on petroleum feedstocks will be less and less used. The additional land area needed to produce wool, cotton or linen for clothing will have to be subtracted from the area available for growing food. Finally, as petroleum disappears, draft animals may again be used in farming, and pasturage for them will have to be subtracted from the land available for agriculture. These factors will contribute to the predicted global food crisis discussed in Chapter 4.

Hydroelectric power

At present 20% of the world's electricity comes from hydroelectric power. In the developed countries, the potential for increasing this percentage is small, because most of the suitable sites for dams are already in use. Mountainous regions of course have the greatest potential for hydroelectric power, and this correlates well with the fact that virtually all of the electricity generated in Norway comes from hydro, while in Iceland and Austria the figures are respectively 83% and 67%. Among the large hydroelectric power stations now in use are the La Grande complex in Canada (16 GW_e) and the Itapú station on the border between Brazil and Paraguay (14 GW_e). The Three Gorges Dam under construction in China is planned to produce 18.2 GW_e by 2009.

Even in regions where the percentage of hydro in electricity generation is not so high, it plays an important role because hydropower can be used selectively at moments of peak demand. Pumping of water into reservoirs can also be used to store energy.

The creation of lakes behind new dams in developing countries often involves problems, for example relocation of people living on land that will be covered by water, and loss of the land for other purposes⁶. However the energy gain per unit area of lake can be very large - over 100 W_e/m². Fish ladders can be used to enable fish to reach their spawning grounds above dams. In addition to generating electrical power, dams often play useful roles in flood control and irrigation.

At present, hydroelectric power is used in energy-intensive industrial processes, such as the production of aluminum. However, as the global energy crisis becomes more severe, we can expect that metals derived from elec-

⁶Over a million people were displaced by the construction of the Three Gorges Dam in China, and many sites of cultural value were lost



Figure 3.11: *Construction of the Three Gorges Dam (2006).*

trollysis, such as aluminum and magnesium, will be very largely replaced by other materials, because the world will no longer be able to afford the energy needed to produce them.

Geothermal energy

The ultimate source of geothermal energy is the decay of radioactive nuclei in the interior of the earth. Because of the heat produced by this radioactive decay, the temperature of the earth's core is 4300 degrees C. The inner core is composed of solid iron, while the outer core consists of molten iron and sulfur compounds. Above the core is the mantle, which consists of a viscous liquid containing compounds of magnesium, iron, aluminum, silicon and oxygen. The temperature of the mantle gradually decreases from 3700 degrees C near the core to 1000 degrees C near the crust. The crust of the earth consists of relatively light solid rocks and it varies in thickness from 5 to 70 km.

The outward flow of heat from radioactive decay produces convection currents in the interior of the earth. These convection currents, interacting with the earth's rotation, produce patterns of flow similar to the trade winds of the atmosphere. One result of the currents of molten conducting material in the interior of the earth is the earth's magnetic field. The crust is divided

into large sections called “tectonic plates”, and the currents of molten material in the interior of the earth also drag the plates into collision with each other. At the boundaries, where the plates collide or split apart, volcanic activity occurs. Volcanic regions near the tectonic plate boundaries are the best sites for collection of geothermal energy.

The entire Pacific Ocean is ringed by regions of volcanic and earthquake activity, the so-called Ring of Fire. This ring extends from Tierra del Fuego at the southernmost tip of South America, northward along the western coasts of both South America and North America to Alaska. The ring then crosses the Pacific at the line formed by the Aleutian Islands, and it reaches the Kamchatka Peninsula in Russia. From there it extends southward along the Kuril Island chain and across Japan to the Philippine Islands, Indonesia and New Zealand. Many of the islands of the Pacific are volcanic in nature. Another important region of volcanic activity extends northward along the Rift Valley of Africa to Turkey, Greece and Italy. In the Central Atlantic region, two tectonic plates are splitting apart, thus producing the volcanic activity of Iceland. All of these regions are very favorable for the collection of geothermal power.

The average rate at which the energy created by radioactive decay in the interior of the earth is transported to the surface is $0.06 \text{ W}_t/\text{m}^2$. However, in volcanic regions near the boundaries of tectonic plates, the rate at which the energy is conducted to the surface is much higher - typically $0.3 \text{ W}_t/\text{m}^2$. If we insert these figures into the thermal conductivity law

$$q = K_T \frac{\Delta T}{z}$$

we can obtain an understanding of the types of geothermal resources available throughout the world. In the thermal conductivity equation, q is the power conducted per unit area, while K_T is the thermal conductivity of the material through the energy is passing. For sandstones, limestones and most crystalline rocks, thermal conductivities are in the range $2.5\text{-}3.5 \text{ W}_t/(\text{m } ^\circ\text{C})$. Inserting these values into the thermal conductivity equation, we find that in regions near tectonic plate boundaries we can reach temperatures of 200°C by drilling only 2 kilometers into rocks of the types named above. If the strata at that depth contain water, it will be in the form of highly-compressed steam. Such a geothermal resource is called a *high-enthalpy* resource⁷.

⁷Enthalpy $\equiv H \equiv U + PV$ is a thermodynamic quantity that takes into account not

In addition to high-enthalpy geothermal resources there are *low-enthalpy* resources in nonvolcanic regions of the world, especially in basins covered by sedimentary rocks. Clays and shales have a low thermal conductivity, typically $1\text{--}2 \text{ W}_t/(\text{m } ^\circ\text{C})$. When we combine these figures with the global average geothermal power transmission, $q = 0.06 \text{ W}_t/\text{m}^2$, the thermal conduction equation tells us that $\Delta T/z = 0.04 \text{ } ^\circ\text{C}/\text{m}$. In such a region the geothermal resources may not be suitable for the generation of electrical power, but nevertheless adequate for heating buildings. The Creil district heating scheme north of Paris is an example of a project where geothermal energy from a low enthalpy resource is used for heating buildings.

The total quantity of geothermal electrical power produced in the world today is 8 GW_e , with an additional 16 GW_t used for heating houses and buildings. In the United States alone, 2.7 GW_e are derived from geothermal sources. In some countries, for example Iceland and Canada, geothermal energy is used both for electrical power generation and for heating houses.

There are three methods for obtaining geothermal power in common use today: Deep wells may yield dry steam, which can be used directly to drive turbines. Alternatively water so hot that it boils when brought to the surface may be pumped from deep wells in volcanic regions. The steam is then used to drive turbines. Finally, if the water from geothermal wells is less hot, it may be used in binary plants, where its heat is exchanged with an organic fluid which then boils. In this last method, the organic vapor drives the turbines. In all three methods, water is pumped back into the wells to be reheated. The largest dry steam field in the world is The Geysers, 145 kilometers north of San Francisco, which produces $1,000 \text{ MW}_e$.

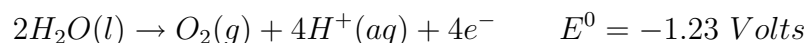
There is a fourth method of obtaining geothermal energy, in which water is pumped down from the surface and is heated by hot dry rocks. In order to obtain a sufficiently large area for heat exchange the fissure systems in the rocks must be augmented, for example by pumping water down at high pressures several hundred meters away from the collection well. The European Union has established an experimental station at Soultz-sous-Forêts in the Upper Rhine to explore this technique. The experiments performed at Soultz will determine whether the “hot dry rock” method can be made economically viable. If so, it can potentially offer the world a very important source of renewable energy.

only the internal energy U of a gas, but also energy PV that may be obtained by allowing it to expand.

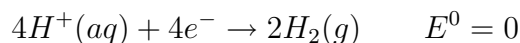
The molten lava of volcanoes also offers a potential source of geothermal energy that may become available in the future, but at present, no technology has been developed that is capable of using it.

Hydrogen technologies

When water containing a little acid is placed in a container with two electrodes and subjected to an external direct current voltage greater than 1.23 Volts, bubbles of hydrogen gas form at one electrode (the cathode), while bubbles of oxygen gas form at the other electrode (the anode). At the cathode, the half-reaction

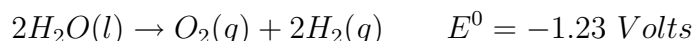


takes place, while at the anode, the half-reaction



occurs.

Half-reactions differ from ordinary chemical reactions in containing electrons either as reactants or as products. In electrochemical reactions, such as the electrolysis of water, these electrons are either supplied or removed by the external circuit. When the two half-reactions are added together, we obtain the total reaction:



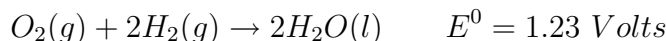
Notice that $4H^+$ and $4e^-$ cancel out when the two half-reactions are added. The total reaction does not occur spontaneously (as is discussed in Appendix A), but it can be driven by an external potential E , provided that the magnitude of E is greater than 1.23 volts.

When this experiment is performed in the laboratory, platinum is often used for the electrodes, but electrolysis of water can also be performed using electrodes made of graphite.

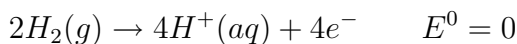
Electrolysis of water to produce hydrogen gas has been proposed as a method for energy storage in a future renewable energy system. For example, it might be used to store energy generated by photovoltaics in desert areas of the world. Compressed hydrogen gas could then be transported to other regions and used in fuel cells. Electrolysis of water and storage of hydrogen could also be used to solve the problem of intermittency associated with wind energy or solar energy.

Hydrogen fuel cells

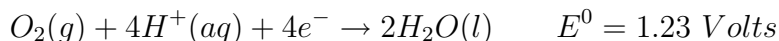
Fuel cells allow us to convert the energy of chemical reactions directly into electrical power. In hydrogen fuel cells, for example, the exact reverse of the electrolysis of water takes place. Hydrogen reacts with oxygen, and produces electricity and water, the reaction being



The arrangement of the a hydrogen fuel cell is such that the hydrogen cannot react directly with the oxygen, releasing heat. Instead, two half reactions take place, one at each electrode, as was just mentioned in connection with the electrolysis of water. In a hydrogen fuel cell, hydrogen gas produces electrons and hydrogen H^+ ions at one of the electrodes.



The electrons flow through the external circuit to the oxygen electrode, while the hydrogen ions complete the circuit by flowing through the interior of the cell (from which the hydrogen and oxygen molecules are excluded by semipermeable membranes) to the oxygen electrode. Here the electrons react with oxygen molecules and H^+ ions to form water.



In this process, a large part of the chemical energy of the reaction becomes available as electrical power.

We can recall that the theoretical maximum efficiency of a heat engine operating between a cold reservoir at temperature T_C and a hot reservoir at T_H is $1 - T_C/T_H$, where the temperatures are expressed on the Kelvin scale. Since fuel cells are not heat engines, their theoretical maximum efficiency is not limited in this way. Thus it can be much more efficient to generate electricity by reacting hydrogen and oxygen in a fuel cell than it would be to burn the hydrogen in a heat engine and then use the power of the engine to drive a generator.

Hydrogen technologies are still at an experimental stage. Furthermore, they do not offer us a source of renewable energy, but only means for storage, transportation and utilization of energy derived from other sources. Nevertheless, it seems likely that hydrogen technologies will have great importance in the future.

Some concluding remarks on energy

It can be seen from our discussion of renewable energy technologies that they can potentially offer a partial replacement for the fossil fuels on which the world is now dependent. All forms of renewable energy should be developed simultaneously, since all will be needed. Energy conservation and changes of lifestyle will also be necessary. Much of the limited amount of energy that will be available in the future will be needed for agriculture, and therefore less energy will be available for transportation and industry.

It seems likely that photovoltaics, solar thermal power, wind power, biomass and wave power will become the major energy sources of the future. In addition, hydropower is extremely helpful in overcoming the problem of intermittency, while other forms of renewable energy may have great advantages in certain locations.

The transition to renewable energy will require wholehearted governmental commitment, tax changes, and a considerable investment in research. At present nuclear energy, nuclear research and the oil industry all receive enormous governmental support. It is vital that this support should go instead to renewable energy technologies.

The time factor is also important. The Hubbert peak for oil will occur in a decade, and the peak for natural gas in two decades. After that, the outlook for the future is that petroleum and natural gas will become more and more expensive - finally so expensive that they will not be used as fuels. To minimize the shock of these events, and to avoid dangerous climate change, serious work on substitutes must begin immediately, and on a large scale. At present the development of renewable energy is proceeding so slowly that if the trend is not corrected, we can anticipate a period of great energy scarcity and economic trauma.

The transition to renewable energy will involve rededication of much land from agriculture to energy generation. This will be easiest in countries where the population density is low, and difficult in countries that already have problems in feeding their people.

Metals

W. David Menzie (Chief of the Minerals Information Team of the U.S. Geological Survey) testified to a committee of the U.S. House of Representatives

in 2006 that global reserves of copper are approximately 470 million tons. He also stated that world consumption of copper in 2000 was 14.9 million tons per year, but that it is increasing at 3.1% per year and is expected to reach 27 Mt/y by 2020. Menzie predicted that most of this increase will be in the developing countries. For example, China's use of copper is expected to increase from 2 Mt/y in 2000 to 5.6 Mt/y in 2020, while for India, the increase will be from 0.4 Mt/y to 1.6 Mt/y.

At the 2000 rate of use, global copper reserves will be exhausted in 31 years, while if used at a higher rate, the reserves will last for a shorter time. It is predicted that a Hubbert peak will occur for copper, analogous to the Hubbert peaks for petroleum and natural gas. Thus, copper will not disappear entirely, but there will be a date when the production of copper will reach a maximum and afterward decline because of rising prices.

Reserve indices

The reserve index of a metal is defined as the size of its reserves divided by the current annual rate of production. Today, many metals have reserve indices between 10 years and 100 years. These include indium, tantalum, gold, bismuth, silver, cadmium, cobalt, arsenic, tungsten, molybdenum, tin, nickel, lead, zinc, and copper, while magnesium and iron have reserve indices of approximately 100 years⁸.

Recycling metals

Future exploration may increase the size of known reserves of metals; and future advances in technology may also make it possible to use lower grade ores. However, we must remember that the extraction of metals from their ores requires much energy. In the long-term future, energy will probably not be available for the production of (for example) iron, steel, and aluminum on the scale that we know today. Thus, recycling will assume great importance.

Substitutes for metals

It seems likely that composite materials, such as carbon-fiber-reinforced plastic and glass-reinforced plastic (fiberglass), will become important in the fu-

⁸Craig, J.R., Vaugn, D.J. and Skinner, B.J., *Resources of the Earth: Origin, Use and Environmental Impact, Third Edition*, page 64.

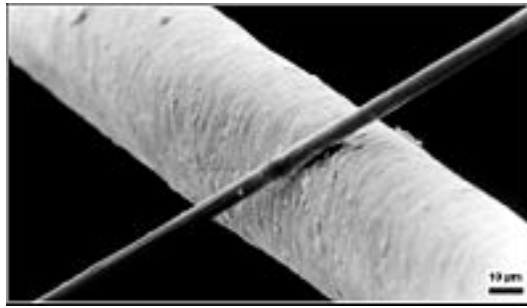


Figure 3.12: A carbon fiber, 0.006 mm in diameter, is much thinner than a human hair (shown for comparison). Nevertheless it has great strength.

ture as substitutes for metals. Carbon fiber consists of threads of carbon as thin as 6 microns (0.006 mm). The carbon atoms in such a fiber are bonded together in crystals, aligned along the axis of the fiber, and in this configuration they have incredible strength in relation to their weight. In the composite material, the carbon fibers are protected by a resin. The result is a material that has both toughness and an extremely high strength-to-weight ratio.

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Chapter 4

THE GLOBAL FOOD CRISIS

“Unless progress with agricultural yields remains very strong, the next century will experience human misery that, on a sheer numerical scale, will exceed everything that has come before”

Nobel Laureate Norman Borlaug speaking of a global food crisis in the 21st century

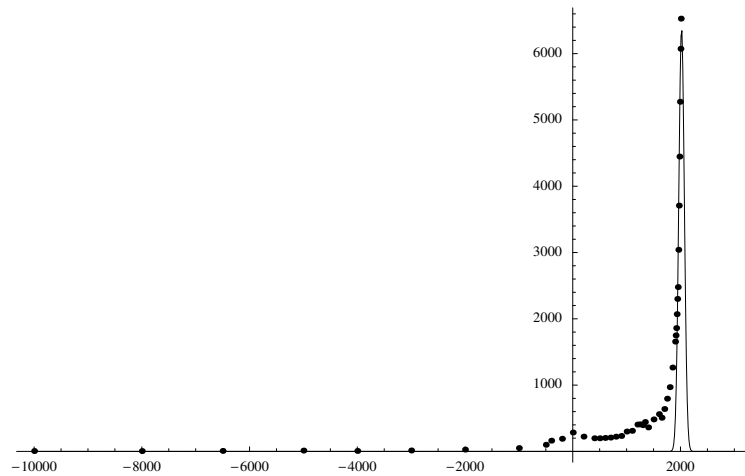


Figure 4.1: *Population growth and fossil fuel use, seen on a time-scale of several thousand years. The dots are population estimates in millions from the US Census Bureau. Fossil fuel use appears as a spike-like curve, rising from almost nothing to a high value, and then falling again to almost nothing in the space of a few centuries. When the two curves are plotted together, the explosive rise of global population is seen to be simultaneous with, and perhaps partially driven by, the rise of fossil fuel use. This raises the question of whether the world's population is headed for a crash when the fossil fuel era has ended.*

Optimum population in the distant future

What is the optimum population of the world? It is certainly not the maximum number that can be squeezed onto the globe by eradicating every species of plant and animal that cannot be eaten. The optimum global population is one that can be supported in comfort, equality and dignity - and with respect for the environment.

In 1848 (when there were just over one billion people in the world), John Stuart Mill described the optimal global population in the following words:

“The density of population necessary to enable mankind to obtain, in the greatest degree, all the advantages of cooperation and social intercourse, has, in the most populous countries, been attained. A population may be too crowded, although all be amply supplied with food and raiment.”

“... Nor is there much satisfaction in contemplating the world with noth-

ing left to the spontaneous activity of nature; with every rood of land brought into cultivation, which is capable of growing food for human beings; every flowery waste or natural pasture plowed up, all quadrupeds or birds which are not domesticated for man's use exterminated as his rivals for food, every hedgerow or superfluous tree rooted out, and scarcely a place left where a wild shrub or flower could grow without being eradicated as a weed in the name of improved agriculture. If the earth must lose that great portion of its pleasantness which it owes to things that the unlimited increase of wealth and population would extirpate from it, for the mere purpose of enabling it to support a larger, but not better or happier population, I sincerely hope, for the sake of posterity, that they will be content to be stationary, long before necessity compels them to it.”¹

Has the number of humans in the world already exceeded the earth's sustainable limits? Will the global population of humans crash catastrophically after having exceeded the carrying capacity of the environment? There is certainly a danger that this will happen - a danger that the 21st century will bring very large scale famines to vulnerable parts of the world, because modern energy-intensive agriculture will be dealt a severe blow by prohibitively high petroleum prices, and because climate change will reduce the world's agricultural output. When the major glaciers in the Himalayas have melted, they will no longer be able to give India and China summer water supplies; rising oceans will drown much agricultural land; and aridity will reduce the output of many regions that now produce much of the world's grain. Falling water tables in overdrawn aquifers, and loss of topsoil will add to the problem. We should be aware of the threat of a serious global food crisis in the 21st century if we are to have a chance of avoiding it.

The term *ecological footprint* was introduced by William Rees and Mathis Wackernagel in the early 1990's to compare demands on the environment with the earth's capacity to regenerate. In 2005, humanity used environmental resources at such a rate that it would take 1.3 earths to renew them. In other words, we have already exceeded the earth's carrying capacity. Since eliminating the poverty that characterizes much of the world today will require more resources per capita, rather than less. it seems likely that in the era beyond fossil fuels, the optimum global population will be considerably less than the present population of the world.

¹John Stuart Mill, *Principles of Political Economy, With Some of Their Applications to Social Philosophy*, (1848).

Population growth and the Green Revolution

Limitations on cropland

In 1944 the Norwegian-American plant geneticist Norman Borlaug was sent to Mexico by the Rockefeller Foundation to try to produce new wheat varieties that might increase Mexico's agricultural output. Borlaug's dedicated work on this project was spectacularly successful. He remained with the project for 16 years, and his group made 6,000 individual crossings of wheat varieties to produce high-yield disease-resistant strains.

In 1963, Borlaug visited India, bringing with him 100 kg. of seeds from each of his most promising wheat strains. After testing these strains in Asia, he imported 450 tons of the Lerma Rojo and Sonora 64 varieties - 250 tons for Pakistan and 200 for India. By 1968, the success of these varieties was so great that school buildings had to be commandeered to store the output. Borlaug's work began to be called a "Green Revolution". In India, the research on high-yield crops was continued and expanded by Prof. M.S. Swaminathan and his coworkers. The work of Green Revolution scientists, such Norman Borlaug and M.S. Swaminathan, has been credited with saving the lives of as many as a billion people.

Despite these successes, Borlaug believes that the problem of population growth is still a serious one. "Africa and the former Soviet republics", Borlaug states, "and the Cerrado², are the last frontiers. After they are in use, the world will have no additional sizable blocks of arable land left to put into production, unless you are willing to level whole forests, which you should not do. So, future food-production increases will have to come from higher yields. And though I have no doubt that yields will keep going up, whether they can go up enough to feed the population monster is another matter. Unless progress with agricultural yields remains very strong, the next century will experience human misery that, on a sheer numerical scale, will exceed the worst of everything that has come before."

With regard to the prospect of increasing the area of cropland, a report by the United Nations Food and Agricultural Organization (*Provisional Indicative World Plan for Agricultural Development*, FAO, Rome, 1970) states that "In Southern Asia,... in some countries of Eastern Asia, in the Near East and North Africa... there is almost no scope for expanding agricultural

² The Cerrado is a large savanna region of Brazil.



Figure 4.2: *Professor M.S. Swaminathan, father of the Green Revolution in India.*



Figure 4.3: *Norman Borlaug and agronomist George Harrer in 1943.*

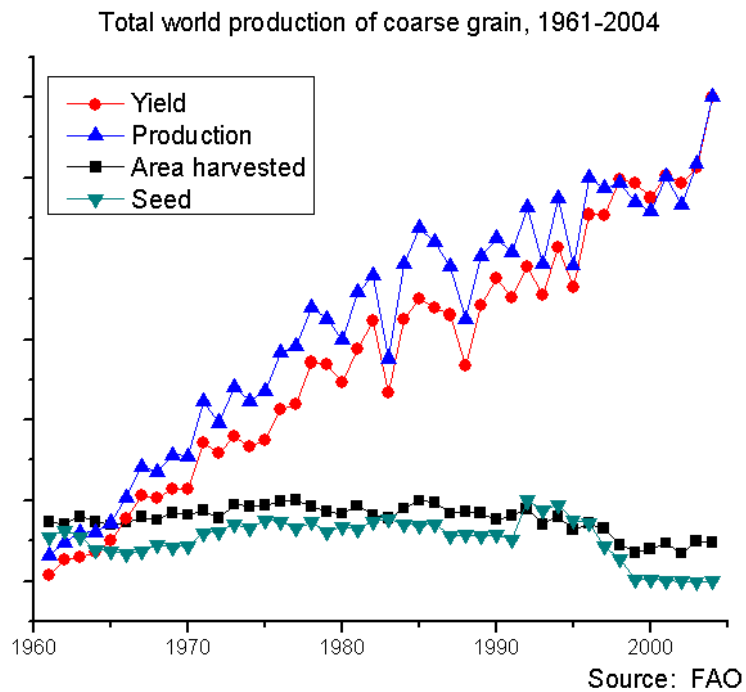


Figure 4.4: *This graph shows the total world production of coarse grain between 1960 and 2004. Because of high-yield varieties, the yield of grain increased greatly. Notice, however, that the land under cultivation remained almost constant. High-yield agriculture depends on large inputs of fossil fuel energy and irrigation, and may be difficult to maintain in the future.*

area... In the drier regions, it will even be necessary to return to permanent pasture the land that is marginal and submarginal for cultivation. In most of Latin America and Africa south of the Sahara, there are still considerable possibilities for expanding cultivated areas; but the costs of development are high, and it will often be more economical to intensify the utilization of areas already settled.” Thus there is a possibility of increasing the area of cropland in Africa south of the Sahara and in Latin America, but only at the cost of heavy investment and at the additional cost of destruction of tropical rain forests.

Rather than an increase in the global area of cropland, we may encounter a future loss of cropland through soil erosion, salination, desertification, loss of topsoil, depletion of minerals in topsoil, urbanization and failure of water supplies. In China and in the southwestern part of the United States, water tables are falling at an alarming rate. The Ogallala aquifer (which supplies water to many of the plains states in the central and southern parts of the United States) has a yearly overdraft of 160%.

In the 1950’s, both the U.S.S.R and Turkey attempted to convert arid grasslands into wheat farms. In both cases, the attempts were defeated by drought and wind erosion, just as the wheat farms of Oklahoma were overcome by drought and dust in the 1930’s.

If irrigation of arid lands is not performed with care, salt may be deposited, so that the land is ruined for agriculture. This type of desertification can be seen, for example, in some parts of Pakistan. Another type of desertification can be seen in the Sahel region of Africa, south of the Sahara. Rapid population growth in the Sahel has led to overgrazing, destruction of trees, and wind erosion, so that the land has become unable to support even its original population.

Especially worrying is a prediction of the International Panel on Climate Change concerning the effect of global warming on the availability of water: According to Model A1 of the IPCC, global warming may, by the 2050’s, have reduced by as much as 30% the water available in large areas of world that now are large producers of grain³.

Added to the agricultural and environmental problems, are problems of finance and distribution. Famines can occur even when grain is available somewhere in the world, because those who are threatened with starvation may not be able to pay for the grain, or for its transportation. The economic

³See the discussion of the Stern Report in Chapter 7.

laws of supply and demand are not able to solve this type of problem. One says that there is no “demand” for the food (meaning demand in the economic sense), even though people are in fact starving.

Energy-dependence of modern agriculture

Food prices and energy prices

A very serious problem with Green Revolution plant varieties is that they require heavy inputs of pesticides, fertilizers and irrigation. Because of this, the use of high-yield varieties contributes to social inequality, since only rich farmers can afford the necessary inputs. Monocultures, such as the Green Revolution varieties may also prove to be vulnerable to future epidemics of plant diseases, such as the epidemic that caused the Irish Potato Famine in 1845. Even more importantly, pesticides, fertilizers and irrigation all depend on the use of fossil fuels. One must therefore ask whether high agricultural yields can be maintained in the future, when fossil fuels are expected to become prohibitively scarce and expensive.

Modern agriculture has become highly dependent on fossil fuels, especially on petroleum and natural gas. This is especially true of production of the high-yield grain varieties introduced in the Green Revolution, since these require especially large inputs of fertilizers, pesticides and irrigation. Today, fertilizers are produced using oil and natural gas, while pesticides are synthesized from petroleum feedstocks, and irrigation is driven by fossil fuel energy. Thus agriculture in the developed countries has become a process where inputs of fossil fuel energy are converted into food calories. If one focuses only on the farming operations, the fossil fuel energy inputs are distributed as follows:

1. Manufacture of inorganic fertilizer, 31%
2. Operation of field machinery, 19%
3. Transportation, 16%
4. Irrigation, 13%
5. Raising livestock (not including livestock feed), 8%
6. Crop drying, 5%
7. Pesticide production, 5%
8. Miscellaneous, 8%

The ratio of the fossil fuel energy inputs to the food calorie outputs depends on how many energy-using elements of food production are included in the accounting. David Pimental and Mario Giampietro of Cornell University estimated in 1994 that U.S. agriculture required 0.7 kcal of fossil fuel energy inputs to produce 1.0 kcal of food energy. However, this figure was based on U.N. statistics that did not include fertilizer feedstocks, pesticide feedstocks, energy and machinery for drying crops, or electricity, construction and maintenance of farm buildings. A more accurate calculation, including these inputs, gives an input/output ratio of approximately 1.0. Finally, if the energy expended on transportation, packaging and retailing of food is included, Pimental and Giampietro found that the input/output ratio for the U.S. food system was approximately 10, and this figure did not include energy used for cooking.

The Brundtland Report's ⁴ estimate of the global potential for food production assumes "that the area under food production can be around 1.5 billion hectares (3.7 billion acres - close to the present level), and that the average yields could go up to 5 tons of grain equivalent per hectare (as against the present average of 2 tons of grain equivalent)." In other words, the Brundtland Report assumes an increase in yields by a factor of 2.5. This would perhaps be possible if traditional agriculture could everywhere be replaced by energy-intensive modern agriculture using Green Revolution plant varieties. However, Pimental and Giampietro's studies show that modern energy-intensive agricultural techniques cannot be maintained after fossil fuels have been exhausted.

At the time when the Brundtland Report was written (1987), the global average of 2 tons of grain equivalent per hectare included much higher yields from the sector using modern agricultural methods. Since energy-intensive petroleum-based agriculture cannot be continued in the post-fossil-fuel era, future average crop yields will probably be much less than 2 tons of grain equivalent per hectare.

The 1987 global population was approximately 5 billion. This population was supported by 3 billion tons of grain equivalent per year. After fossil fuels have been exhausted, the total world agricultural output is likely to be considerably less than that, and therefore the population that it will be

⁴ World Commission on Environment and Development, *Our Common Future*, Oxford University Press, (1987). This book is often called "The Brundtland Report" after Gro Harlem Brundtland, the head of WCED, who was then Prime Minister of Norway.

possible to support will probably be considerably less than 5 billion, assuming that our average daily per capita use of food calories remains the same, and assuming that the amount of cropland and pasturage remains the same (1.5 billion hectares cropland, 3.0 billion hectares pasturage).

The Brundtland Report points out that “The present (1987) global average consumption of plant energy for food, seed and animal feed amounts to 6,000 calories daily, with a range among countries of 3,000-15,000 calories, depending on the level of meat consumption.” Thus there is a certain flexibility in the global population that can survive on a given total agricultural output. If the rich countries were willing to eat less meat, more people could be supported.

Effects of climate change on agriculture

Effects of temperature increase on crops

There is a danger that when climate change causes both temperature increases and increased aridity in regions like the US grain belt, yields will be very much lowered. Of the three main grain types (corn, wheat and rice) corn is the most vulnerable to the direct effect of increases in temperature. One reason for this is the mechanism of pollination of corn: A pollen grain lands on one end of a corn-silk strand, and the germ cell must travel the length of the strand in order to fertilize the kernel. At high temperatures, the corn silk becomes dried out and withered, and is unable to fulfill its biological function. Furthermore, heat can cause the pores on the underside of the corn leaf to close, so that photosynthesis stops.

According to a study made by Mohan Wali and coworkers at Ohio State University, the photosynthetic activity of corn increases until the temperature reaches 20 degrees Celsius. It then remains constant until the temperature reaches 35 degrees, after which it declines. At 40 degrees and above, photosynthesis stops altogether.

Scientists in the Phillipines report that the pollination of rice fails entirely at 40 degrees Celsius, leading to crop failures. Wheat yields are also markedly reduced by temperatures in this range.

Predicted effects on rainfall

According to the Stern Report, some of the major grain-producing areas of the world might lose up to 30% of their rainfall by 2050. These regions include much of the United States, Brazil, the Mediterranean region, Eastern Russia and Belarus, the Middle East, Southern Africa and Australia. Of course possibilities for agriculture may simultaneously increase in other regions, but the net effect of climate change on the world's food supply is predicted to be markedly negative.

Unsustainable use of groundwater

It may seem surprising that fresh water can be regarded as a non-renewable resource. However, groundwater in deep aquifers is often renewed very slowly. Sometimes renewal requires several thousand years. When the rate of withdrawal of groundwater exceeds the rate of renewal, the carrying capacity of the resource has been exceeded, and withdrawal of water becomes analogous to mining a mineral. However, it is more serious than ordinary mining because water is such a necessary support for life.

In many regions of the world today, groundwater is being withdrawn faster than it can be replenished, and important aquifers are being depleted. In China, for example, groundwater levels are falling at an alarming rate. Considerations of water supply in relation to population form the background for China's stringent population policy.

At a recent lecture, Lester Brown of the Worldwatch Institute was asked by a member of the audience to name the resource for which shortages would most quickly become acute. Most of the audience expected him to name oil, but instead he replied "water". Lester Brown then cited China's falling water table. He predicted that within decades, China would be unable to feed itself. He said that this would not cause hunger in China itself: Because of the strength of China's economy, the country would be able to purchase grain on the world market. However Chinese purchases of grain would raise the price, and put world grain out of reach of poor countries in Africa. Thus water shortages in China will produce famine in parts of Africa, Brown predicted.

Under many desert areas of the world are deeply buried water tables formed during glacial periods when the climate of these regions was wetter. These regions include the Middle East and large parts of Africa. Water can be withdrawn from such ancient reservoirs by deep wells and pumping, but

only for a limited amount of time.

In oil-rich Saudi Arabia, petroenergy is used to drill wells for ancient water and to bring it to the surface. Much of this water is used to irrigate wheat fields, and this is done to such an extent that Saudi Arabia exports wheat. The country is, in effect, exporting its ancient heritage of water, a policy that it may, in time, regret. A similarly short-sighted project is Muammar Qaddafi's enormous pipeline, which will bring water from ancient sub-desert reservoirs to coastal cities of Libya.

In the United States, the great Ogallala aquifer is being overdrawn. This aquifer is an enormous stratum of water-saturated sand and gravel underlying parts of northern Texas, Oklahoma, New Mexico, Kansas, Colorado, Nebraska, Wyoming and South Dakota. The average thickness of the aquifer is about 70 meters. The rate of water withdrawal from the aquifer exceeds the rate of recharge by a factor of eight.

Thus we can see that in many regions, the earth's present population is living on its inheritance of water, rather than its income. This fact, coupled with rapidly increasing populations and climate change, may contribute to a food crisis partway through the 21st century.

Glacial melting and summer water supplies

The summer water supplies of both China and India are threatened by the melting of glaciers. The Gangotri glacier, which is the principle glacier feeding India's great Ganges River, is reported to be melting at an accelerating rate, and it could disappear within a few decades. If this happens, the Ganges could become seasonal, flowing only during the monsoon season.

Chinese agriculture is also threatened by disappearing Himalayan glaciers, in this case those on the Tibet-Qinghai Plateau. The respected Chinese glaciologist Yao Tandong estimates that the glaciers feeding the Yangtze and Yellow Rivers are disappearing at the rate of 7% per year.

The Indus and Mekong Rivers will be similarly affected by the melting of glaciers. Lack of water during the summer season could have a serious impact on the irrigation of rice and wheat fields.

Forest loss and climate change

Mature forests contain vast amounts of sequestered carbon, not only in their trees, but also in the carbon-rich soil of the forest floor. When a forest is



Figure 4.5: *Whitechuck Glacier in the North Cascades National Park in 1973.*



Figure 4.6: *The same glacier in 2006*

logged or burned to make way for agriculture, this carbon is released into the atmosphere. One fifth of the global carbon emissions are at present due to destruction of forests. This amount is greater than the CO₂ emissions for the world's transportation systems.

An intact forest pumps water back into the atmosphere, increasing inland rainfall and benefiting agriculture. By contrast, deforestation, for example in the Amazonian rainforest, accelerates the flow of water back into the ocean, thus reducing inland rainfall. There is a danger that the Amazonian rainforest may be destroyed to such an extent that the region will become much more dry. If this happens, the forest may become vulnerable to fires produced by lightning strikes. This is one of the feedback loops against which the Stern Report warns - the drying and burning of the Amazonian rainforest may become irreversible, greatly accelerating climate change, if destruction of the forest proceeds beyond a certain point.

Erosion of topsoil

Besides depending on an adequate supply of water, food production also depends on the condition of the thin layer of topsoil that covers the world's croplands. This topsoil is being degraded and eroded at an alarming rate: According to the World Resources Institute and the United Nations Environment Programme, "It is estimated that since World War II, 1.2 billion hectares... has suffered at least moderate degradation as a result of human activity. This is a vast area, roughly the size of China and India combined." This area is 27% of the total area currently devoted to agriculture ⁵. The report goes on to say that the degradation is greatest in Africa.

The risk of topsoil erosion is greatest when marginal land is brought into cultivation, since marginal land is usually on steep hillsides which are vulnerable to water erosion when wild vegetation is removed.

David Pimental and his associates at Cornell University pointed out in 1995 that "Because of erosion-associated loss of productivity and population growth, the per capita food supply has been reduced over the past 10 years and continues to fall. The Food and Agricultural Organization reports that the per capita production of grains which make up 80% of the world's food supply, has been declining since 1984."

⁵The total area devoted to agriculture throughout the world is 1.5 billion hectares of cropland and 3.0 billion hectares of pasturage.



Figure 4.7: *Two Soviet stamps supporting an anti-desertification campaign. The right-hand stamp shows desert regions of the world that are in danger of spreading.*

Pimental et al. add that “Not only is the availability of cropland per capita decreasing as the world population grows, but arable land is being lost due to excessive pressure on the environment. For instance, during the past 40 years nearly one-third of the world’s cropland (1.5 billion hectares) has been abandoned because of soil erosion and degradation. Most of the replacement has come from marginal land made available by removing forests. Agriculture accounts for 80% of the annual deforestation.”

Topsoil can also be degraded by the accumulation of salt when irrigation water evaporates. The worldwide area of irrigated land has increased from 8 million hectares in 1800 to more than 100 million hectares today. This land is especially important to the world food supply because it is carefully tended and yields are large in proportion to the area. To protect this land from salination, it should be irrigated in such a way that evaporation is minimized.

Finally cropland with valuable topsoil is being lost to urban growth and highway development, a problem that is made more severe by growing populations and by economic growth.

Laterization

Every year, more than 100,000 square kilometers of rain forest are cleared and burned, an area which corresponds to that of Switzerland and the Netherlands combined. Almost half of the world’s tropical forests have already



Figure 4.8: *A boy showing symptoms of kwashiorkor, a disease caused by inadequate intake of protein.*

been destroyed. Ironically, the land thus cleared often becomes unsuitable for agriculture within a few years.

Tropical soils may seem to be fertile when covered with luxuriant vegetation, but they are usually very poor in nutrients because of leeching by heavy rains. The nutrients which remain are contained in the vegetation itself; and when the forest cover is cut and burned, the nutrients are rapidly lost.

Often the remaining soil is rich in aluminum oxide and iron oxide. When such soils are exposed to oxygen and sun-baking, a rocklike substance called Laterite is formed. The temples of Angkor Wat in Cambodia are built of Laterite; and it is thought that laterization of the soil contributed to the disappearance of the Khmer civilization, which built these temples.

The demographic transition

The phrase “developing countries” is more than a euphemism; it expresses the hope that with the help of a transfer of technology from the industrialized nations, all parts of the world can achieve prosperity. Some of the forces that block this hope have just been mentioned. Another factor that prevents the achievement of worldwide prosperity is population growth.

The Stages of the Demographic Transition.

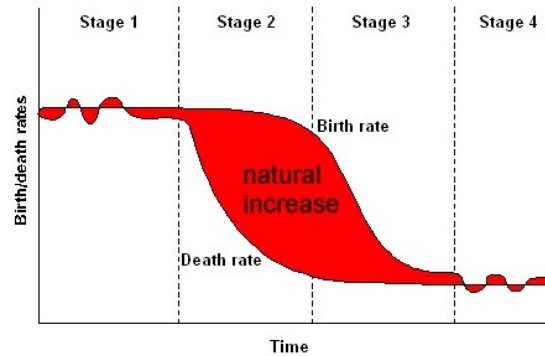


Figure 4.9: A schematic graph showing the demographic transition from an old equilibrium with a high birth rate and high death rate to a new equilibrium where both the birth rate and the death rate are low.

In the words of Dr. Halfdan Mahler, former Director General of the World Health Organization, “Country after country has seen painfully achieved increases in total output, food production, health and educational facilities and employment opportunities reduced or nullified by excessive population growth.”

The growth of population is linked to excessive urbanization, infrastructure failures and unemployment. In rural districts in the developing countries, family farms are often divided among a growing number of heirs until they can no longer be subdivided. Those family members who are no longer needed on the land have no alternative except migration to overcrowded cities, where the infrastructure is unable to cope so many new arrivals. Often the new migrants are forced to live in excrement-filled makeshift slums, where dysentery, hepatitis and typhoid are endemic, and where the conditions for human life sink to the lowest imaginable level. In Brazil, such shanty towns are called “favelas”.

If modern farming methods are introduced in rural areas while population growth continues, the exodus to cities is aggravated, since modern techniques are less labor-intensive and favor large farms. In cities, the development of adequate infrastructure requires time, and it becomes a hopeless task if populations are growing rapidly. Thus, population stabilization is a necessary

first step for development.

It can be observed that birth rates fall as countries develop. However, development is sometimes blocked by the same high birth rates that economic progress might have prevented. In this situation (known as the “demographic trap”), economic gains disappear immediately because of the demands of an exploding population.

For countries caught in the demographic trap, government birth control programs are especially important, because one cannot rely on improved social conditions to slow birth rates. Since health and lowered birth rates should be linked, it is appropriate that family-planning should be an important part of programs for public health and economic development.

A recent study conducted by Robert F. Lapham of Demographic Health Surveys and W. Parker Maudlin of the Rockefeller Foundation has shown that the use of birth control is correlated both with socio-economic setting and with the existence of strong family-planning programs. The implication of this study is that even in the absence of increased living standards, family-planning programs can be successful, provided they have strong government support.

China, the world’s most populous nation, has adopted the somewhat draconian policy of allowing only one child for families in living in towns and cities (35.9% of the population). Chinese leaders obtained popular support for their one-child policy by means of an educational program which emphasized future projections of diminishing water resources and diminishing cropland per person if population increased unchecked. Like other developing countries, China has a very young population, which will continue to grow even when fertility has fallen below the replacement level because so many of its members are contributing to the birth rate rather than to the death rate. China’s present population is 1.3 billion. Its projected population for the year 2025 is 1.5 billion. China’s one-child policy is supported by 75% of the country’s people, but the methods of enforcement are sometimes criticized, and it has led to a M/F sex ratio of 1.17/1.00. The natural baseline for the sex ratio ranges between 1.03/1.00 and 1.07/1.00.

Education of women and higher status for women are vitally important measures, not only for their own sake, but also because in many countries these social reforms have proved to be the key to lower birth rates. Religious leaders who oppose programs for the education of women and for family planning on “ethical” grounds should think carefully about the scope and consequences of the catastrophic global famine which will undoubtedly occur



Figure 4.10: *Education of women and higher status for women are vitally important measures, not only for their own sake, but also because these social reforms have proved to be the key to lower birth rates.*

within the next 50 years if population is allowed to increase unchecked. Do these leaders really wish to be responsible for the suffering and death from starvation of hundreds of millions of people?

At the United Nations Conference on Population and Development, held in Cairo in September, 1994, a theme which emerged very clearly was that one of the most important keys to controlling the global population explosion is giving women better education and equal rights. These goals are desirable for the sake of increased human happiness, and for the sake of the uniquely life-oriented point of view which women can give us; but in addition, education and improved status for women have shown themselves to be closely connected with lowered birth rates. When women lack education and independent careers outside the home, they can be forced into the role of baby-producing machines by men who do not share in the drudgery of cooking, washing and cleaning; but when women have educational, legal, economic, social and political equality with men, experience has shown that they choose to limit their families to a moderate size.

Sir Partha Dasgupta of Cambridge University has pointed out that the changes needed to break the cycle of overpopulation and poverty are all

desirable in themselves. Besides education and higher status for women, they include state-provided social security for old people, provision of water supplies near to dwellings, provision of health services to all, abolition of child labor and general economic development.

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Chapter 5

INTOLERABLE ECONOMIC INEQUALITY

“Every Night & every Morn,
Some to Misery are Born.
Every Night & every Morn,
Some are Born to sweet delight.
Some are Born to sweet delight,
Some are Born to Endless Night.”

William Blake

“Whatever happens, we have got
The Maxim gun, and they have not.”

Hilaire Belloc

Persistent effects of colonialism

The Industrial Revolution opened up an enormous gap in military strength between the industrialized nations and the rest of the world. Taking advantage of their superior weaponry, Europe, the United States and Japan rapidly carved up the remainder of the world into colonies, which acted as sources of raw materials and food, and as markets for manufactured goods. Between 1800 and 1914, the percentage of the earth under the domination of colonial powers increased to 85 percent, if former colonies are included.

The English economist and Fabian, John Atkinson Hobson (1858-1940), offered a famous explanation of the colonial era in his book “Imperialism: A Study” (1902). According to Hobson, the basic problem that led to colonial expansion was an excessively unequal distribution of incomes in the industrialized countries. The result of this unequal distribution was that neither the rich nor the poor could buy back the total output of their society. The incomes of the poor were insufficient, and rich were too few in number. The rich had finite needs, and tended to reinvest their money. As Hobson pointed out, reinvestment in new factories only made the situation worse by increasing output.

Hobson had been sent as a reporter by the Manchester Guardian to cover the Second Boer War. His experiences had convinced him that colonial wars have an economic motive. Such wars are fought, he believed, to facilitate investment of the excess money of the rich in African or Asian plantations and mines, and to make possible the overseas sale of excess manufactured goods. Hobson believed imperialism to be immoral, since it entails suffering both among colonial peoples and among the poor of the industrial nations. The cure that he recommended was a more equal distribution of incomes in the manufacturing countries.

Neocolonialism?

In his book, *Neocolonialism, The Last Stage of Imperialism* (Thomas Nielsen, London, 1965), Kwamail Nkrumah defined neocolonialism with the following words: “The essence of neocolonialism is that the State which is subject to it is, in theory independent, and has all the outward trappings of international sovereignty. In reality its economic system and thus its political policy is directed from the outside. The methods and form of this direction can take various shapes. For example, in an extreme case, the troops of the impe-



Figure 5.1: A late 19th century French cartoon showing England, Germany, Russia, France and Japan slicing up the pie of China.



Figure 5.2: A cartoon showing Cecil Rhodes' colonial ambitions for Africa. The thread in his hands represents a proposed Cape-Town-to-Cairo telegraph line. He wanted to "paint the map British red", and declared, "If I could, I would annex other planets."

rial power may garrison the territory of the neocolonial State and control the government of it. More often, however, neocolonial control is exercised through monetary means... The struggle against neocolonialism is not aimed at excluding the capital of the developed world from operating in less developed countries. It is aimed at preventing the financial power of the developed countries from being used in such a way as to impoverish the less developed.”

The resource curse

The way in which the industrialized countries maintain their control over less developed nations can be illustrated by the “resource curse”, i.e. the fact that resource-rich developing countries are no better off economically than those that lack resources, but are cursed with corrupt and undemocratic governments. This is because foreign corporations extracting local resources under unfair agreements exist in a symbiotic relationship with corrupt local officials.

One might think that taxation of foreign resource-extracting firms would provide developing countries with large incomes. However, there is at present no international law governing multinational tax arrangements. These are usually agreed to on a bilateral basis, and the industrialized countries have stronger bargaining powers in arranging the bilateral agreements.

Small arms and endemic conflict

Manufacture and export of small arms

Another important poverty-generating factor in the developing countries is war - often civil war. The five permanent members of the U.N. Security Council are, ironically, the five largest exporters of small arms. Small arms have a long life. The weapons poured into Africa by both sides during the Cold War are still there, and they contribute to political chaos and civil wars that block development and cause enormous human suffering.

The United Nations website on Peace and Security through Disarmament states that “Small arms and light weapons destabilize regions; spark, fuel and prolong conflicts; obstruct relief programmes; undermine peace initiatives; exacerbate human rights abuses; hamper development; and foster a ‘culture of violence’.”



Figure 5.3: *Ironically, the five permanent members of the UN Security Council are the world's largest exporters of small arms. These weapons cause enormous human misery by contributing to endemic conflicts and by blocking development.*

An estimated 639 million small arms and light weapons are in circulation worldwide, one for every ten people. Approximately 300,000 people are killed every year by these weapons, many of them women and children.

Examples of endemic conflict

In several regions of Africa, long-lasting conflicts have prevented development and caused enormous human misery. These regions include Ethiopia, Eritria, Somalia (Darfur), Chad, Zimbabwe and the Democratic Republic of Congo. In the Congo, the death toll reached 5.4 million in 2008, with most of the victims dying of disease and starvation, but with war as the root cause. In view of these statistics, the international community can be seen to have a strong responsibility to stop supplying small arms and ammunition to regions of conflict. There is absolutely no excuse for the large-scale manufacture and international sale of small arms that exists today.



Figure 5.4: *Sleeping on the street in Bogota.*



Figure 5.5: *An article on child mortality from starvation.*



Figure 5.6: *Men from Bathurst Island in Australia's Northern Territories. Indigenous people everywhere in the world are under great pressure from those who desire their land. Indigenous cultures and languages are in danger of being lost.*

The plight of indigenous peoples

Readers of Charles Darwin's book describing *The Voyage of the Beagle* will remember his horrifying account of General Rosas' genocidal war against the Amerind population of Argentina. Similar genocidal violence has been experienced by indigenous peoples throughout South and Central America, and indeed throughout the world. In general, the cultures of indigenous peoples require much land, and greed for this land is the motive for violence against them. However, the genetic and cultural heritage of indigenous peoples can potentially be of enormous value to humanity, and great efforts should be made to protect them.

The resurgence of infectious disease

Tropical diseases

Endemic disease is strongly linked to poverty. Great improvements in reducing the effects of diseases like HIV/AIDS, malaria, shistosomiasis, trichoniosis, and river blindness could be made if pharmaceutical companies could be induced to do more research on tropical diseases and to provide drugs to developing countries at affordable prices. Other important measures would be universal vaccination programs, and the provision of safe water to all. It is in the interests of developed countries to promote health in the developing world, because air travel can quickly spread epidemics from one region to another.

HIV/AIDS

In 2004, there were approximately 39.4 million people living with HIV, 4.9 million new HIV infections, and 3.1 million deaths due to AIDS. It is estimated that in five populous countries, Nigeria, Ethiopia, Russia, India and China, the number of people infected with HIV/AIDS will grow from 14-23 million currently to 50-75 million by 2010. 95% of those living with HIV/AIDS do not know that they are infected with the disease.

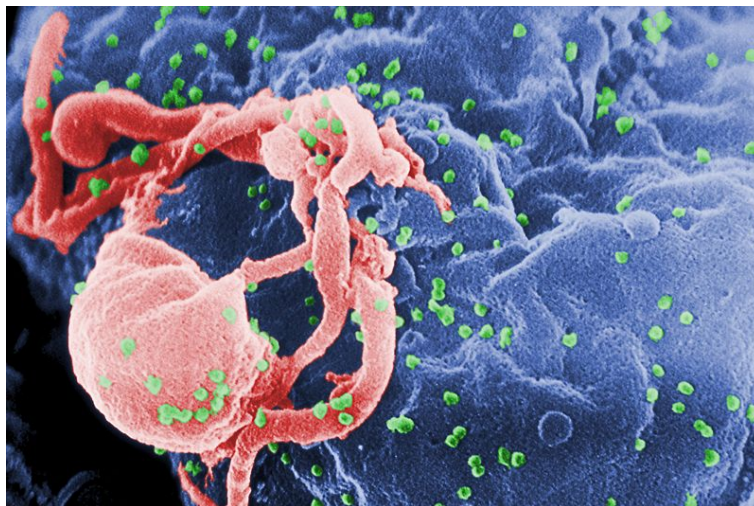


Figure 5.7: A scanning electron microphotograph showing *HIV-1* virus budding from a lymphocyte.

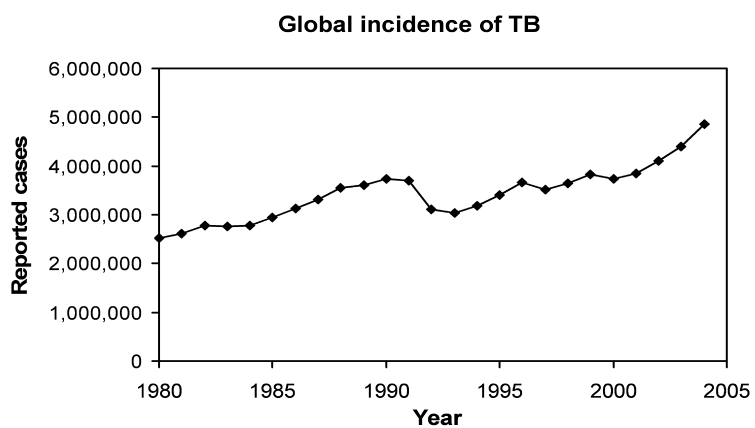


Figure 5.8: Number of new reported cases of tuberculosis (from WHO data). The number of new cases doubled between 1980 and 2005.

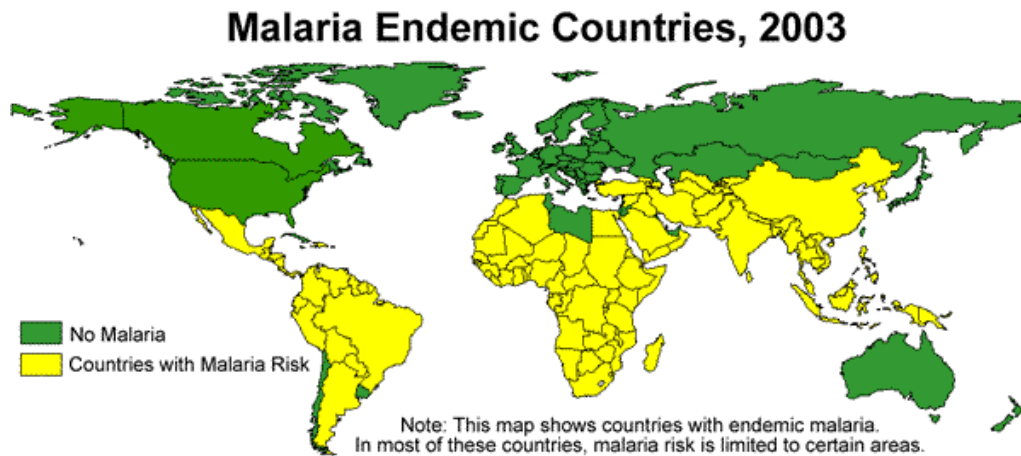


Figure 5.9: *Countries with endemic malaria.*

Tuberculosis

Approximately 2 billion people (one third of the world's population!) are infected with TB, often in a latent form. 90% of the burden of TB falls on the developing countries; on India alone, 30%. Roughly 2 million people die from TB each year. It is the number one killer of women of childbearing age.

Malaria

Every year there are 300 million cases of malaria, and it causes about one million deaths. There are roughly 10 new cases of malaria every second, 90% of which are in Africa. A quarter of all childhood deaths in Africa are due to malaria.

North-South relationships

Adverse effects of globalization

Today, economic globalization aims at increased trade throughout the world. At first sight, this might seem to be a benefit. However, laws preventing the exploitation of labor are not universal. The same unspeakable conditions experienced by workers in factories and mines during the early phases of the Industrial Revolution in Europe can be found today among factory workers in

Indonesia or children weaving oriental carpets in Pakistan; and it is estimated that in India alone there are 80,000,000 child laborers.

In many developing countries today, industrialization involves slave-like working conditions. Meanwhile, in the industrialized countries, workers may lose their jobs because they cannot compete with underpaid labor in the Third World. Large multinational corporations are tending to move their operations to regions where salaries and living standards are very low.

For free trade to be truly beneficial to all the peoples of the world, universal laws must be established to regulate business and industry globally, and to ensure that multinationals act in a way that is both socially and ecologically responsible. Adam Smith advocated complete freedom from governmental restraint, but the history of the Industrial Revolution demonstrates the need for regulatory social legislation. The historical perspective makes it clear that laws establishing minimum wage levels and laws prohibiting child labor are needed to avoid horrors such as those described by John Fielden in "The Curse of the Factory System". Today, birth control is also necessary on a global scale, just as it once was needed in England, to raise workers above the starvation level. Finally, unions must be permitted everywhere in the world. If trade is globalized, the hard-won reforms achieved by Francis Place, Annie Besant the Fabians and others must also be globalized.

The story of globalization has until now been a story of escape from regulatory legislation. For example, many Danish farmers have moved their operations to Poland or to the Baltic nations in order to escape from Denmark's strict environmental regulations. Another example is escape from taxation: One might think that taxation of foreign resource-extracting firms would provide developing countries with large incomes. However, there is at present no international law governing multinational tax arrangements. These are usually agreed to on a bilateral basis, and the industrialized countries have stronger bargaining powers in arranging the bilateral agreements. As a result, such agreements are usually very unfair, and multinationals escape all but the mildest taxation.

We can also consider the "non-discrimination" principle adopted by GATT (the General Agreement on Tariffs and Trade). This principle states that participating countries "cannot discriminate between like products on the basis of the method of production". This single principle allows multinational commerce to escape from all the humanitarian and environmental reforms that have been achieved since the start of the Industrial Revolution. No matter if the method of production involves destruction of a tropical rain forest, no

matter if forced labor was used, we are not allowed to discriminate “on the basis of the method of production”.

The present situation is that agriculture, trade and industry have become global, but the world still lacks adequate institutions at the global level to watch over what is happening and to insure respect for human needs and respect for the natural environment.

Today’s global economic interdependence, instantaneous worldwide communication, and the need for peaceful resolution of international conflicts all call for strong governmental institutions at the global level, but the United Nations today lacks many things that would be necessary if it is to perform such a role: It lacks a legislature with the power to make laws binding on individuals and corporations. It lacks mechanisms for enforcing such laws. And it lacks a large and dependable source of income.

It would be logical to improve the United Nations by giving it the things just mentioned, and by giving it at the same time the task of regulating multinational corporations to ensure that they act in a socially and ecologically responsible manner. It would also be logical to entitle the UN to a fee for acting as a referee in relationships between multinationals and the developing countries. These reforms must come someday because of the logic of our present situation, and I hope that they will come soon.

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Chapter 6

THE THREAT OF NUCLEAR WAR

“The unleashed power of the atom has changed everything except our ways of thinking, and thus we drift towards unparalleled catastrophes.”

“I don’t know what will be used in the next world war, but the 4th will be fought with stones.”

Albert Einstein



Figure 6.1: *Pablo Picasso's painting "Guernica", commemorating the Basque town destroyed by Nazi bombing in 1937.*



Figure 6.2: *Saint Paul's Cathedral during the London Blitz. Determined firefighting by citizens saved the cathedral from burning,*



Figure 6.3: *A view of Dresden after the firebombing with a statue of “Goodness” in the foreground.*

Targeting civilians

The erosion of ethical principles during World War II

When Hitler invaded Poland in September, 1939, US President Franklin Delano Roosevelt appealed to Great Britain, France, and Germany to spare innocent civilians from terror bombing. “The ruthless bombing from the air of civilians in unfortified centers of population during the course of the hostilities”, Roosevelt said (referring to the use of air bombardment during World War I) “...has sickened the hearts of every civilized man and woman, and has profoundly shocked the conscience of humanity.” He urged “every Government which may be engaged in hostilities publicly to affirm its determination that its armed forces shall in no event, and under no circumstances, undertake the bombardment from the air of civilian populations or of unfortified cities.”

Two weeks later, British Prime Minister Neville Chamberlain responded to Roosevelt’s appeal with the words: “Whatever the lengths to which others may go, His Majesty’s Government will never resort to the deliberate attack on women and children and other civilians for purposes of mere terrorism.”

Much was destroyed during World War II, and among the casualties of the war were the ethical principles that Roosevelt and Chamberlain announced at its outset. At the time of Roosevelt and Chamberlain’s declarations, terror bombing of civilians had already begun in the Far East. On 22 and 23 September, 1937, Japanese bombers attacked civilian populations in Nanjing and Canton. The attacks provoked widespread protests. The British Under Secretary of State for Foreign Affairs, Lord Cranborne, wrote: “Words cannot express the feelings of profound horror with which the news of these raids has been received by the whole civilized world. They are often directed against places far from the actual area of hostilities. The military objective, where it exists, seems to take a completely second place. The main object seems to be to inspire terror by the indiscriminate slaughter of civilians...”

On the 25th of September, 1939, Hitler’s air force began a series of intense attacks on Warsaw. Civilian areas of the city, hospitals marked with the Red Cross symbol, and fleeing refugees all were targeted in a effort to force the surrender of the city through terror. On the 14th of May, 1940, Rotterdam was also devastated. Between the 7th of September 1940 and the 10th of May 1941, the German Luftwaffe carried out massive air attacks on targets in Britain. By May, 1941, 43,000 British civilians were killed and more than

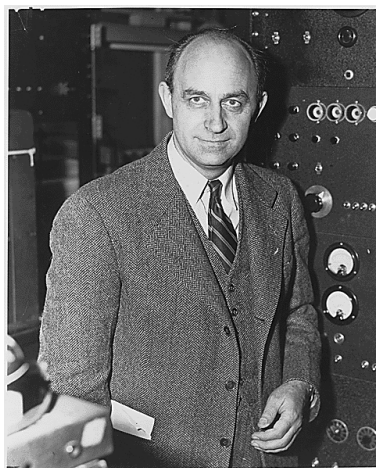


Figure 6.4: *Enrico Fermi (1901–1954). In 1934, he and his team of young Italian physicists split uranium atoms without realizing it.*

a million houses destroyed.

By the end of the war the United States and Great Britain were bombing of civilians on a far greater scale than Japan and Germany had ever done. For example, on July 24-28, 1943, British and American bombers attacked Hamburg with an enormous incendiary raid whose official intention was “the total destruction” of the city.

The result was a firestorm that did, if fact, lead to the total destruction of the city. One airman recalled, that “As far as I could see was one mass of fire. ‘A sea of flame’ has been the description, and that’s an understatement. It was so bright that I could read the target maps and adjust the bomb-sight.” Another pilot was “...amazed at the awe-inspiring sight of the target area. It seemed as though the whole of Hamburg was on fire from one end to the other and a huge column of smoke was towering well above us - and we were on 20,000 feet! It all seemed almost incredible and, when I realized that I was looking at a city with a population of two millions, or about that, it became almost frightening to think of what must be going on down there in Hamburg.”

Below, in the burning city, temperatures reached 1400 degrees Fahrenheit, a temperature at which lead and aluminum have long since liquefied. Powerful winds sucked new air into the firestorm. There were reports of babies being torn by the high winds from their mothers’ arms and sucked into

the flames. Of the 45,000 people killed, it has been estimated that 50 percent were women and children and many of the men killed were elderly, above military age. For weeks after the raids, survivors were plagued by "...droves of vicious rats, grown strong by feeding on the corpses that were left unburied within the rubble as well as the potatoes and other food supplies lost beneath the broken buildings."

The German cities Kassel, Pforzheim, Mainz, Dresden and Berlin were similarly destroyed, and in Japan, US bombing created firestorms in many cities, for example Tokyo, Kobe and Yokohama. In Tokyo alone, incendiary bombing caused more than 100,000 civilian casualties.

The Manhattan Project

Fermi, Hahn, Meitner and Frisch

The first indication that nuclear weapons might be possible came in 1896 with the discovery of radioactivity by the French physicist Henri Becquerel. He observed that compounds of uranium emitted a strange radiation that was able to darken a photographic plate even though the plate was wrapped in an opaque covering. Becquerel was able to show that the radiation had nothing to do with chemical reactions. It was a phenomenon of the nuclei of the uranium atoms.

Two of the most basic assumptions of classical physics were challenged by Becquerel's discovery - the indivisibility of the atom and the conservation of energy. Later studies indicated that in radioactive decay, mass was being converted to energy, the equivalence being given by Einstein's famous formula, $E = mc^2$.

By 1917, the English physicist Ernest Rutherford was able to produce artificial nuclear transmutations of elements by bombarding them with the alpha particles (helium nuclei) that are thrown off at high velocity by radioactive elements such as uranium or radium. For example, in one of Rutherford's experiments a nitrogen nucleus absorbed an alpha particle and later emitted a proton, thus becoming a nucleus of oxygen, one place higher in the periodic system.

Only light nuclei could be bombarded using Rutherford's method. The charges on the nuclei of heavy elements were so large that the alpha particles were too strongly repelled. The splitting of nuclei was thought to be

impossible. However, in 1932, a new elementary particle - the neutron - was discovered by Rutherford's assistant, James Chadwick. Since it had no charge, the neutron was not repelled by the large charges of heavy nuclei. In Italy, Enrico Fermi tried bombarding all the elements of the periodic system with Chadwick's newly-discovered neutrons, and in 1934 he unwittingly split the uranium atom.

The fact that Fermi had actually split uranium nuclei by bombarding them with neutrons became clear in 1938 through the work of Otto Hahn in Germany and studies by O.R. Frisch and Lise Meitner in Sweden and Denmark. By consulting tables of the weights of isotopes and using Einstein's relation, $E = mc^2$, Frisch and Meitner were also able to show that when a single uranium nucleus is split, 200,000,000 electron volts of energy are released. Thus in nuclear fission, roughly a hundred million times as much energy is released as in an ordinary chemical reaction.

Experiments performed by Frisch at Niels Bohr's laboratory in Copenhagen observed the giant pulses of ionization produced by fission fragments rushing apart with enormous kinetic energies inside a Geiger counter. Later experiments by Fermi and others showed that the fission of a uranium nucleus not only releases enormous amounts of energy, but also several neutrons. Thus it became clear to physicists in both Europe and America that in principle it would be possible to construct enormously powerful nuclear bombs utilizing nuclear chain reactions.

Bohr and Wheeler

A paper published in 1939 by Niels Bohr and John A. Wheeler indicated that it was the rare isotope of uranium, U-235, that undergoes fission. A bomb could be constructed if enough highly enriched U-235 could be isolated from the more common isotope, U-238.¹ Calculations showed that the "critical mass" of highly enriched uranium needed is quite small - only a few kilograms.

¹Uranium has atomic number 92, i.e., a neutral uranium atom has a nucleus containing 92 positively-charged protons, around which 92 negatively-charged electrons circle. All of the isotopes of uranium have the same number of protons and electrons, and hence the same chemical properties, but they differ in the number of neutrons in their nuclei. For example, the nucleus of U-235 has 143 neutrons, while that of U-238 has 146. This means that U-238 is slightly heavier than U-235. If the two isotopes are to be separated, difficult physical methods dependent on mass must be used, since their chemical properties are identical.

Meanwhile night was falling on Europe. In 1929, an economic depression had begun in the United States and had spread to Europe. Without the influx of American capital, the postwar reconstruction of the German economy collapsed. The German middle class, which had been dealt a severe blow by the great inflation of 1923, now received a second heavy blow. The desperation produced by economic chaos drove German voters into the hands of political extremists.

On January 30, 1933, Adolf Hitler was appointed Chancellor and leader of a coalition cabinet by President Hindenburg. Although Hitler was appointed legally to this post, he quickly consolidated his power by unconstitutional means: On May 2, Hitler's police seized the headquarters of all trade unions, and arrested labor leaders. The Communist and Socialist parties were also banned, their assets seized and their leaders arrested. Other political parties were also smashed. Acts were passed eliminating Jews from public service; and innocent Jewish citizens were boycotted, beaten and arrested. On March 11, 1938, Nazi troops entered Austria.

On March 16, 1939, the same day that Bohr and Wheeler mailed their paper on uranium to a journal, Enrico Fermi (who by then was a refugee in America) went to Washington to inform the Office of Naval Operations that it might be possible to construct an atomic bomb; and on the same day, German troops poured into Czechoslovakia.

A few days later, a meeting of six German atomic physicists was held in Berlin to discuss the applications of uranium fission. Otto Hahn, the discoverer of fission, was not present, since it was known that he was opposed to the Nazi regime. He was even said to have exclaimed: "I only hope that you physicists will never construct a uranium bomb! If Hitler ever gets a weapon like that, I'll commit suicide."

The meeting of German atomic physicists was supposed to be secret; but one of the participants reported what had been said to Dr. S. Flügge, who wrote an article about uranium fission and about the possibility of a chain reaction. Flügge's article appeared in the July issue of *Naturwissenschaften*, and a popular version of it was printed in the *Deutsche Allgemeine Zeitung*. These articles greatly increased the alarm of American atomic scientists, who reasoned that if the Nazis permitted so much to be printed, they must be far advanced on the road to building an atomic bomb.

Einstein writes to Roosevelt

In the summer of 1939, while Hitler was preparing to invade Poland, alarming news reached the physicists in the United States: A second meeting of German atomic scientists had been held in Berlin, this time under the auspices of the Research Division of the German Army Weapons Department. Furthermore, Germany had stopped the sale of uranium from mines in Czechoslovakia.

The world's most abundant supply of uranium, however, was not in Czechoslovakia, but in Belgian Congo. Leo Szilard, a refugee Hungarian physicist who had worked with Fermi to measure the number of neutrons produced in uranium fission, was deeply worried that the Nazis were about to construct atomic bombs; and it occurred to him that uranium from Belgian Congo should not be allowed to fall into their hands.

Szilard knew that his former teacher, Albert Einstein, was a personal friend of Elizabeth, the Belgian Queen Mother. Einstein had met Queen Elizabeth and King Albert of Belgium at the Solvay Conferences, and mutual love of music had cemented a friendship between them. When Hitler came to power in 1933, Einstein had moved to the Institute of Advanced Studies at Princeton; and Szilard decided to visit him there. Szilard reasoned that because of Einstein's great prestige, and because of his long-standing friendship with the Belgian Royal Family, he would be the proper person to warn the Belgians not to let their uranium fall into the hands of the Nazis.

Einstein agreed to write to the Belgian king and queen. On August 2, 1939, Szilard again visited Einstein, accompanied by Edward Teller and Eugene Wigner, who (like Szilard) were refugee Hungarian physicists. By this time, Szilard's plans had grown more ambitious; and he carried with him the draft of another letter, this time to the American President, Franklin D. Roosevelt. Einstein made a few corrections, and then signed the fateful letter, which reads (in part) as follows:

"Some recent work of E. Fermi and L. Szilard, which has been communicated to me in manuscript, leads me to expect that the element uranium may be turned into an important source of energy in the immediate future. Certain aspects of the situation seem to call for watchfulness and, if necessary, quick action on the part of the Administration. I believe, therefore, that it is my duty to bring to your attention the following.."

"It is conceivable that extremely powerful bombs of a new type may be constructed. A single bomb of this type, carried by boat and exploded in

a port, might very well destroy the whole port, together with some of the surrounding territory..”

“I understand that Germany has actually stopped the sale of uranium from Czechoslovakian mines which she has taken over. That she should have taken such an early action might perhaps be understood on the ground that the son of the German Under-Secretary of State, von Weizäcker, is attached to the Kaiser Wilhelm Institute in Berlin, where some of the American work is being repeated.”

On October 11, 1939, three weeks after the defeat of Poland, Roosevelt’s economic adviser, Alexander Sachs, personally delivered the letter to the President. After discussing it with Sachs, the President commented, “This calls for action.” Later, when atomic bombs were dropped on civilian populations in an already virtually-defeated Japan, Einstein bitterly regretted having signed the letter to Roosevelt.

The first nuclear reactor

As a result of Einstein’s letter, President Roosevelt set up an advisory Committee on Uranium. On December 6, 1941, the day before the Japanese attack on Pearl Harbor, the Committee decided to make an all-out effort to develop atomic energy and atomic bombs. This decision was based in part on intelligence reports indicating that the Germans had set aside a large section of the Kaiser Wilhelm Institute for Research on uranium; and it was based in part on promising results obtained by Enrico Fermi’s group at Columbia University.

Fermi soon moved to the University of Chicago, and on December 2, 1942, he and his coworkers produced a world’s first controlled chain reaction within a pile of cans containing ordinary (nonenriched) uranium powder, separated by blocks of very pure graphite. The graphite moderator slowed the neutrons, making them more effective. The chain-reacting pile had a double significance: It represented a new source of energy for mankind, but at the same time it represented an easy path to nuclear weapons, since one of the by-products of the reaction was a fissionable isotope of plutonium, Pu-239.

According to the Bohr-Wheeler theory, it was predicted that Pu-239 should be just as fissionable as U-235. Instead of trying to separate the rare isotope, U-235, from the common isotope, U-238, physicists could just operate a nuclear reactor until a sufficient amount of Pu-239 accumulated,

and then separate it out by ordinary chemical means.

This was done on a very large scale by the Dupont chemical company. Four large chain-reacting piles were built beside the Colombia River at Hanford, Washington. Cold water from the river was allowed to flow through the piles to carry away the heat.

An alternative method for producing atomic bombs was to separate the rare fissionable isotope of uranium from the common isotope. Three different methods for isotope separation seemed possible: One could make a gaseous compound of uranium and allow it to diffuse through a porous barrier. (The lighter isotope would diffuse slightly faster.) Alternatively, one could use a high-speed gas centrifuge; or one could separate the isotopes in a mass spectrograph.

All three methods of isotope separation were tried, and all proved successful. A huge plant to carry out the gaseous separation methods was constructed at Oak Ridge Tennessee; and at the University of California in Berkeley, Ernest O. Lawrence and his group converted the new giant cyclotron into a mass spectrograph. Ultimately, 150,000 people were working at Hanford, Oak Ridge and Berkeley, producing material for atomic bombs. Of these, only a few knew the true purpose of the work in which they were engaged. In addition, a secret laboratory for the actual construction of atomic bombs was established at Los Alamos New Mexico under the direction of J. Robert Oppenheimer.

As time passed, many of the scientists at Los Alamos, including Niels Bohr, became deeply worried about the ethical aspects of work on the atomic bomb. When the project had first begun, everyone was sure that the Germans had a great lead in the development of nuclear weapons. They were convinced that the only way to save civilization from the threat of Nazi atomic bombs would be to have a counter-threat. In 1944, however, as the Allied invasion of Europe began, and no German atomic bombs appeared, this dogma seemed less certain.

Unfortunately, it was too late for the scientists to stop the machine which they themselves had set in motion. President Franklin Roosevelt might have stopped the use of the bomb; but in August, 1945, he was dead. On his desk, unread, lay letters from Albert Einstein and Leo Szilard - the same men who had written to Roosevelt six years previously, thus initiating the American atomic bomb project. In 1945, both Einstein and Szilard wrote again to Roosevelt, this time desperately urging him not to use nuclear weapons against Japan; but their letters arrived too late.

In Roosevelt's place was a new President, Harry Truman, who had been in office only a few weeks. He came from a small town in Missouri; and he was shocked to find himself suddenly thrust into a position of enormous power. He was overwhelmed with new responsibilities, and was cautiously feeling his way. Until Roosevelt's death he had known nothing whatever about the atomic bomb project; and he therefore had little chance to absorb its full meaning.

By contrast, General Leslie Groves, the military commander of the bomb project, was very sure of himself; and he was determined to use atomic bombs against Japan. General Groves had supervised the spending of two billion dollars of the American taxpayers' money. He was anxious to gain credit for winning the war, rather than to be blamed for the money's misuse.

Under these circumstances, it is understandable that Truman did nothing to stop the use of the atomic bomb. In General Groves' words, "Truman did not so much say 'yes', as not say 'no'. It would, indeed, have taken a lot of nerve to say 'no' at that time."

Nuclear insanity

Hiroshima and Nagasaki

On August 6, 1945, at 8:15 in the morning, an atomic bomb was exploded in the air over Hiroshima. The force of the explosion was equivalent to twenty thousand tons of T.N.T.. Out of a city of two hundred and fifty thousand people, almost one hundred thousand were killed by the bomb; and another hundred thousand were hurt.

In some places, near the center of the city, people were completely vaporized, so that only their shadows on the pavement marked the places where they had been. Many people who were not killed by the blast or by burns from the explosion, were trapped under the wreckage of their houses. Unable to move, they were burned to death in the fire which followed.

Some accounts of the destruction of Hiroshima, written by children who survived it, have been collected by Professor Arata Osada. Among them is the following account, written by a boy named Hisato Ito. He was 11 years old when the atomic bomb was exploded over the city:

"On the morning of August 5th (we went) to Hiroshima to see my brother, who was at college there. My brother spent the night with us in a hotel... On

the morning of the 6th, my mother was standing near the entrance, talking with the hotel proprietor before paying the bill, while I played with the cat. It was then that a violent flash of blue-white light swept in through the doorway.”

“I regained consciousness after a little while, but everything was dark. I had been flung to the far end of the hall, and was lying under a pile of debris caused by the collapse of two floors of the hotel. Although I tried to crawl out of this, I could not move. The fine central pillar, of which the proprietor was so proud, lay flat in front of me. ”

“I closed my eyes and was quite overcome, thinking that I was going to die, when I heard my mother calling my name. At the sound of her voice, I opened my eyes; and then I saw the flames creeping close to me. I called frantically to my mother, for I knew that I should be burnt alive if I did not escape at once. My mother pulled away some burning boards and saved me. I shall never forget how happy I felt at that moment - like a bird let out of a cage.”

“Everything was so altered that I felt bewildered. As far as my eyes could see, almost all the houses were destroyed and on fire. People passed by, their bodies red, as if they had been peeled. Their cries were pitiful. Others were dead. It was impossible to go farther along the street on account of the bodies, the ruined houses, and the badly wounded who lay about moaning. I did not know what to do; and as I turned to the west, I saw that the flames were drawing nearer..”

“At the water’s edge, opposite the old Sentai gardens, I suddenly realized that I had become separated from my mother. The people who had been burned were plunging into the river Kobashi, and then were crying out: ‘It’s hot! It’s hot!’ They were too weak to swim, and they drowned while crying for help.”

In 1951, shortly after writing this account, Hisato Ito died of radiation sickness. His mother died soon afterward from the same cause.

The postwar nuclear arms race

When the news of the atomic bombing of Hiroshima and Nagasaki reached Albert Einstein, his sorrow and remorse were extreme. During the remainder of his life, he did his utmost to promote the cause of peace and to warn humanity against the dangers of nuclear warfare. Together with Bertrand Russell and Joseph Rotblat he helped to found Pugwash Conferences on



Figure 6.5: *Hiroshima*

Science and World Affairs (Nobel Peace Prize 1995), an organization of scientists and other scholars devoted to world peace and to the abolition of nuclear weapons.

When Otto Hahn, the discoverer of fission, heard the news of the destruction of Hiroshima, he and nine other German atomic scientists were being held prisoner at an English country house near Cambridge. Hahn became so depressed that his colleagues feared that he would take his own life.

World public opinion was also greatly affected by the indiscriminate destruction of human life in Hiroshima and Nagasaki. Shortly after the bombings, the French existentialist author Albert Camus wrote: “Our technical civilization has just reached its greatest level of savagery. We will have to choose, in the more or less near future, between collective suicide and the intelligent use of our scientific conquests. Before the terrifying prospects now available to humanity, we see even more clearly that peace is the only battle worth waging. This is no longer a prayer, but a demand to be made by all peoples to their governments - a demand to choose definitively between hell and reason.”

Among the scientists who had worked at Chicago and Los Alamos, there was relief that the war was over; but as descriptions of Hiroshima and Nagasaki became available there were also sharp feelings of guilt. Many scientists who had worked on the bomb project made great efforts to persuade the governments of the United States, England and the Soviet Union to agree to international control of atomic energy; but these efforts met with failure;



Figure 6.6: *Hiroshima*. In the central part of the city, the only building left standing was this domed structure. It has been preserved as a memorial of the tragedy.

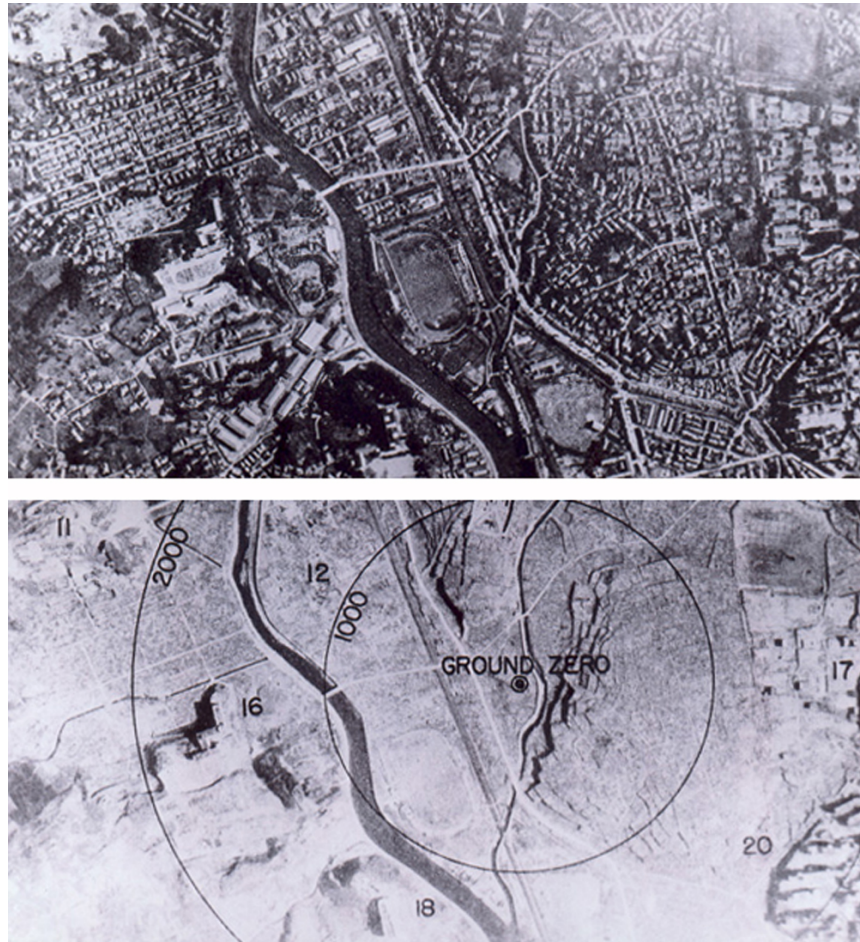


Figure 6.7: *Nagasaki before and after the nuclear explosion.*

and the nuclear arms race developed with increasing momentum.

In 1946, the United States proposed the Baruch Plan to internationalize atomic energy, but the plan was rejected by the Soviet Union, which had been conducting its own secret nuclear weapons program since 1943. On August 29, 1949, the USSR exploded its first nuclear bomb. It had a yield equivalent to 21,000 tons of TNT, and had been constructed from Pu-239 produced in a nuclear reactor. Meanwhile the United Kingdom had begun to build its own nuclear weapons.

The explosion of the Soviet nuclear bomb caused feelings of panic in the United States, and President Truman authorized an all-out effort to build



Figure 6.8: *The photograph shows a hydrogen bomb exploded near the island of Enewetak in the South Pacific in 1952. The explosive force of the bomb was 500 times greater than the bombs that destroyed Hiroshima and Nagasaki. The Soviet Union tested its first hydrogen bomb in 1953. In March, 1954, the US tested another hydrogen bomb at the Bikini Atoll in the Pacific Ocean. It was 1000 times more powerful than the Hiroshima bomb. The Japanese fishing boat, Lucky Dragon, was 130 kilometers from the Bikini explosion, but radioactive fallout from the test killed one crew member and made all the others seriously ill. In England, Prof. Joseph Rotblat, a Polish scientist who had resigned from the Manhattan Project for moral reasons when it became clear that Germany would not develop nuclear weapons, was asked to appear on a BBC program to discuss the Bikini test. He was asked to discuss the technical aspects of H-bombs, while the Archbishop of Canterbury and the philosopher Lord Bertrand Russell were asked to discuss the moral aspects. Rotblat had become convinced that the Bikini bomb must have involved a third stage, where fast neutrons from the hydrogen thermonuclear reaction produced fission in a casing of ordinary uranium. Such a bomb would produce enormous amounts of highly dangerous radioactive fallout, and Rotblat became extremely worried about the possibly fatal effect on all living things if large numbers of such bombs were ever used in a war. He confided his worries to Bertrand Russell, whom he had met on the BBC program.*



Figure 6.9: *After discussing the Bikini test and its radioactive fallout with Joseph Rotblat, Lord Russell became concerned for the future of the human gene pool if large numbers of such bombs should ever be used in a war. To warn humanity of the danger, he wrote what came to be known as the Russell-Einstein Manifesto. On July 9, 1955, with Rotblat in the chair, Russell read the Manifesto to a packed press conference. The document contains the words: “Here then is the problem that we present to you, stark and dreadful and inescapable: Shall we put an end to the human race, or shall mankind renounce war?... There lies before us, if we choose, continual progress in happiness, knowledge and wisdom. Shall we, instead, choose death because we cannot forget our quarrels? We appeal as human beings to human beings: Remember your humanity, and forget the rest. If you can do so, the way lies open to a new Paradise; if you cannot, there lies before you the risk of universal death.” Lord Russell devoted much of the remainder of his life to working for the abolition of nuclear weapons. Here he is seen in 1962 in Trafalgar Square, London, addressing a meeting of the Campaign for Nuclear Disarmament.*

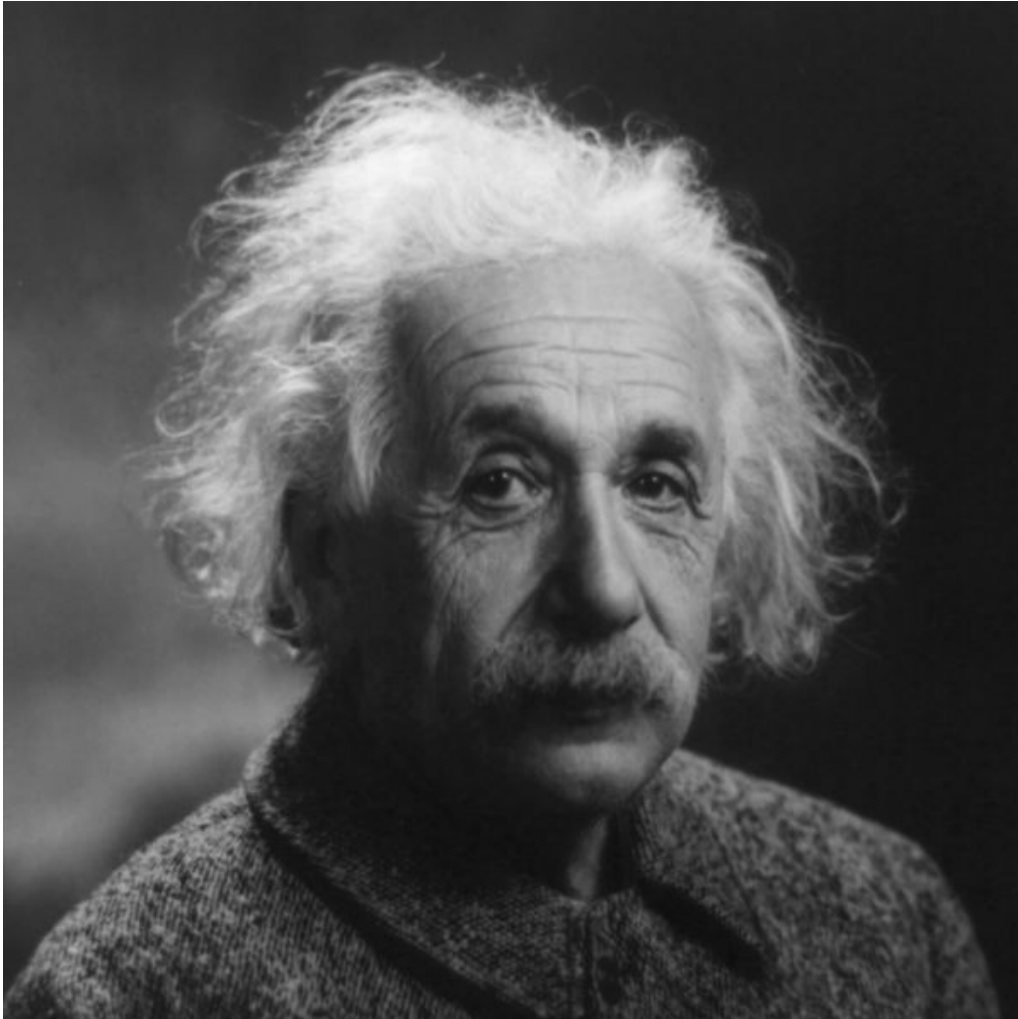


Figure 6.10: *Albert Einstein wrote: “The unleashed power of the atom has changed everything save our modes of thinking, and we thus drift toward unparalleled catastrophes.” He also said, “I don’t know what will be used in the next world war, but the 4th will be fought with stones.”*



Figure 6.11: *Joseph Rotblat devoted the remainder of his life to working for peace and for the abolition of nuclear weapons. He became the president and guiding spirit of the Pugwash Conferences on Science and World Affairs, an organization of scientists and other scholars devoted to these goals. In his 1995 Nobel Peace Prize acceptance speech, Sir Joseph Rotblat (as he soon became) emphasized the same point that had been made in the Russell-Einstein Manifesto - that war itself must be eliminated in order to free civilization from the danger of nuclear destruction. The reason for this is that the knowledge of how to make nuclear weapons can never be forgotten. Even if they were eliminated, these weapons could be rebuilt during a major war. Thus the final abolition of nuclear weapons is linked to a change of heart in world politics and to the abolition of the institution of war. “The quest for a war-free world”, Sir Joseph concluded, “has a basic purpose: survival. But if in the process we can learn how to achieve it by love rather than fear, by kindness rather than compulsion; if in the process we can learn to combine the essential with the enjoyable, the expedient with the benevolent, the practical with the beautiful, this will be an extra incentive to embark on this great task. Above all, remember your humanity.”*

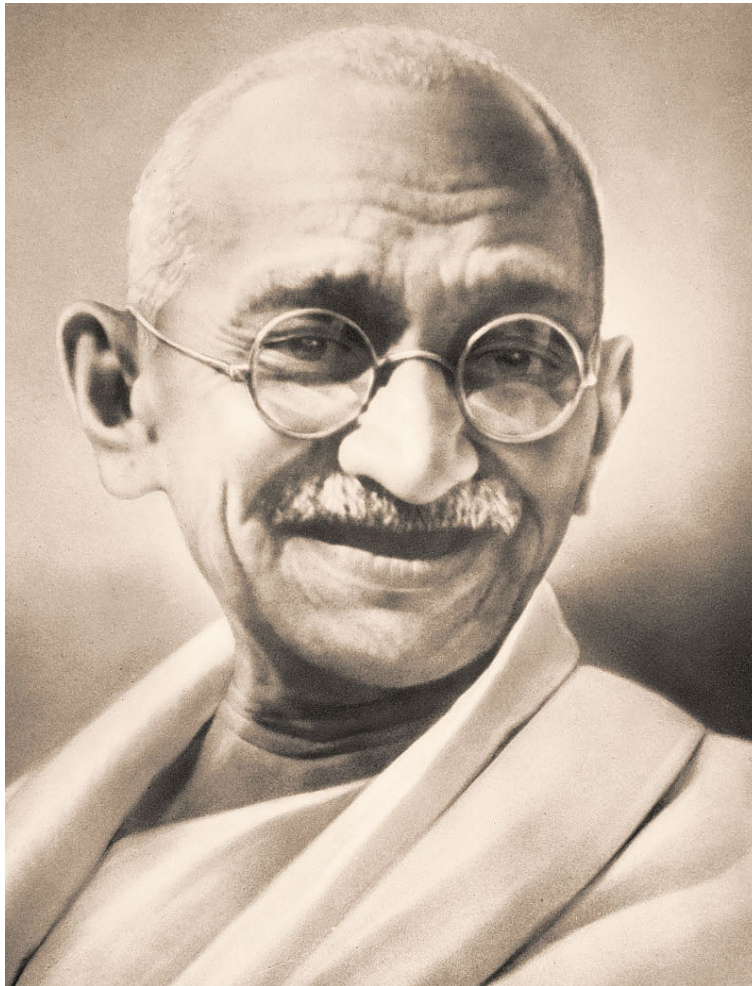


Figure 6.12: *To the insidious argument that “the end justifies the means”, Mahatma Gandhi answered firmly: “They say ‘means are after all means’. I would say ‘means are after all everything’. As the means, so the end. Indeed the Creator has given us control (and that very limited) over means, none over end... The means may be likened to a seed, and the end to a tree; and there is the same inviolable connection between the means and the end as there is between the seed and the tree. Means and end are convertible terms in my philosophy of life.” In other words, if evil means are used, the end achieved will be contaminated by the means used to achieve it. Gandhi’s insight can be applied to the argument that the nuclear bombings that destroyed Hiroshima and Nagasaki helped to end World War II and were therefore justified. In fact, these terrible events lead to a nuclear arms race that still casts an extremely dark shadow over the future of human civilization.*

superbombs using thermonuclear reactions - the reactions that heat the sun and stars. The idea of using a U-235 fission bomb to trigger a thermonuclear reaction in a mixture of light elements had first been proposed by Enrico Fermi in a 1941 conversation with his Chicago colleague Edward Teller. After this conversation, Teller (perhaps the model for Stanley Kubrick's character Dr. Strangelove) became a fanatical advocate of the superbomb.

After Truman's go-ahead, the American program to build thermonuclear weapons made rapid progress, and on October 31, 1952, the first US thermonuclear device was exploded at Eniwetok Atoll in the Pacific Ocean. It had a yield of 10.4 megatons, that is to say it had an explosive power equivalent to 10,400,000 tons of TNT. Thus the first thermonuclear bomb was five hundred times as powerful as the bombs that had devastated Hiroshima and Nagasaki. Lighter versions of the device were soon developed, and these could be dropped from aircraft or delivered by rockets.

The Soviet Union and the United Kingdom were not far behind. In 1955 the Soviets exploded their first thermonuclear device, followed in 1957 by the UK. In 1961 the USSR exploded a thermonuclear bomb with a yield of 58 megatons. A bomb of this size, three thousand times the size of the Hiroshima bomb, would be able to totally destroy a city even if it missed it by 50 kilometers. Fall-out casualties would extend to a far greater distance.

In the late 1950's General Gavin, Chief of Army Research and Development in the United States, was asked by the Symington Committee, "If we got into a nuclear war and our strategic air force made an assault in force against Russia with nuclear weapons exploded in a way where the prevailing winds would carry them south-east over Russia, what would be the effect in the way of death?"

General Gavin replied: "Current planning estimates run on the order of several hundred million deaths. That would be either way depending on which way the wind blew. If the wind blew to the south-east they would be mostly in the USSR, although they would extend into the Japanese area and perhaps down into the Philippine area. If the wind blew the other way, they would extend well back into Western Europe."

Between October 16 and October 28, 1962, the Cuban Missile Crisis occurred, an incident in which the world came extremely close to a full-scale thermonuclear war. During the crisis, President Kennedy and his advisers estimated that the chance of an all-out nuclear war with Russia was 50%. Recently-released documents indicate that the probability of war was even higher than Kennedy's estimate. Robert McNamara, who was Secretary of

Defense at the time, wrote later, “We came within a hairbreadth of nuclear war without realizing it... It’s no credit to us that we missed nuclear war...”

In 1964 the first Chinese nuclear weapon was tested, and this was followed in 1967 by a Chinese thermonuclear bomb with a yield of 3.3 megatons. France quickly followed suit testing a fission bomb in 1966 and a thermonuclear bomb in 1968. In all about thirty nations contemplated building nuclear weapons, and many made active efforts to do so.

Because the concept of deterrence required an attacked nation to be able to retaliate massively even though many of its weapons might be destroyed by a preemptive strike, the production of nuclear warheads reached insane heights, driven by the collective paranoia of the Cold War. More than 50,000 nuclear warheads were produced worldwide, a large number of them thermonuclear. The collective explosive power of these warheads was equivalent to 20,000,000,000 tons of TNT, i.e. 4 tons for every man, woman and child on the planet, or, expressed differently, a million times the explosive power of the bomb that destroyed Hiroshima.

The end of the Cold War

In 1985, Michael Gorbachev (1931-) became the General Secretary of the Communist Party of the Soviet Union. Gorbachev had become convinced by his conversations with scientists that the policy of nuclear confrontation between the United States and the USSR was far too dangerous to be continued over a long period of time. If continued, sooner or later, through accident of miscalculation, it would result in a disaster of unprecedented proportions. Gorbachev also believed that the USSR was in need of reform, and he introduced two words to characterize what he felt was needed: *glasnost* (openness) and *perestroika* (reconstruction).

In 1986, US President Ronald Reagan met Mikhail Gorbachev in Reykjavik, Iceland. The two leaders hoped that they might find ways of reducing the danger that a thermonuclear Third World War would be fought between their two countries. Donald Reagan, the White House Chief of Staff, was present at the meeting, and he records the following conversation: “At one point in time Gorbachev said ‘I would like to do away with all nuclear weapons’. And Reagan hit the table and said ‘Well why didn’t you say so in the first place! That’s exactly what I want to do! And if you want to do away with all the weapons, I’ll agree to do away with all the weapons. Of course we’ll do away with all the weapons.’ ‘Good’, [said Gorbachev] ‘That’s great,

but you must confine SDI to the laboratory.’ ‘No I won’t,’ said Reagan. ‘No way. SDI continues. I told you that I am never going to give up SDI.’” The SDI program, which seemingly prevented Presidents Reagan and Gorbachev from reaching an agreement to completely eliminate their nuclear weapons was Reagan’s “Star Wars” program which (in violation of the ABM Treaty) proposed to set up a system of radar, satellites and missiles to shoot down attacking missiles.

Gorbachev’s reforms effectively granted self-government to the various parts of the Soviet Union, and he himself soon resigned from his post as its leader, since the office was no longer meaningful. Most of the newly-independent parts of the old USSR began to introduce market economies, and an astonished world witnessed a series of unexpected and rapid changes: On September 10, 1989 Hungarian government opened its border for East German refugees; on November 9, 1989 Berlin Wall was reopened; on December 22, 1989 Brandenburg Gate was opened; and on October 3, 1990 Germany was reunited. The Cold War was over!

The Non-Proliferation Treaty

During the Cold War, a number of international treaties attempting to reduce the global nuclear peril had been achieved after much struggle. Among these, the 1968 Nuclear Non-Proliferation Treaty (NPT) has special importance. The NPT was designed to prevent the spread of nuclear weapons beyond the five nations that already had them; to provide assurance that “peaceful” nuclear activities of non-nuclear-weapon states would not be used to produce such weapons; to promote peaceful use of nuclear energy to the greatest extent consistent with non-proliferation of nuclear weapons; and finally, to ensure that definite steps towards complete nuclear disarmament would be taken by all states, as well steps towards comprehensive control of conventional armaments (Article VI).

The non-nuclear-weapon states insisted that Article VI be included in the treaty as a price for giving up their own ambitions. The full text of Article VI is as follows: “Each of the Parties to the Treaty undertakes to pursue negotiations in good faith on effective measures relating cessation of the nuclear arms race at an early date and to nuclear disarmament, and on a Treaty on general and complete disarmament under strict international control.”

The NPT has now been signed by 187 countries and has been in force as

international law since 1970. However, Israel, India, Pakistan, and Cuba have refused to sign, and North Korea, after signing the treaty, withdrew from it in 1993. Israel began producing nuclear weapons in the late 1960's (with the help of a reactor provided by France) and the country is now believed to possess 100-150 of them, including neutron bombs. Israel's policy is one of "nuclear opacity" - i.e., visibly possessing nuclear weapons while denying their existence.

South Africa, with the help of Israel and France, also produced nuclear weapons, which it tested in the Indian Ocean in 1979. In 1991 however, South Africa signed the NPT and destroyed its nuclear weapons.

India produced what it described as a "peaceful nuclear explosion" in 1974. By 1989 Indian scientists were making efforts to purify the lithium-6 isotope, a key component of the much more powerful thermonuclear bombs. In 1998, India conducted underground tests of nuclear weapons, and is now believed to have roughly 60 warheads, constructed from Pu-239 produced in "peaceful" reactors.

Pakistan's efforts to obtain nuclear weapons were spurred by India's 1974 "peaceful nuclear explosion". Zulfikar Ali Bhutto, who initiated Pakistan's program, first as Minister of Fuel, Power and Natural Resources, and later as President and Prime Minister, declared: "There is a Christian Bomb, a Jewish Bomb and a Hindu Bomb. There must be an Islamic Bomb! We will get it even if we have to starve - even if we have to eat grass!" As early as 1970, the laboratory of Dr. Abdul Qadeer Khan, (a metallurgist who was to become Pakistan's leading nuclear bomb maker) had been able to obtain from a Dutch firm the high-speed ultracentrifuges needed for uranium enrichment. With unlimited financial support and freedom from auditing requirements, Dr. Khan purchased restricted items needed for nuclear weapon construction from companies in Europe and the United States. In the process, Dr. Khan became an extremely wealthy man. With additional help from China, Pakistan was ready to test five nuclear weapons in 1998. The Indian and Pakistani nuclear bomb tests, conducted in rapid succession, presented the world with the danger that these devastating bombs would be used in the conflict over Kashmir. Indeed, Pakistan announced that if a war broke out using conventional weapons, Pakistan's nuclear weapons would be used "at an early stage".

In Pakistan, Dr. A.Q. Khan became a great national hero. He was presented as the person who had saved Pakistan from attack by India by

creating Pakistan's own nuclear weapons. In a Washington Post article² Pervez Hoodbhoy wrote: "Nuclear nationalism was the order of the day as governments vigorously promoted the bomb as the symbol of Pakistan's high scientific achievement and self-respect, and as the harbinger of a new Muslim era." Similar manifestations of nuclear nationalism could also be seen in India after India's 1998 bomb tests.

Early in 2004, it was revealed that Dr. Khan had for years been selling nuclear secrets and equipment to Lybia, Iran and North Korea. However, observers considered that it was unlikely that Khan would be tried for these offenses, since a trial might implicate Pakistan's army as well as two of its former prime ministers. Furthermore, Dr. Khan has the strong support of Pakistan's Islamic fundamentalists. Recent assassinations emphasize the precariousness of Pakistan's government. There is a danger that it may be overthrown by Islamic fundamentalists, who would give Pakistan's nuclear weapons to terrorist organizations. This type of danger is a general one associated with nuclear proliferation. As more and more countries obtain nuclear weapons, it becomes increasingly likely that one of them will undergo a revolution, during the course of which nuclear weapons will fall into the hands of subnational organizations.

Article VIII of the Non-Proliferation Treaty provides for a conference to be held every five years to make sure that the NPT is operating as intended. In the 1995 NPT Review Conference, the lifetime of the treaty was extended indefinitely, despite the general dissatisfaction with the bad faith of the nuclear weapon states: They had dismantled some of their warheads but had taken no significant steps towards complete nuclear disarmament. The 2000 NPT Review Conference made it clear that the nuclear weapons states could not postpone indefinitely their commitment to nuclear disarmament by linking it to general and complete disarmament, since these are separate and independent goals of Article VI. The Final Document of the conference also contained 13 Practical Steps for Nuclear Disarmament, including ratification of a Comprehensive Test Ban Treaty (CTBT), negotiations on a Fissile Materials Cutoff Treaty, the preservation and strengthening of the Anti-Ballistic Missile (ABM) Treaty, greater transparency with regard to nuclear arsenals, and making irreversibility a principle of nuclear reductions. Another review conference is scheduled for 2010, a year that marks the 55th anniversary of the destruction of Hiroshima and Nagasaki.

²1 February, 2004

Something must be said about the concept of irreversability mentioned in the Final Document of the 2000 NPT Review Conference. Nuclear weapons can be destroyed in a completely irreversible way by getting rid of the special isotopes which they use. In the case of highly enriched uranium (HEU), this can be done by mixing it thoroughly with ordinary unenriched uranium. In natural uranium, the rare fissile isotope U-235 is only 0.7%. The remaining 99.3% consists of the common isotope, U-238, which under ordinary circumstances cannot undergo fission. If HEU is mixed with a sufficient quantity of natural uranium, so that the concentration of U-235 falls below 20%, it can no longer be used in nuclear weapons.

Getting rid of plutonium irreversibly is more difficult, but it could be cast into large concrete blocks and dumped into extremely deep parts of the ocean (e.g. the Japan Trench) where recovery would be almost impossible. Alternatively, it could be placed in the bottom of very deep mine shafts, which could afterwards be destroyed by means of conventional explosives. None of the strategic arms reduction treaties, neither the SALT treaties nor the 2002 Moscow Treaty, incorporate irreversability.

The recent recommendation by four distinguished German statesmen that all short-range nuclear weapons be destroyed is particularly interesting [13]. The strongest argument for the removal of US tactical nuclear weapons from Europe is the danger of collapse of the NPT. The 2005 NPT Review Conference was a disaster, and there is a danger that at the 2010 Review Conference, the NPT will collapse entirely because of the discriminatory position of the nuclear weapon states (NWS) and their failure to honor their commitments under Article VI. NATO's present nuclear weapon policy also violates the NPT, and correcting this violation would help to save the 2010 Review Conference from failure.

At present, the air forces of the European countries in which the US nuclear weapons are stationed perform regular training exercises in which they learn how to deliver the weapons. This violates the spirit, and probably also the letter, of Article IV, which prohibits the transfer of nuclear weapons from an NWS to a non-NWS. The "nuclear sharing" proponents maintain that such transfers would only happen in an emergency; but there is nothing in the NPT saying that the treaty would not hold under all circumstances. Furthermore, NATO would be improved, rather than damaged, by giving up "nuclear sharing". If President Obama wishes to fulfill his campaign promises [14] - if he wishes to save the NPT - a logical first step would be to remove US tactical nuclear weapons from Europe.

Flaws in the concept of nuclear deterrence

Before discussing other defects in the concept of deterrence, it must be said very clearly that the idea of “massive nuclear retaliation” is completely unacceptable from an ethical point of view. The doctrine of retaliation, performed on a massive scale, violates not only the principles of common human decency and common sense, but also the ethical principles of every major religion. Retaliation is especially contrary to the central commandment of Christianity which tells us to love our neighbor, even if he or she is far away from us, belonging to a different ethnic or political group, and even if our distant neighbor has seriously injured us. This principle has a fundamental place not only in Christianity but also in Buddhism. “Massive retaliation” completely violates these very central ethical principles, which are not only clearly stated and fundamental but also very practical, since they prevent escalatory cycles of revenge and counter-revenge.

Contrast Christian ethics with estimates of the number of deaths that would follow a US nuclear strike against Russia: Several hundred million deaths. These horrifying estimates shock us not only because of the enormous magnitude of the expected mortality, but also because the victims would include people of every kind: women, men, old people, children and infants, completely irrespective of any degree of guilt that they might have. As a result of such an attack, many millions of people in neutral countries would also die. This type of killing has to be classified as genocide.

When a suspected criminal is tried for a wrongdoing, great efforts are devoted to clarifying the question of guilt or innocence. Punishment only follows if guilt can be proved beyond any reasonable doubt. Contrast this with the totally indiscriminate mass slaughter that results from a nuclear attack!

It might be objected that disregard for the guilt or innocence of victims is a universal characteristic of modern war, since statistics show that, with time, a larger and larger percentage of the victims have been civilians, and especially children. For example, the air attacks on Coventry during World War II, or the fire bombings of Dresden and Tokyo, produced massive casualties which involved all segments of the population with complete disregard for the question of guilt or innocence. The answer, I think, is that modern war has become generally unacceptable from an ethical point of view, and this unacceptability is epitomized in nuclear weapons.

The enormous and indiscriminate destruction produced by nuclear wea-

pons formed the background for an historic 1996 decision by the International Court of Justice in the Hague. In response to questions put to it by WHO and the UN General Assembly, the Court ruled that “the threat and use of nuclear weapons would generally be contrary to the rules of international law applicable in armed conflict, and particularly the principles and rules of humanitarian law.” The only *possible* exception to this general rule might be “an extreme circumstance of self-defense, in which the very survival of a state would be at stake”. But the Court refused to say that even in this extreme circumstance the threat or use of nuclear weapons would be legal. It left the exceptional case undecided. In addition, the World Court added unanimously that “there exists an obligation to pursue in good faith *and bring to a conclusion* negotiations leading to nuclear disarmament in all its aspects under strict international control.”

This landmark decision has been criticized by the nuclear weapon states as being decided “by a narrow margin”, but the structuring of the vote made the margin seem more narrow than it actually was. Seven judges voted against Paragraph 2E of the decision (the paragraph which states that the threat or use of nuclear weapons would be generally illegal, but which mentions as a possible exception the case where a nation might be defending itself from an attack that threatened its very existence.) Seven judges voted for the paragraph, with the President of the Court, Muhammad Bedjaoui of Algeria casting the deciding vote. Thus the Court adopted it, seemingly by a narrow margin. But three of the judges who voted against 2E did so because they believed that no possible exception should be mentioned! Thus, if the vote had been slightly differently structured, the result would have been ten to four.

Of the remaining four judges who cast dissenting votes, three represented nuclear weapons states, while the fourth thought that the Court ought not to have accepted the questions from WHO and the UN. However Judge Schwebel from the United States, who voted against Paragraph 2E, nevertheless added, in a separate opinion, “It cannot be accepted that the use of nuclear weapons on a scale which would - or could - result in the deaths of many millions in indiscriminate inferno and by far-reaching fallout, have pernicious effects in space and time, and render uninhabitable much of the earth, could be lawful.” Judge Higgins from the UK, the first woman judge in the history of the Court, had problems with the word “generally” in Paragraph 2E and therefore voted against it, but she thought that a more profound analysis might have led the Court to conclude in favor of illegality in all circumstances. Judge Fleischhauer of Germany said in his separate opinion, “The nuclear

weapon is, in many ways, the negation of the humanitarian considerations underlying the law applicable in armed conflict and the principle of neutrality. The nuclear weapon cannot distinguish between civilian and military targets. It causes immeasurable suffering. The radiation released by it is unable to respect the territorial integrity of neutral States.”

President Bedjaoui, summarizing the majority opinion, called nuclear weapons “the ultimate evil”, and said “By its nature, the nuclear weapon, this blind weapon, destabilizes humanitarian law, the law of discrimination in the use of weapons... The ultimate aim of every action in the field of nuclear arms will always be nuclear disarmament, an aim which is no longer utopian and which all have a duty to pursue more actively than ever.”

Thus the concept of nuclear deterrence is not only unacceptable from the standpoint of ethics; it is also contrary to international law. The World Court’s 1996 advisory Opinion unquestionably also represents the opinion of the majority of the world’s peoples. Although no formal plebiscite has been taken, the votes in numerous resolutions of the UN General Assembly speak very clearly on this question. For example the New Agenda Resolution (53/77Y) was adopted by the General Assembly on 4 December 1998 by a massively affirmative vote, in which only 18 out of the 170 member states voted against the resolution.³ The New Agenda Resolution proposes numerous practical steps towards complete nuclear disarmament, and it calls on the Nuclear-Weapon States “to demonstrate an unequivocal commitment to the speedy and total elimination of their nuclear weapons and without delay to pursue in good faith and bring to a conclusion negotiations leading to the elimination of these weapons, thereby fulfilling their obligations under Article VI of the Treaty on the Non-Proliferation of Nuclear Weapons (NPT)”. Thus, in addition to being ethically unacceptable and contrary to international law, nuclear weapons also contrary to the principles of democracy.

Having said these important things, we can now turn to some of the other defects in the concept of nuclear deterrence. One important defect is that nuclear war may occur through accident or miscalculation - through technical defects or human failings. This possibility is made greater by the fact that despite the end of the Cold War, thousands of missiles carrying nuclear warheads are still kept on a “hair-trigger” state of alert with a quasi-

³Of the 18 countries that voted against the New Agenda resolution, 10 were Eastern European countries hoping for acceptance into NATO, whose votes seem to have been traded for increased probability of acceptance.

automatic reaction time measured in minutes. There is a constant danger that a nuclear war will be triggered by error in evaluating the signal on a radar screen. For example, the BBC reported recently that a group of scientists and military leaders are worried that a small asteroid entering the earth's atmosphere and exploding could trigger a nuclear war if mistaken for a missile strike.

A number of prominent political and military figures (many of whom have ample knowledge of the system of deterrence, having been part of it) have expressed concern about the danger of accidental nuclear war. Colin S. Grey⁴ expressed this concern as follows: "The problem, indeed the enduring problem, is that we are resting our future upon a nuclear deterrence system concerning which we cannot tolerate even a single malfunction." General Curtis E. LeMay⁵ has written, "In my opinion a general war will grow through a series of political miscalculations and accidents rather than through any deliberate attack by either side." Bruce G. Blair⁶ has remarked that "It is obvious that the rushed nature of the process, from warning to decision to action, risks causing a catastrophic mistake."... "This system is an accident waiting to happen."

"But nobody can predict that the fatal accident or unauthorized act will never happen", Fred Ikle of the Rand Corporation has written, "Given the huge and far-flung missile forces, ready to be launched from land and sea on on both sides, the scope for disaster by accident is immense... In a matter of seconds - through technical accident or human failure - mutual deterrence might thus collapse."

Another serious failure of the concept of nuclear deterrence is that it does not take into account the possibility that atomic bombs may be used by terrorists. Indeed, the threat of nuclear terrorism has today become one of the most pressing dangers that the world faces, a danger that is particularly acute in the United States.

Since 1945, more than 3,000 metric tons (3,000,000 kilograms) of highly enriched uranium and plutonium have been produced - enough for several hundred thousand nuclear weapons. Of this, roughly a million kilograms are in Russia, inadequately guarded, in establishments where the technicians are poorly paid and vulnerable to the temptations of bribery. There is a continu-

⁴Chairman, National Institute for Public Policy

⁵Founder and former Commander in Chief of the United States Strategic Air Command

⁶Brookings Institute

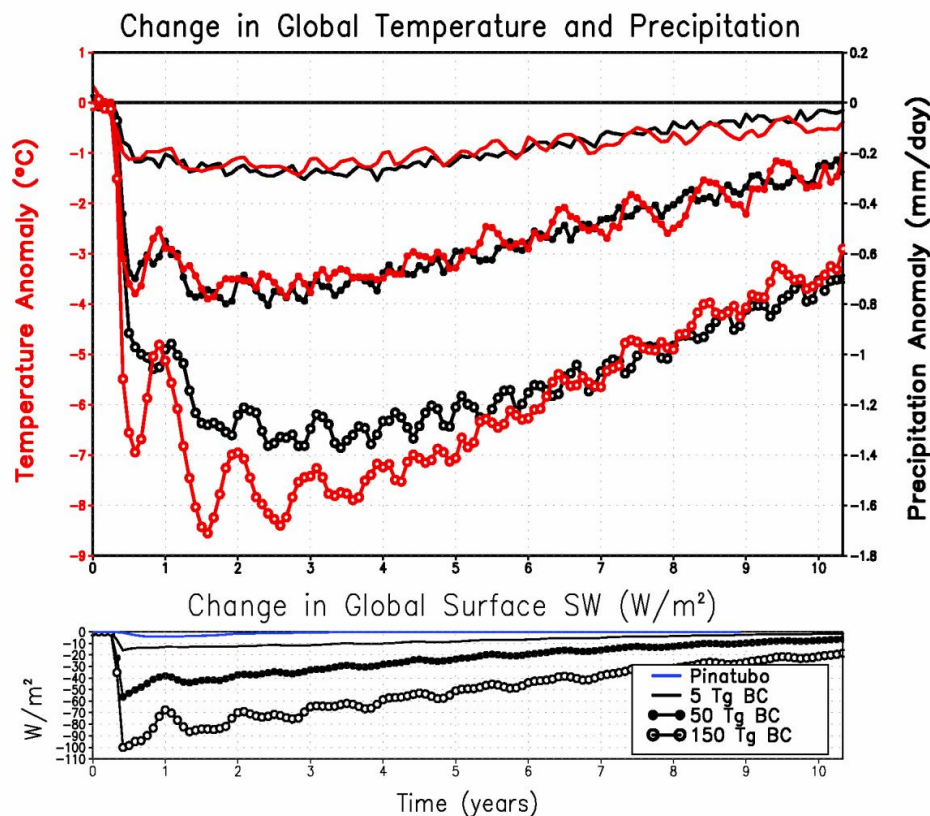


Figure 6.13: Recent studies by atmospheric scientists have shown that the smoke from burning cities produced by even a limited nuclear war would have a devastating effect on global agriculture. The studies show that the smoke would rise to the stratosphere, where it would spread globally and remain for a decade, blocking sunlight and destroying the ozone layer. Because of the devastating effect on global agriculture, darkness from even a small nuclear war (e.g. between India and Pakistan) would result in an estimated billion deaths from famine. Nuclear darkness resulting from a large-scale war involving all of the nuclear weapons that are now on high alert status would destroy all agriculture on earth for a period of ten years, and almost all humans would die of starvation. (See O. Toon, A. Robock, and R. Turco, “The Environmental Consequences of Nuclear War”, *Physics Today*, vol. 61, No. 12, 2008, p. 37-42).

ing danger that these fissile materials will fall into the hands of terrorists, or organized criminals, or irresponsible governments. Also, an extensive black market for fissile materials, nuclear weapons components etc. has recently been revealed in connection with the confessions of Pakistan's bomb-maker, Dr. A.Q. Khan. Furthermore, if Pakistan's less-than-stable government should be overthrown, complete nuclear weapons could fall into the hands of terrorists.

On November 3, 2003, Mohamed ElBaradei, Director General of the International Atomic Energy Agency, made a speech to the United Nations in which he called for "limiting the processing of weapons-usable material (separated plutonium and high enriched uranium) in civilian nuclear programmes - as well as the production of new material through reprocessing and enrichment - by agreeing to restrict these operations to facilities exclusively under international control." It is almost incredible, considering the dangers of nuclear proliferation and nuclear terrorism, that such restrictions were not imposed long ago. Nuclear reactors used for "peaceful" purposes unfortunately also generate fissionable isotopes of plutonium, neptunium and americium. Thus all nuclear reactors must be regarded as ambiguous in function, and all must be put under strict international control. One might ask, in fact, whether globally widespread use of nuclear energy is worth the danger that it entails.

The Italian nuclear physicist Francesco Calogero, who has studied the matter closely, believes that terrorists could easily construct a simple gun-type nuclear bomb if they were in possession of a critical mass of highly enriched uranium. In such a simple atomic bomb, two grapefruit-sized sub-critical portions of HEU are placed at opposite ends of the barrel of an artillery piece and are driven together by means of a conventional explosive. Prof. Calogero estimates that the fatalities produced by the explosion of such a device in the center of a large city could exceed 100,000.

We must remember the remark of U.N. Secretary General Kofi Annan after the 9/11/2001 attacks on the World Trade Center. He said, "*This time it was not a nuclear explosion*". The meaning of his remark is clear: If the world does not take strong steps to eliminate fissionable materials and nuclear weapons, it will only be a matter of time before they will be used in terrorist attacks on major cities. Neither terrorists nor organized criminals can be deterred by the threat of nuclear retaliation, since they have no territory against which such retaliation could be directed. They blend invisibly into the general population. Nor can a "missile defense system" prevent terrorists

from using nuclear weapons, since the weapons can be brought into a port in any one of the hundreds of thousands of containers that enter on ships each year, a number far too large to be checked exhaustively.

In this dangerous situation, the only logical thing for the world to do is to get rid of both fissile materials and nuclear weapons as rapidly as possible. We must acknowledge that the idea of nuclear deterrence is a dangerous fallacy, and acknowledge that the development of military systems based on nuclear weapons has been a terrible mistake, a false step that needs to be reversed. If the most prestigious of the nuclear weapons states can sincerely acknowledge their mistakes and begin to reverse them, nuclear weapons will seem less glamorous to countries like India, Pakistan, North Korea and Iran, where they now are symbols of national pride and modernism.

Civilians have for too long played the role of passive targets, hostages in the power struggles of politicians. It is time for civil society to make its will felt. If our leaders continue to enthusiastically support the institution of war, if they will not abolish nuclear weapons, then let us have new leaders.

Establishment opinion shifts towards nuclear abolition

Today there are indications that the establishment is moving towards the point of view that the peace movement has always held: - that nuclear weapons are essentially genocidal, illegal and unworthy of civilization; and that they must be completely abolished as quickly as possible. There is a rapidly-growing global consensus that a nuclear-weapon-free world can and must be achieved in the very near future.

One of the first indications of the change was the famous Wall Street Journal article by Schultz, Perry, Kissinger and Nunn advocating complete abolition of nuclear arms [1]. This was followed quickly by Mikhail Gorbachev's supporting article, published in the same journal [2], and a statement by distinguished Italian statesmen [3]. Meanwhile, in October 2007, the Hoover Institution had arranged a symposium entitled "Reykjavik Revisited; Steps Towards a World Free of Nuclear Weapons" [4].

In Britain, Sir Malcolm Rifkind, Lord Hurd and Lord Owen (all former Foreign Secretaries) joined the former NATO Secretary General Lord Robertson as authors of an article in The Times advocating complete abolition of nuclear weapons [5]. The UK's Secretary of State for Defense, Des Brown, speaking at a disarmament conference in Geneva, proposed that the UK "host a technical conference of P5 nuclear laboratories on the verification of

nuclear disarmament before the next NPT Review Conference in 2010” to enable the nuclear weapon states to work together on technical issues.

In February, 2008, the Government of Norway hosted an international conference on “Achieving the Vision of a World Free of Nuclear Weapons” [7]. A week later, Norway’s Foreign Minister, Jonas Gahr Støre, reported the results of the conference to a disarmament meeting in Geneva [8]. On July 11, 2008, speaking at a Pugwash Conference in Canada, Norway’s Defense Minister, Anne-Grete Strøm-Erichsen, reiterated her country’s strong support for the complete abolition of nuclear weapons [9].

In July 2008, Barack Obama said in his Berlin speech, “It is time to secure all loose nuclear materials; to stop the spread of nuclear weapons; and to reduce the arsenals from another era. This is the moment to begin the work of seeking the peace of a world without nuclear weapons.”

Later that year, in September, Vladimir Putin said, “Had I been told just two or three years ago I wouldn’t believe that it would be possible, but I believe that it is now quite possible to liberate humanity from nuclear weapons...”

Other highly-placed statesmen added their voices to the growing consensus: Australia’s Prime Minister, Kevin Rudd, visited the Peace Museum at Hiroshima, where he made a strong speech advocating nuclear abolition. He later set up an International Commission on Nuclear Non-Proliferation and Disarmament co-chaired by Australia and Japan [10].

On January 9, 2009, four distinguished German statesmen (Richard von Weizsäcker, Helmut Schmidt, Egon Bahr and Hans-Dietrich Genscher) published an article entitled “Towards a Nuclear-Free World: a German View” in the International Herald Tribune [12]. Among the immediate steps recommended in the article are the following:

- The vision of a nuclear-weapon-free world... must be rekindled.
- Negotiations aimed at drastically reducing the number of nuclear weapons must begin...
- The Nuclear Non-Proliferation Treaty (NPT) must be greatly reinforced.
- America should ratify the Comprehensive Nuclear Test-Ban Treaty.
- All short-range nuclear weapons must be destroyed.
- The Anti-Ballistic Missile (ABM) Treaty must be restored. Outer space may only be used for peaceful purposes.

Going to zero

On December 8-9, 2008, approximately 100 international leaders met in Paris to launch the Global Zero Campaign [11]. They included Her Majesty Queen Noor of Jordan, Norway's former Prime Minister Gro Harlem Brundtland, former UK Foreign Secretaries Sir Malcolm Rifkind, Margaret Beckett and David Owen, Ireland's former Prime Minister Mary Robinson, UK philanthropist Sir Richard Branson, former UN Under-Secretary-General Jayantha Dhanapala, and Nobel Peace Prize winners President Jimmy Carter, President Mikhail Gorbachev, Archbishop Desmond Tutu and Prof. Muhammad Yunus. The concrete steps advocated by Global Zero include:

- Deep reductions to Russian-US arsenals, which comprise 96% of the world's 27,000 nuclear weapons.
- Russia and the United States, joined by other nuclear weapons states, cutting arsenals to zero in phased and verified reductions.
- Establishing verification systems and international management of the fuel cycle to prevent future development of nuclear weapons.

The Global Zero website [11] contains a report on a new public opinion poll covering 21 nations, including all of the nuclear weapons states. The poll showed that public opinion overwhelmingly favors an international agreement for eliminating all nuclear weapons according to a timetable. It was specified that the agreement would include monitoring. The average in all countries of the percent favoring such an agreement was 76%. A few results of special interest mentioned in the report are Russia 69%; the United States, 77%; China, 83%; France, 86%, and Great Britain, 81%.

In his April 5, 2009 speech in Prague the newly-elected U.S. President Barack Obama said: "To reduce our warheads and stockpiles, we will negotiate a new strategic arms reduction treaty with Russia this year. President Medvedev and I will begin this process in London, and we will seek an agreement by the end of the year that is sufficiently bold. This will set the stage for further cuts, and we will seek to involve all nuclear weapon states in this endeavor... To achieve a global ban on nuclear testing, my administration will immediately and aggressively pursue U.S. ratification of the Comprehensive Test Ban Treaty."

A few days later, on April 24, 2009, the European Parliament recommended complete nuclear disarmament by 2020. An amendment introducing the "Model Nuclear Weapons Convention" and the "Hiroshima-Nagasaki

Protocol” as concrete tools to achieve a nuclear weapons free world by 2020 was approved with a majority of 177 votes against 130. The Nuclear Weapons Convention is analogous to the conventions that have successfully banned chemical and biological weapons.

The role of public opinion

Public opinion is extremely important for the actual achievement of complete nuclear abolition. In the first place, the fact that the public is overwhelmingly against the retention of nuclear weapons means that the continuation of nuclear arsenals violates democratic principles. Secondly, the weapons are small enough to be easily hidden. Therefore the help of “whistle-blowers” will be needed to help inspection teams to make sure that no country violates its agreement to irreversibly destroy every atomic bomb. What is needed is a universal recognition that nuclear weapons are an absolute evil, and that their continued existence is a threat to human civilization and to the life of every person on the planet.

Our aim must be to delegitimize nuclear weapons, in much the same way that unnecessary greenhouse gas emissions have recently been delegitimized, or cigarette smoking delegitimized, or racism delegitimized. This should be an easy task because of the essentially genocidal nature of nuclear weapons. For half a century, ordinary people have been held as hostages, never knowing from day to day whether their own lives and the lives of those they love would suddenly be sacrificed on the alter of thermonuclear nationalism and power politics. We must let the politicians know that we are no longer willing to be hostages; and we must also accept individual responsibility for reporting violations of international treaties, although our own nation might be the violator.

Most of us grew up in schools where we were taught that duty to our nation was the highest duty; but the times we live in today demand a change of heart, a higher loyalty to humanity as a whole. If the mass media cooperate in delegitimizing nuclear weapons, if educational systems cooperate and if religions ⁷ cooperate, the change of heart that we need - the global ethic that we need - can quickly be achieved.

⁷As an example of the role that religions can play, we can consider the Buddhist organization Soka Gokkai International (SGI), which has 12 million members throughout the world. SGI's President Daisaku Ikeda has declared nuclear weapons to be an absolute evil and for more than 50 years the organization has worked for their abolition.



Figure 6.14: *Protesters at the Greenham Commons nuclear missile site.*



Figure 6.15: *A peace march from Stockholm to Minsk in 1982.*

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Chapter 7

THE DEVIL'S DYNAMO

“We must stand guard against the acquisition of unwarranted influence, whether sought or unsought, by the military-industrial complex. The potential for the disastrous rise of misplaced power exists and will persist.”

Dwight David Eisenhower

“Naturally, the common people don’t want war, neither in Russia nor in England, nor for that matter in Germany. That is understood. But, after all, it is the leaders of the country that determine the policy, and it is always a simple matter to drag the people along, whether it is a democracy or a fascist dictatorship... All you have to do is to tell them that they are being attacked, and denounce the peacemakers for lack of patriotism and exposing the country to danger. It works the same in any country.”

Herman Goering, interviewed in Spandau Prison

Outlawing war

The United Nations Charter

The Second World War was terrible enough to make world leaders resolve to end the institution of war once and for all, and the United Nations was set up for this purpose.

Article 2 of the UN Charter requires that “All members shall refrain in their international relations from the threat or use of force against the territorial integrity or political independence of any state.”

This requirement is somewhat qualified by Article 51, which says that “Nothing in the present Charter shall impair the inherent right of individual or collective self-defense if an armed attack occurs against a Member of the United Nations, until the Security Council has taken measures necessary to maintain international peace and security.”

Thus, in general, war is illegal under the UN Charter. Self-defense against an armed attack is permitted, but only for a limited time, until the Security Council has had time to act.

The Nuremberg Principles

At the end of the Second World War, when the full extent of the atrocities that had been committed by the Nazi's became known, it was decided to prosecute Nazi leaders for crimes against peace, war crimes, and crimes against humanity (such as extermination camps). There was disagreement about how such trials should be held, but after some debate between the Allied countries, it was agreed that 24 Nazi officials and military leaders would be tried by an International Military Tribunal in Nuremberg, Germany, a former center of Nazi politics. There were originally 24 defendants, but two of them committed suicide. One was presumed dead but was nevertheless tried in absentia. Of the twenty-one remaining defendants, eleven were given the death penalty, eight were sentenced to long prison terms, and three were acquitted. Similar trials also took place in Japan.

In 1946 the United Nations General Assembly unanimously affirmed “the principles of international law recognized by the Charter of the Nuremberg Tribunal and the judgment of the Tribunal”. The General Assembly also established an International Law Commission to formalize the Nuremberg Principles, and the result was the following list:

- **Principle I:** Any person who commits an act which constitutes a crime under international law is responsible, and therefore liable to punishment.
- **Principle II:** The fact that internal law does not impose a penalty for an act which constitutes a crime under international law does not relieve the person who committed the act from responsibility under international law.
- **Principle III:** The fact that the person who committed an act which constitutes a crime under international law acted as Head of State or responsible government official does not relieve him from responsibility under international law.
- **Principle IV:** The fact that a person acted pursuant to order of his Government or of a superior does not relieve him of responsibility under international law, provided that a moral choice was in fact possible for him.
- **Principle V:** Any person charged with a crime under international law has the right to a fair trial on the facts and law.
- **Principle VI:** The crimes hereinafter set out are punishable as crimes under international law:
 - a. Crimes against peace: (i) Planning, preparation, initiation or waging of war of aggression or a war in violation of international treaties, agreements or assurances; (ii) Participation in a common plan or conspiracy for the accomplishment of any of the acts mentioned under (i).
 - b. War crimes: Violations of the laws or customs of war which include, but are not limited to, murder, ill-treatment of prisoners of war or persons on the seas, killing of hostages, plunder of public or private property, wanton destruction of cities, towns or villages, or devastation not justified by military necessity.
 - c. Crimes against humanity: Atrocities and offenses, including but not limited to, murder, extermination, deportation, imprisonment, torture, rape, or other inhumane acts committed against any civilian population, or persecutions on political, racial or religious grounds, whether

or not in violation of the laws of the country where perpetrated.

- **Principle VII:** Complicity in the commission of a crime against peace, a war crime, or a crime against humanity as set forth in Principle VI is a crime under international law.

The Nuremberg Principles are being used today as the basis for the International Criminal Court's trials of individuals accused of genocide and war crimes in Rwanda and in the former Yugoslavia.

The Principles throw an interesting light onto the status of soldiers. According to the Nuremberg Principles, it is not only the right, but also the duty of individuals to make moral and legal judgments concerning wars in which they are asked to fight. If a soldier participates in an illegal war (and all wars, apart from actions of the UN Security Council, are now illegal) then the soldier is liable to prosecution for violating international law. The fact that he or she was acting under orders is not an excuse. The training of soldiers is designed to remove the burdens of moral and legal responsibility from a soldier's individual shoulders; but the Nuremberg Principles are designed to put these burdens squarely back where they belong - on the shoulders of the individual.

The Universal Declaration of Human Rights

On December 10, 1948, the General Assembly of the United Nations adopted a Universal Declaration of Human Rights. 48 states voted for adoption, while 8 states abstained from voting. Not a single state voted against the Declaration. In addition, the General Assembly decided to continue work on the problem of implementing human rights. The preamble of the Declaration stated that it was intended "as a common standard of achievement for all peoples and nations, to the end that every individual and every organ of society, keeping this Declaration constantly in mind, shall strive by teaching and education to promote respect for these rights and freedoms."

Articles 1 and 2 of the Declaration state that "all human beings are born free and equal in dignity and in rights", and that everyone is entitled to the rights and freedoms mentioned in the Declaration without distinctions of any kind. Neither race color, sex, language, religion, political or other opinion, national or social origin, property or social origin must make a difference.

The Declaration states that everyone has a right to life, liberty and security of person and property. Slavery and the slave trade are prohibited, as well as torture and cruel, inhuman or degrading punishments. All people must be equal before the law, and no person must be subject to arbitrary arrest, detention or exile. In criminal proceedings an accused person must be presumed innocent until proven guilty by an impartial public hearing where all necessary provisions have been made for the defense of the accused.

No one shall be subjected to interference with his privacy, family, home or correspondence. Attacks on an individual's honor are also forbidden. Everyone has the right of freedom of movement and residence within the borders of a state, the right to leave any country, including his own, as well as the right to return to his own country. Every person has the right to a nationality and cannot be arbitrarily deprived of his or her nationality.

All people of full age have a right to marry and to establish a family. Men and women have equal rights within a marriage and at its dissolution, if this takes place. Marriage must require the full consent of both parties.

The Declaration also guarantees freedom of religion, of conscience, and of opinion and expression, as well as freedom of peaceful assembly and association. Everyone is entitled to participate in his or her own government, either directly or through democratically chosen representatives. Governments must be based on the will of the people, expressed in periodic and genuine elections with universal and equal suffrage. Voting must be secret.

Everyone has the right to the economic, social and cultural conditions needed for dignity and free development of personality. The right to work is affirmed. The job shall be of a person's own choosing, with favorable conditions of work, and remuneration consistent with human dignity, supplemented if necessary with social support. All workers have the right to form and to join trade unions.

Article 25 of the Declaration states that everyone has the right to an adequate standard of living, including food, clothing, housing and medical care, together with social services. All people have the right to security in the event of unemployment, sickness, disability, widowhood or old age. Expectant mothers are promised special care and assistance, and children, whether born in or out of wedlock, shall enjoy the same social protection. Everyone has the right to education, which shall be free in the elementary stages. Higher education shall be accessible to all on the basis of merit. Education must be directed towards the full development of the human personality and to strengthening respect for human rights and fundamental freedoms. Ed-

ucation must promote understanding, tolerance, and friendship among all nations, racial and religious groups, and it must further the activities of the United Nations for the maintenance of peace¹.

The Declaration affirms that everyone has the right to participate freely in the cultural life of the community, to enjoy the arts, and to share in the benefits of science. The moral and material rights of authors, artists and innovators are to be protected.

A supplementary document, the Convention on the Rights of the Child, was adopted by the United Nations General Assembly on the 12th of December, 1989.

Perpetual (illegal) war

Eisenhower warns against the military-industrial complex

The two world wars of the 20th Century involved a complete reordering of the economies of the belligerent countries, and a dangerous modern phenomenon was created - the military-industrial complex.

In his farewell address (January 17, 1961) US President Dwight David Eisenhower warned of the dangers of the war-based economy that World War II had forced his nation to build: "...We have been compelled to create an armaments industry of vast proportions", Eisenhower said, "...Now this conjunction of an immense military establishment and a large arms industry is new in American experience. The total influence - economic, political, even spiritual - is felt in every city, every state house, every office in the federal government. ...We must not fail to comprehend its grave implications. Our toil, resources and livelihood are all involved; so is the very structure of our society. ... We must stand guard against the acquisition of unwarranted influence, whether sought or unsought, by the military-industrial complex. The potential for the disastrous rise of misplaced power exists and will persist. We must never let the weight of this combination endanger our democratic processes. We should take nothing for granted."

¹Many provisions of the Universal Declaration of Human Rights, for example the one just quoted, might be accused of being wishful thinking. Nevertheless, they have great value in defining the norms towards which the world ought to be striving.

This farsighted speech by Eisenhower deserves to be studied by every student of economics. As the retiring president pointed out, the military-industrial complex is a threat both to peace and to democracy. It is not unique to the United States but exists in many countries. The world today spends roughly a trillion (i.e. a million million) US dollars each year on armaments. It is obvious that very many people make their living from war, and therefore it is correct to speak of war as a social, political and economic institution. The military-industrial complex is one of the main reasons why war persists, although everyone realizes that war is the cause of much of the suffering of humanity. We know that war is madness, but it persists. We know that it threatens the survival of our species, but it persists, entrenched in the attitudes of historians, newspaper editors and television producers, entrenched in the methods by which politicians finance their campaigns, and entrenched in the financial power of arms manufacturers - entrenched also in the ponderous and costly hardware of war, the fleets of warships, bombers, tanks, nuclear missiles and so on.

As we try to introduce ethical elements into economics, we should remember the existence of this “devil’s dynamo”. It perpetuates the institution of war although the peoples of the world long for peace, and despite the fact that human civilization itself is threatened by all-destroying modern weapons. What is to be done? More attention to this problem is needed, and more research, more public awareness.

The urgent need for enemies

The Cold War

The military-industrial complex needs enemies. Without them it would wither. Thus at the end of the Second World War, this vast power complex was faced with a crisis, but it was saved by the discovery of a new enemy - communism.

The United States emerged from the two global wars as the world’s dominant industrial power, taking over the position that Britain had held during the 19th century. The economies of its rivals had been destroyed by the two wars, but no fighting had taken place on American soil. Because of its unique position as the only large country whose economy was completely intact in 1945, the United States found itself suddenly thrust, almost unwillingly, into



Figure 7.1: *Eisenhower's Farewell Address deserves to be read by everyone who feels concern for the future of the world. The power of the military-industrial complex, against which the retiring US President warned, is one of the main reasons why the institution of war persists, although everyone realizes that it is responsible for much of the suffering of humanity.*

the center of the world's political stage.

The new role as “leader of the free world” was accepted by the United States with a certain amount of nervousness. America's previous attitude had been isolationism - a wish to be “free from the wars and quarrels of Europe”. After the Second World War, however, this was replaced by a much more active international role. Perhaps the new US interest in the rest of the world reflected the country's powerful and rapidly growing industrial economy and its need for raw materials and markets (the classical motive for empires). Publicly, however, it was the threat of Communism that was presented to American voters as the justification for interference in the internal affairs of other countries. (Today, after the end of the Cold War, it has become necessary to find another respectable motivation that can be used to justify foreign intervention, and the “Crusade Against Communism” has now been replaced by the “War on Terror”.)

During the period from 1945 to the present the US interfered, militarily or covertly, in the internal affairs of a large number of nations: China, 1945-49; Italy, 1947-48; Greece, 1947-49; Philippines, 1946-53; South Korea, 1945-53; Albania, 1949-53; Germany, 1950s; Iran, 1953; Guatemala, 1953-1990s; Middle East, 1956-58; Indonesia, 1957-58; British Guiana/Guyana, 1953-64; Vietnam, 1950-73; Cambodia, 1955-73; The Congo/Zaire, 1960-65; Brazil, 1961-64; Dominican Republic, 1963-66; Cuba, 1959-present; Indonesia, 1965; Chile, 1964-73; Greece, 1964-74; East Timor, 1975-present; Nicaragua, 1978-89; Grenada, 1979-84; Libya, 1981-89; Panama, 1989; Iraq, 1990-present; Afghanistan 1979-92; El Salvador, 1980-92; Haiti, 1987-94; Yugoslavia, 1999; and Afghanistan, 2001-present. Most of these interventions were explained to the American people as being necessary to combat communism (or more recently, terrorism), but an underlying motive was undoubtedly the desire to put in place governments and laws that would be favorable to the economic interests of the US and its allies

For the sake of balance, we should remember that during the Cold War period, the Soviet Union and China also intervened in the internal affairs of many countries, for example in Korea in 1950-53, Tibet, 1950-present, Hungary in 1956, Czechoslovakia in 1968, Afghanistan, 1979-1989, and so on. These Cold War interventions were also unjustifiable, like those mentioned above. Neither a fervently-held conviction that capitalism is wicked and communism good nor an equally fervently-held conviction that the opposite is true can justify military or covert interference by superpowers in the internal affairs of smaller countries, since people have a right to live under

governments of their own choosing even if those governments are not optimal.

The “War Against Terrorism”

At the end of the Cold War there was another terrible crisis for the military establishment, the arms manufacturers and their supporters in research, government and the mass media. People spoke of the “peace dividend”, i.e., constructive use of the trillion dollars that the world wastes each year on armaments. However, just in time, the military-industrial complex was saved from the nightmare of the “peace dividend” by the September 11 attacks on New York and Washington. No matter that the attacks were crimes committed by individuals rather than acts of war, crimes against which police action rather than military action would have been appropriate. The Bush Administration (and CNN, Fox, etc.) quickly proclaimed that a state of war existed, and that the rules of war were in effect. The Cold War was replaced with the “War on Terrorism”. To a large extent, this over-reaction to the events of 9/11/2001 can be interpreted in terms of the needs of the military-industrial complex against which Eisenhower had warned. Without a state of war and without enemies, this vast conglomerate of organizations and pressure groups would have languished.

Blood for oil

There is a close relationship between petroleum and war. James A. Paul, Executive Director of the Global Policy Forum, has described this relationship very clearly in the following words:

“Modern warfare particularly depends on oil, because virtually all weapons systems rely on oil-based fuel - tanks, trucks, armored vehicles, self-propelled artillery pieces, airplanes, and naval ships. For this reason, the governments and general staffs of powerful nations seek to ensure a steady supply of oil during wartime, to fuel oil-hungry military forces in far-flung operational theaters.”

“Just as governments like the US and UK need oil companies to secure fuel for their global war-making capacity, so the oil companies need their governments to secure control over global oilfields and transportation routes. It is no accident, then, that the world’s largest oil companies are located in the world’s most powerful countries.”

“Almost all of the world’s oil-producing countries have suffered abusive, corrupt and undemocratic governments and an absence of durable development. Indonesia, Saudi Arabia, Libya, Iraq, Iran, Angola, Colombia, Venezuela, Kuwait, Mexico, Algeria - these and many other oil producers have a sad record, which includes dictatorships installed from abroad, bloody coups engineered by foreign intelligence services, militarization of government and intolerant right-wing nationalism.”

Iraq, in particular, has been the scene of a number of wars motivated by the West’s thirst for oil. During World War I, 1914-1918, the British captured the area (then known as Mesopotamia) from the Ottoman Empire after four years of bloody fighting. Although Lord Curzon² denied that the British conquest of Mesopotamia was motivated by oil, there is ample evidence that British policy was indeed motivated by a desire for control of the region’s petroleum. For example, Curzon’s Cabinet colleague Sir Maurice Hankey stated in a private letter that oil was “a first-class war aim”. Furthermore, British forces continued to fight after the signing of the Mudros Armistice. In this way, they seized Mosul, the capital of a major oil-producing region, thus frustrating the plans of the French, who had been promised the area earlier in the secret Sykes-Picot Agreement. Lord Curzon was well aware of the military importance of oil, and following the end of the First World War he remarked: “The Allied cause has floated to victory on a wave of oil”.

During the period between 1918 and 1930, fierce Iraqi resistance to the occupation was crushed by the British, who used poison gas, airplanes, incendiary bombs, and mobile armored cars, together with forces drawn from the Indian Army. Winston Churchill, who was Colonial Secretary at the time, regarded the conflict in Iraq as an important test of modern military-colonial methods.

In 1932, Britain granted nominal independence to Iraq, but kept large military forces in the country and maintained control of it through indirect methods. In 1941, however, it seemed likely that Germany might try to capture the Iraqi oilfields, and therefore the British again seized direct political power in Iraq by means of military force. It was not only Germany that Britain feared, but also US attempts to gain access to Iraqi oil.

The British fear of US interest in Iraqi oil was soon confirmed by events. In 1963 the US secretly backed a military coup in Iraq that brought Saddam

²a member of the British War Cabinet who became Foreign Minister immediately after the war



Figure 7.2: *Donald Rumsfeld shaking hands with Saddam Hussein on December 20, 1983. The United States and Britain supported and armed Saddam because they regarded him as a bulwark against Iran.*

Hussein's Ba'ath Party to power.³ In 1979 the western-backed Shah of Iran was overthrown, and the United States regarded the fundamentalist Shi'ite regime that replaced him as a threat to supplies of oil from Saudi Arabia. Washington saw Saddam's Iraq as a bulwark against the militant Shi'ite extremism of Iran that was threatening oil supplies from pro-American states such as Kuwait and Saudi Arabia.

In 1980, encouraged to do so by the fact that Iran had lost its US backing, Saddam Hussein's government attacked Iran. This was the start of a extremely bloody and destructive war that lasted for eight years, inflicting almost a million casualties on the two nations. Iraq used both mustard gas and the nerve gases Tabun and Sarin against Iran, in violation of the Geneva Protocol.

Both the United States and Britain helped Saddam Hussein's government to obtain chemical weapons. A chemical plant, called Falluja 2, was built by Britain in 1985, and this plant was used to produce mustard gas and nerve gas. Also, according to the Riegel Report to the US Senate, May 25, (1994), the Reagan Administration turned a blind eye to the export of chemical weapon precursors to Iraq, as well as anthrax and plague cultures that could be used as the basis for biological weapons. According to the Riegel Report, "records available from the supplier for the period 1985 until the present show that during this time, pathogenic (meaning disease producing) and toxigenic (meaning poisonous), and other biological research materials were

³This was not the CIA's first sponsorship of Saddam: In 1959 he had been part of a CIA-authorized six-man squad that tried to assassinate the Iraqi Prime Minister, Abd al-Karim Qasim.

exported to Iraq pursuant to application and licensing by the US Department of Commerce.”

In 1984, Donald Rumsfeld, Reagan’s newly appointed Middle East Envoy, visited Saddam Hussein to assure him of America’s continuing friendship, despite Iraqi use of poison gas. When (in 1988) Hussein went so far as to use poison gas against civilian citizens of his own country in the Kurdish village of Halabja, the United States worked to prevent international condemnation of the act. Indeed US support for Saddam was so unconditional that he obtained the false impression that he had a free hand to do whatever he liked in the region.

On July 25, 1990, US Ambassador April Glaspie met with Saddam Hussein to discuss oil prices and how to improve US-Iraq relations. According to the transcript of the meeting, Ms Glaspie assured Saddam that the US “had no opinion on the Arab-Arab conflicts, like your border disagreement with Kuwait.” She then left on vacation. Mistaking this conversation for a green light, Saddam invaded Kuwait eight days later.

By invading Kuwait, Hussein severely worried western oil companies and governments, since Saudi Arabia might be next in line. As George Bush senior said in 1990, at the time of the Gulf War, “Our jobs, our way of life, our own freedom and the freedom of friendly countries around the world would all suffer if control of the world’s great oil reserves fell into the hands of Saddam Hussein.”

On August 6, 1990, the UN Security Council imposed comprehensive economic sanctions against Iraq with the aim of forcing Iraq to withdraw from Kuwait. Meanwhile, US Secretary of State James A. Baker III used arm-twisting methods in the Security Council to line up votes for UN military action against Iraq. In Baker’s own words, he undertook the process of “cajoling, extracting, threatening and occasionally buying votes”.

On November 29, 1990, the Council passed Resolution 678, authorizing the use of “all necessary means” (by implication also military means) to force Iraq to withdraw from Kuwait. There was nothing at all wrong with this, since the Security Council had been set up by the UN Charter to prevent states from invading their neighbors. However, one can ask whether the response to Saddam Hussein’s invasion of Kuwait would have been so wholehearted if oil had not been involved.

There is much that can be criticized in the way that the Gulf War of 1990-1991 was carried out. Besides military targets, the US and its allies bombed electrical generation facilities with the aim of creating postwar leverage over

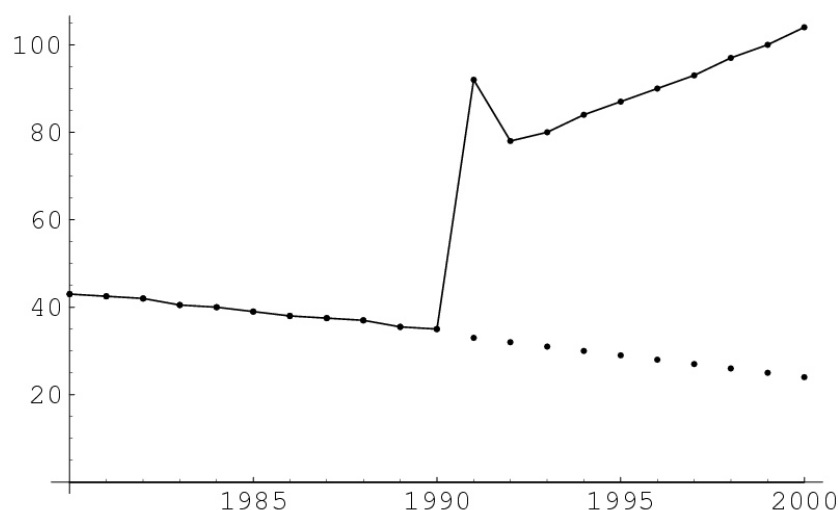


Figure 7.3: *Deaths per year of children under five years of age in Iraq, measured in thousands. This graph is based on a study by UNICEF, and it shows the effect of sanctions on child mortality. From UNICEF's figures it can be seen that the sanctions imposed on Iraq caused the deaths of more than half a million children.*

Iraq. The electrical generating plants would have to be rebuilt with the help of foreign technical assistance, and this help could be traded for postwar compliance. In the meantime, hospitals and water-purification plants were without electricity. Also, during the Gulf War, a large number of projectiles made of depleted uranium were fired by allied planes and tanks. The result was a sharp increase in cancer in Iraq. Finally, both Shi'ites and Kurds were encouraged by the Allies to rebel against Saddam Hussein's government, but were later abandoned by the allies and slaughtered by Saddam.

The most terrible misuse of power, however, was the US and UK insistence the sanctions against Iraq should remain in place after the end of the Gulf War. These two countries used their veto power in the Security Council to prevent the removal of the sanctions. Their motive seems to have been the hope that the economic and psychological impact would provoke the Iraqi people to revolt against Saddam. However that brutal dictator remained firmly in place, supported by universal fear of his police and by massive propaganda. The effect of the sanctions was to produce more than half a million deaths of children under five years of age, as is documented by

UNICEF data. The total number of deaths that the sanctions produced among Iraqi civilians probably exceeded a million, if older children and adults are included.

Ramsey Clark, who studied the effects of the sanctions in Iraq from 1991 onwards, wrote to the Security Council that most of the deaths “are from the effects of malnutrition including marasmas and kwashiorkor, wasting or emaciation which has reached twelve per cent of all children, stunted growth which affects twenty-eight per cent, diarrhea, dehydration from bad water or food, which is ordinarily easily controlled and cured, common communicable diseases preventable by vaccinations, and epidemics from deteriorating sanitary conditions. There are no deaths crueler than these. They are suffering slowly, helplessly, without simple remedial medication, without simple sedation to relieve pain, without mercy.”

September 11, 2001

On the morning of September 11, 2001, two hijacked airliners were deliberately crashed into New York’s World Trade Center, causing the collapse of of three skyscrapers and the deaths of more than three thousand people. Almost simultaneously, another hijacked airliner was driven into the Pentagon in Washington DC, and a fourth hijacked plane crashed in a field in Pennsylvania. The fourth plane probably was to have made a suicide attack on the White House or the Capitol, but passengers on the airliner became aware what was happening through their mobile telephones, and they overpowered the hijackers.

Blame for the September 11 attacks soon centered on the wealthy Saudi Arabian Islamic extremist, Osama bin Laden, and on his terrorist organization, al-Qaeda. In a later statement acknowledging responsibility for the terrorist attacks, bin Ladin gave as his main reasons firstly the massive US support for Israel, a country that, in his view, was committing atrocities against the Palestinians, and secondly the presence of US troops in Saudi Arabia.

Like Saddam Hussein, Osama bin Ladin was an ex-protegé of the CIA, by whom he had previously been armed, trained, and supported. The history of bin Ladin’s relationship with the CIA began in 1979, when the CIA, acting through Pakistan’s Inter-Services Intelligence Agency, began to train and arm the Mujaheddin, an international force of Islamic fundamentalists who were encouraged to attack Afghanistan’s secular socialist government.

US National Security Advisor Zbigniew Bryzinski anticipated that the Soviets would respond by sending troops to protect the socialist government of Afghanistan, and he believed that the resulting war would be the Soviet Union's version of Viet Nam: It would be a war that would fatally weaken the Soviet Union. Thus he saw the war that he was provoking in Afghanistan as an important step in the liberation of Eastern Europe. "What is most important in the history of the world?", Polish-born Bryzinski asked in a 1998 interview, "The Taliban, or the collapse of the Soviet empire? Some stirred-up Muslims, or the liberation of central Europe...?" It was, in fact, these same "stirred-up Muslims" who guided two hijacked aircraft into the Twin Towers on September 11, 2001.

Bin Ladin's father was the head of an extremely wealthy Saudi Arabian family, owner of a very large construction company, with close ties both to the Saudi royal family and the Bush family in America. Through his father's construction company, Osama bin Ladin became involved in building roads and bases for the Mujaheddin in Pakistan and Afghanistan. He also recruited Mujaheddin fighters and solicited support for them. After three years of fighting with covert US support, the Mujaheddin succeeded in defeating the Soviets and in gaining control of Afghanistan. Over eight years, the CIA had spent almost three billion dollars to support and train Islamic militants.

Despite his father's close connections with the Saudi ruling family, Osama bin Laden became progressively more radical in his views, which were influenced by the Wahhabi sect⁴. He wished to expel the US from the Middle East, and especially to expel US troops from Saudi Arabia. He also dreamed of leading a popular revolt to overthrow the Saudi rulers. He perhaps also visualized the formation of an Islamic superstate with control of much of the world's oil.

After the defeat of Soviet troops in Afghanistan, Osama bin Laden returned to Saudi Arabia, where he worked in his family's construction business. However, in 1991 he was expelled from Saudi Arabia for anti-government activities. He took refuge in Sudan, where he spent the next five years.

Bin Ladin is suspected of arranging a bomb attack on the World Trade Center in 1993, and the bombings of two US embassies in Africa in 1998, as well as an attack on the USS Cole in Yemen in 2000. When Sudan became unsafe for Osama and his organization, he moved to Afghanistan, where the

⁴The Wahhabi sect of Islam was founded by Abdul Wahhab (1703-1792). It is known for extremely strict observance of the Koran, and it flourishes mainly in Saudi Arabia.

Taliban movement had gained power. Because of his connection with the Mujaheddin, he was welcomed by the Taliban.

The Taliban began as predominantly Pashtun students of the religious madras schools of Pakistan, where an extreme Saudi-style Islamic fundamentalism was taught. In fact, the word “Taliban” means “student”. Many of the Taliban had been born in refugee camps in Pakistan, and had thus lived with war all their lives. They became an ultraconservative militia, and when they gained control of much of Afghanistan, they reversed many of the liberties and reforms that had been achieved by the previous secular government. In particular, the position of Afghan women was greatly worsened by the Taliban, and production of heroin was much increased.

In discussing Iraq, we mentioned oil as a motivation for western interest. Similar considerations hold also for Afghanistan. US-controlled oil companies have long had plans for an oil pipeline from Turkmenistan, passing through Afghanistan to the Arabian Sea, as well as plans for a natural gas pipeline from Turkmenistan through Afghanistan to Pakistan.

The September 11 terrorist attacks resulted in a spontaneous worldwide outpouring of sympathy for the United States, and within the US, patriotic support of President George W. Bush at a time of national crisis. Bush’s response to the attacks seems to have been to inquire from his advisors whether he was now free to invade Iraq. According to former counterterrorism chief, Richard Clarke, Bush was “obsessed” with Iraq as his principal target after 9/11.

The British Prime Minister, Tony Blair, was a guest at a private White House dinner nine days after the terrorist attacks on New York and Washington. Sir Christopher Meyer, former UK Ambassador to Washington, was also present at the dinner. According to Meyer, Blair said to Bush that they must not get distracted from their main goal - dealing with the Taliban and al-Qaeda in Afghanistan, and Bush replied: “I agree with you Tony. We must deal with this first. But when we have dealt with Afghanistan, we must come back to Iraq.” Faced with the prospect of wars in both Iraq and Afghanistan, Blair did not protest, according to Meyer.

During the summer of 2002, Bush and Blair discussed Iraq by telephone. A senior official from Vice-President Dick Cheney’s office who read the transcript of the call is quoted by the magazine *Vanity Fair* as saying: “The way it read was that come what may, Saddam was going to go; they said that they were going forward, they were going to take out the regime, and they were doing the right thing. Blair did not need any convincing. There was no



Figure 7.4: *The doctrine of “preventive war” was promptly denounced by the Catholic Church. Archbishop Renato Martino, Prefect of the Vatican Council for Peace and Justice, stated firmly that “unilateralism is not acceptable”.*

‘Come on, Tony, we’ve got to get you on board’. I remember reading it and then thinking, ‘OK, now I know what we’re going to be doing for the next year.’”

On June 1, 2002, Bush announced a new US policy which not only totally violated all precedents in American foreign policy but also undermined the United Nations Charter and international law⁵. Speaking at the graduation ceremony of the US Military Academy at West Point he asserted that the United States had the right to initiate a preemptive war against any country that might in the future become a danger to the United States. “If we wait for threats to fully materialize,” he said, “we will have waited too long.” He indicated that 60 countries might fall into this category, roughly a third of the nations of the world.

The assertion that the United States, or any other country, has the right to initiate preemptive wars specifically violates Chapter 1, Articles 2.3 and 2.4, of the United Nations Charter. These require that “All members shall settle their disputes by peaceful means in such a manner that international

⁵He had previously abrogated a number of important treaties.

peace, security and justice are not endangered”, and that “All members shall refrain in their international relations from the threat or use of force against the territorial integrity of any state, or in any other manner inconsistent with the purposes of the United Nations.” The UN Charter allows a nation that is actually under attack to defend itself, but only until the Security Council has had time to act.

Bush’s principle of preemptive war was promptly condemned by the Catholic Church. Senior Vatican officials pointed to the Catholic teaching that “preventive” war is unjustifiable, and Archbishop Renato Martino, prefect of the Vatican Council for Justice and Peace, stated firmly that “unilateralism is not acceptable”. However, in the United States, the shocking content of Bush’s West Point address was not fully debated. The speech was delivered only a few months after the 9/11 terrorist attacks, and the US supported whatever exceptional measures its President thought might be necessary for the sake of national security. American citizens, worried by the phenomenon of terrorism, did not fully appreciate that the principle of preemptive war could justify almost any aggression, and that in the long run, if practiced by all countries, it would undermine the security of the United States as well as that of the entire world.

During the spring of 2003, our television and newspapers presented us with the spectacle of an attack by two technologically superior powers on a much less industrialized nation, a nation with an ancient and beautiful culture. The ensuing war was one-sided. Missiles guided by laser beams and signals from space satellites were more than a match for less sophisticated weapons. Speeches were made to justify the attack. It was said to be needed because of weapons of mass destruction (some countries are allowed to have them, others not). It was said to be necessary to get rid of a cruel dictator (whom the attacking powers had previously supported and armed). But the suspicion remained that the attack was resource-motivated. It was about oil.

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Chapter 8

THE EVOLUTION OF COOPERATION

“Alas, two souls are living in my breast!”

Goethe’s Faust

“No man is an island, entire of itself; every man is a piece of the continent, a part of the main. If a clod be washed away by the sea, Europe is the less, as well as if a promontory were, as well as if a manor of thy friend’s or thine own were...”

John Donne

The passions of mankind

The explosion of human knowledge

Cultural evolution depends on the non-genetic storage, transmission, diffusion and utilization of information. The development of human speech, the invention of writing, the development of paper and printing, and finally in modern times, mass media, computers and the Internet - all these have been crucial steps in society's explosive accumulation of information and knowledge. Human cultural evolution proceeds at a constantly-accelerating speed, so great in fact that it threatens to shake society to pieces.

Every species changes gradually through genetic evolution; but with humans, cultural evolution has rushed ahead with such a speed that it has completely outstripped the slow rate of genetic change. Genetically we are quite similar to our neolithic ancestors, but their world has been replaced by a world of quantum theory, relativity, supercomputers, antibiotics, genetic engineering and space telescopes - unfortunately also a world of nuclear weapons and nerve gas.

Because of the slowness of genetic evolution in comparison to the rapid and constantly-accelerating rate of cultural change, our bodies and emotions (as Malthus put it, the "passions of mankind") are not completely adapted to our new way of life. They still reflect the way of life of our hunter-gatherer ancestors.

Within rapidly-moving cultural evolution, we can observe that technical change now moves with such astonishing rapidity that neither social institutions, nor political structures, nor education, nor public opinion can keep pace. The lightning-like pace of technical progress has made many of our ideas and institutions obsolete. For example, the absolutely-sovereign nation-state and the institution of war have both become dangerous anachronisms in an era of instantaneous communication, global interdependence and all-destroying weapons.

In many respects, human cultural evolution can be regarded as an enormous success. However, at the start of the 21st century, most thoughtful observers agree that civilization is entering a period of crisis. As all curves move exponentially upward - population, production, consumption, rates of scientific discovery, and so on - one can observe signs of increasing environmental stress, while the continued existence and spread of nuclear weapons threatens civilization with destruction. Thus while the explosive growth of

knowledge has brought many benefits, the problem of achieving a stable, peaceful and sustainable world remains serious, challenging and unsolved.

Tribal emotions and nationalism

In discussing conflicts, we must be very careful to distinguish between two distinct types of aggression exhibited by both humans and animals. The first is intra-group aggression, which is often seen in rank-determining struggles, for example when two wolves fight for pack leadership, or when males fight for the privilege of mating with females. Another, completely different, type of aggression is seen when a group is threatened by outsiders. Most animals, including humans, then exhibit a communal defense response - self-sacrificing and heroic combat against whatever is perceived to be an external threat. It is this second type of aggression that makes war possible.

Arthur Koestler has described inter-group aggression in an essay entitled *The Urge to Self-Destruction*¹, where he writes: “Even a cursory glance at history should convince one that individual crimes, committed for selfish motives, play a quite insignificant role in the human tragedy compared with the numbers massacred in unselfish love of one’s tribe, nation, dynasty, church or ideology... Wars are not fought for personal gain, but out of loyalty and devotion to king, country or cause...”

“We have seen on the screen the radiant love of the Führer on the faces of the Hitler Youth... They are transfixed with love, like monks in ecstasy on religious paintings. The sound of the nation’s anthem, the sight of its proud flag, makes you feel part of a wonderfully loving community. The fanatic is prepared to lay down his life for the object of his worship, as the lover is prepared to die for his idol. He is, alas, also prepared to kill anybody who represents a supposed threat to the idol.” The emotion described here by Koestler is the same as the communal defense mechanism (“militant enthusiasm”) described below in biological terms by the Nobel Laureate ethologist Konrad Lorenz.

In *On Aggression*, Lorenz gives the following description of the emotions of a hero preparing to risk his life for the sake of the group: “In reality, militant enthusiasm is a specialized form of communal aggression, clearly distinct from and yet functionally related to the more primitive forms of individual

¹in *The Place of Value in a World of Facts*, A. Tiselius and S. Nielsson editors, Wiley, New York, (1970)

aggression. Every man of normally strong emotions knows, from his own experience, the subjective phenomena that go hand in hand with the response of militant enthusiasm. A shiver runs down the back and, as more exact observation shows, along the outside of both arms. One soars elated, above all the ties of everyday life, one is ready to abandon all for the call of what, in the moment of this specific emotion, seems to be a sacred duty. All obstacles in its path become unimportant; the instinctive inhibitions against hurting or killing one's fellows lose, unfortunately, much of their power. Rational considerations, criticisms, and all reasonable arguments against the behavior dictated by militant enthusiasm are silenced by an amazing reversal of all values, making them appear not only untenable, but base and dishonorable. Men may enjoy the feeling of absolute righteousness even while they commit atrocities. Conceptual thought and moral responsibility are at their lowest ebb. As the Ukrainian proverb says: 'When the banner is unfurled, all reason is in the trumpet'."

"The subjective experiences just described are correlated with the following objectively demonstrable phenomena. The tone of the striated musculature is raised, the carriage is stiffened, the arms are raised from the sides and slightly rotated inward, so that the elbows point outward. The head is proudly raised, the chin stuck out, and the facial muscles mime the 'hero face' familiar from the films. On the back and along the outer surface of the arms, the hair stands on end. This is the objectively observed aspect of the shiver!"

"Anybody who has ever seen the corresponding behavior of the male chimpanzee defending his band or family with self-sacrificing courage will doubt the purely spiritual character of human enthusiasm. The chimp, too, sticks out his chin, stiffens his body, and raises his elbows; his hair stands on end, producing a terrifying magnification of his body contours as seen from the front. The inward rotation of the arms obviously has the purpose of turning the longest-haired side outward to enhance the effect. The whole combination of body attitude and hair-raising constitutes a bluff. This is also seen when a cat humps its back, and is calculated to make the animal appear bigger and more dangerous than it really is. Our shiver, which in German poetry is called a 'Heiliger Schauer', a 'holy' shiver, turns out to be the vestige of a prehuman vegetative response for making a fur bristle which we no longer have. To the humble seeker for biological truth, there cannot be the slightest doubt that human militant enthusiasm evolved out of a communal defense response of our prehuman ancestor."

Lorenz goes on to say, “An impartial visitor from another planet, looking at man as he is today - in his hand the atom bomb, the product of his intelligence - in his heart the aggression drive, inherited from his anthropoid ancestors, which the same intelligence cannot control - such a visitor would not give mankind much chance of survival.”

Members of tribe-like groups are bound together by strong bonds of altruism and loyalty. Echos of these bonds can be seen in present-day family groups, in team sports, in the fellowship of religious congregations, and in the bonds that link soldiers to their army comrades and to their nation.

Warfare involves not only a high degree of aggression, but also an extremely high degree of altruism. Soldiers kill, but they also sacrifice their own lives. Thus patriotism and duty are as essential to war as the willingness to kill.

Tribalism involves passionate attachment to one's own group, self-sacrifice for the sake of the group, willingness both to die and to kill if necessary to defend the group from its enemies, and belief that in case of a conflict, one's own group is always in the right. Unfortunately these emotions make war possible; and today a Third World War might lead to the destruction of civilization.

Population genetics

The mystery of self-sacrifice in war

At first sight, the willingness of humans to die defending their social groups seems hard to explain from the standpoint of Darwinian natural selection. After the heroic death of such a human, he or she will be unable to produce more children, or to care for those already born. Therefore one might at first suppose that natural selection would work strongly to eliminate the trait of self-sacrifice from human nature. However, the theory of population genetics and group selection can explain both the willingness of humans to sacrifice themselves for their own group, and also the terrible aggression that they sometimes exhibit towards competing groups. It can explain both intra-group altruism and inter-group aggression.



Figure 8.1: *Nikolaas Tinbergen (left) and Konrad Lorenz. They and Karl von Frisch shared the 1973 Nobel Prize in Medicine and Physiology for studies of behavior patterns in animals.*

Fisher, Haldane and Hamilton

The idea of group selection in evolution was proposed in the 1930's by J.B.S. Haldane and R.A. Fisher, and more recently it has been discussed by W.D. Hamilton.

If we examine altruism and aggression in humans, we notice that members of our species exhibit great altruism towards their own children. Kindness towards close relatives is also characteristic of human behavior, and the closer the biological relationship is between two humans, the greater is the altruism they tend to show towards each other. This profile of altruism is easy to explain on the basis of Darwinian natural selection since two closely related individuals share many genes and, if they cooperate, the genes will be more effectively propagated.

To explain from an evolutionary point of view the communal defense mechanism discussed by Lorenz - the willingness of humans to kill and be killed in defense of their communities - we have only to imagine that our ancestors lived in small tribes and that marriage was likely to take place within a tribe rather than across tribal boundaries. Under these circumstances, each tribe would tend to consist of genetically similar individuals. The tribe itself, rather than the individual, would be the unit on which the evolutionary forces of natural selection would act.

According to the group selection model, a tribe whose members showed altruism towards each other would be more likely to survive than a tribe whose members cooperated less effectively. Since several tribes might be in competition for the same territory, successful aggression against a neighboring group could increase the chances for survival of one's own tribe. Thus, on the basis of the group selection model, one would expect humans to be kind and cooperative towards members of their own group, but at the same time to sometimes exhibit aggression towards members of other groups, especially in conflicts over territory. One would also expect intergroup conflicts to be most severe in cases where the boundaries between groups are sharpest - where marriage is forbidden across the boundaries.

Language, religion and tribal markings

In biology, a species is defined to be a group of mutually fertile organisms. Thus all humans form a single species, since mixed marriages between all known races will produce children, and subsequent generations in mixed mar-



Figure 8.2: *Sir Ronald Aylmer Fisher (1890-1962). In his book “The Genetical Foundations of Natural Selection”, published in 1930, Fisher laid the foundations of population genetics.*

riages are also fertile. However, although there is never a biological barrier to marriages across ethnic and racial boundaries, there are often very severe cultural barriers.

Irenäus Eibl-Eibesfeldt, a student of Konrad Lorenz, introduced the word *pseudospeciation* to denote cases where cultural barriers between two groups of humans are so strongly marked that marriages across the boundary are difficult and infrequent. In such cases, she pointed out, the two groups function as though they were separate species, although from a biological standpoint this is nonsense. When two such groups are competing for the same land, the same water, the same resources, and the same jobs, the conflicts between them can become very bitter indeed. Each group regards the other as being “not truly human”.

In her book *The Biology of War and Peace*, Eibl-Eibesfeldt discusses the “tribal markings” used by groups of humans to underline their own identity and to clearly mark the boundary between themselves and other groups. One of the illustrations in her book shows the marks left by ritual scarification on the faces of the members of certain African tribes. These scars would be hard to counterfeit, and they help to establish and strengthen tribal identity. Seeing a photograph of the marks left by ritual scarification on the faces of African tribesmen, it is impossible not to be reminded of the dueling scars that Prussian army officers once used to distinguish their caste from outsiders.

Surveying the human scene, one can find endless examples of signs that mark the bearer as a member of a particular group - signs that can be thought of as “tribal markings”: tattoos; piercing; bones through the nose or ears; elongated necks or ears; filed teeth; Chinese binding of feet; circumcision, both male and female; unique hair styles; decorations of the tongue, nose, or naval; peculiarities of dress, kilts, tartans, school ties, veils, chadors, and headdresses; caste markings in India; use or nonuse of perfumes; codes of honor and value systems; traditions of hospitality and manners; peculiarities of diet (certain foods forbidden, others preferred); giving traditional names to children; knowledge of dances and songs; knowledge of recipes; knowledge of common stories, literature, myths, poetry or common history; festivals, ceremonies, and rituals; burial customs, treatment of the dead and ancestor worship; methods of building and decorating homes; games and sports peculiar to a culture; relationship to animals, knowledge of horses and ability to ride; nonrational systems of belief. Even a baseball hat worn backwards or the professed ability to enjoy atonal music can mark a person as a member



Figure 8.3: *Tatoos on the face of a member of a minority group in Myanmar. Tribal markings help social groups to establish their identity and to sharply define the boundaries of the group. Within the group boundaries, humans tend to exhibit altruism, while across the boundaries, aggression is often exhibited. In modern nations, genetically dissimilar humans often use tribal markings to establish social cohesion over a larger group than would otherwise be possible.*

of a special “tribe”. Undoubtedly there are many people in New York who would never think of marrying someone who could not appreciate the paintings of Jasper Johns, and many in London who would consider anyone had not read all the books of Virginia Wolfe to be entirely outside the bounds of civilization.

By far the most important mark of ethnic identity is language, and within a particular language, dialect and accent. If the only purpose of language were communication, it would be logical for the people of a small country like Denmark to stop speaking Danish and go over to a more universally-understood international language such as English. However, language has another function in addition to communication: It is also a mark of identity. It establishes the boundary of the group.

Within a particular language, dialects and accents mark the boundaries of subgroups. For example, in England, great social significance is attached to accents and diction, a tendency that George Bernard Shaw satirized in his play, *Pygmalion*, which later gained greater fame as the musical comedy, *My Fair Lady*. This being the case, we can ask why all citizens of England do not follow the example of Eliza Doolittle in Shaw’s play, and improve their social positions by acquiring Oxford accents. However, to do so would be to run the risk of being laughed at by one’s peers and regarded as a traitor to one’s own local community and friends. School children everywhere can be very cruel to any child who does not fit into the local pattern. At Eton, an Oxford accent is compulsory; but in a Yorkshire school, a child with an Oxford accent would suffer for it.

Next after language, the most important “tribal marking” is religion. It seems probable that in the early history of our hunter-gatherer ancestors, religion evolved as a mechanism for perpetuating tribal traditions and culture. Like language, and like the innate facial expressions studied by Darwin, religion is a universal characteristic of all human societies. All known races and cultures practice some sort of religion. Thus a tendency to be religious seems to be built into human nature, or at any rate, the needs that religion satisfies seem to be a part of our inherited makeup. Otherwise, religion would not be as universal as it is.

Formation of group identity

Although humans originally lived in small, genetically homogeneous tribes, the social and political groups of the modern world are much larger, and are

often multiracial and multiethnic.

There are a number of large countries that are remarkable for their diversity, for example Brazil, Argentina and the United States. Nevertheless it has been possible to establish social cohesion and group identity within each of these enormous nations. India and China too, are mosaics of diverse peoples, but nevertheless, they function as coherent societies. Thus we see that group identity is a social construction, in which artificial “tribal markings” define the boundaries of the group.

As an example of the use of tribal markings to establish social cohesion over a large group of genetically dissimilar humans, one can think of the role of baseball and football in the United States. Affection for these sports and knowledge of their intricacies is able to establish social bonds that transcend racial and religious barriers.

One gains hope for the future by observing how it has been possible to produce both internal peace and social cohesion over very large areas of the globe - areas that contain extremely diverse populations. The difference between making large, ethnically diverse countries function as coherent sociopolitical units and making the entire world function as a unit is not very great.

Since group identity is a social construction, it is not an impossible goal to think of enlarging the already-large groups of the modern world to include all of humanity.

Non-human examples of aggression and altruism

Aggression associated with mating

We must be careful not to confuse intergroup aggression with aggression associated with mating behavior. Among many species of fish, birds and animals, males fight for the privilege of mating. This type of aggression is often associated with sexual dimorphism, i.e. secondary differences in structure between males and females of the same species. For example, the large antlers of male deer are used for rank-determining fights, which confer greater reproductive success on the winner; but herds of deer do not engage in war with other herds. Thus there is a distinction between rank-determining aggression and inter-group aggression.

Chimpanzees and bonobos

The line of descent leading to humans diverged from the line leading to chimpanzees and bonobos between 5 and 6 million years ago. Chimps and bonobos look very similar, and until recent times, naturalists did not realize that they are separate species. However, modern studies have revealed the distinctness of the two species, as well as great differences in their social behavior. Chimpanzee groups are male-dominated, and far more aggressive than bonobo societies, which are female-dominated. Besides the aggression associated with mating (just discussed), chimpanzees also exhibit terrible inter-group aggression.

In his book *Before the Dawn*, Nicholas Wade describes what Jane Goodall, John Mitani, and other primatologists have discovered concerning male chimpanzees' aggression towards neighboring groups of their own species: "Chimpanzees carefully calculate the odds, and seek to minimize risk, a very necessary procedure if one fights on a regular basis. They prefer to attack an isolated individual, and then retreat into their own territory. If they encounter an opposing patrol, they will assess the size of their opponents' party, and retreat if outnumbered. Researchers have confirmed this behavior by playing the call of a single male to chimp parties of various sizes. They find that the chimps will approach if they number three or more; parties of two will slink away. Three against one is the preferred odds: two to hold the victim down, and a third to batter him to death." Interestingly, the female-dominated bonobo societies do not exhibit this type of inter-group warfare, which, among chimpanzees, is conducted exclusively by the males.

The social insects

The social² insects, ants, bees, wasps and termites, exhibit nearly perfect altruism towards members of their own group. This extreme form of altruism towards near relations (kin altruism) is closely connected with the peculiar method of reproduction of the social insects³. The workers are sterile or nearly sterile, while the queen is the only reproductive female. The result of this special method of reproduction is that very nearly perfect altruism

²The technical term is *eusocial*.

³Interestingly a similar method of reproduction, associated with extreme intra-group altruism has evolved among mammals, but is represented by only two species: the naked mole rat and Damaraland mole rat.



Figure 8.4: *A chimpanzee mother and child. The pioneering studies of Jane Goodall showed that male chimpanzees (but not bonobos) frequently engage in raids in which the aim is to ambush and kill males of their own species from neighboring troops.*

is possible within a hive or nest, since genetic changes favoring antisocial behavior would be detrimental to the hive or nest as a whole. The hive or nest can, in some sense, be regarded as a superorganism, with the individuals cooperating totally in much the same way that cells cooperate within a multicellular organism. The social insects exhibit aggression towards members of their own species from other hives or nests, and can be said to engage in wars.

The evolution of cooperation

From Thomas Huxley to Lynn Margulis and symbiosis

Charles Darwin (1809-1882) was acutely aware of close and mutually beneficial relationships between organisms. For example, in his work on the fertilization of flowers, he studied the ways in which insects and plants can become exquisitely adapted to each other's needs.

On the other hand Thomas Henry Huxley (1825-1895), although he was a strong supporter of Darwin, saw competition as the main mechanism of evolution. In his essay *Struggle for Existence and its Bearing Upon Man* Huxley wrote: "From the point of view of the moralist, the animal world is about on the same level as a gladiators' show. The creatures are fairly well treated and set to fight; hereby the strongest, the swiftest, and the cunningest live to fight another day. The spectator has no need to turn his thumbs down, as no quarter is granted."

Prince Peter Kropotkin (1842-1921) argued strongly against Huxley's point of view in his book *Mutual Aid; A Factor of Evolution*. "If we ask Nature", Kropotkin wrote, "who are the fittest: those who are continually at war with each other, or those who support one another?", we at once see that those animals that acquire habits of mutual aid are undoubtedly the fittest. They have more chances to survive, and they attain, in their respective classes, the highest development of intelligence and bodily organization."

Today, the insights of modern biology show that although competition plays an important role, most of the great upward steps in evolution have involved cooperation. The biologist Lynn Margulis (1938-) has been one of the pioneers of the modern viewpoint which recognizes symbiosis as a central mechanism in evolution.

One-celled organisms seen as examples of cooperation

The first small bacterial cells (prokaryotic cells) can be thought of as cooperative communities in which autocatalytic molecules thrived better together than they had previously done separately.

The next great upward step in evolution, the development of large and complex (eukaryotic) cells, also involved cooperation: Many of their components, for example mitochondria (small granular structures that are needed for respiration) and chloroplasts (the photosynthetic units of higher plants) are believed to have begun their existence as free-living prokaryotic cells. They now have become components of complex cells, cooperating biochemically with the other subcellular structures. Both mitochondria and chloroplasts possess their own DNA, which shows that they were once free-living bacteria-like organisms, but they have survived better in a cooperative relationship.

Cooperation between cells; multicellular organisms

Multicellular organisms evolved from cooperative communities of eukaryotic cells. Some insights into how this happened can be gained from examples which are just on the borderline between the multicellular organisms and single-celled ones. The cooperative behavior of a genus of unicellular eukaryotes called slime molds is particularly interesting because it gives us a glimpse of how multicellular organisms may have originated. The name of the slime molds is misleading, since they are not fungi, but are similar to amoebae. Under ordinary circumstances, the individual cells wander about independently searching for food, which they draw into their interiors and digest. However, when food is scarce, they send out a chemical signal of distress. (Researchers have analyzed the molecule which expresses slime mold unhappiness, and they have found it to be cyclic adenosine monophosphate.) At this signal, the cells congregate and the mass of cells begins to crawl, leaving a slimy trail. As it crawls, the community of cells gradually develops into a tall stalk, surmounted by a sphere - the "fruiting body". Inside the sphere, spores are produced by a sexual process. If a small animal, for example a mouse, passes by, the spores may adhere to its coat; and in this way they may be transported to another part of the forest where food is more plentiful. Thus slime molds represent a sort of missing link between unicellular and multicellular organisms. Normally the cells behave as individualists,



Figure 8.5: *Thomas Henry Huxley (1825-1895), caricatured in Vanity Fair. Huxley was a strong supporter of Darwin, but he placed much more emphasis on competition in evolution than Darwin did. In fact, Darwin himself was strongly aware of the great role that cooperation plays.*



Figure 8.6: *The biologist Lynn Margulis argued strongly that eukaryotic cells should be regarded as cooperative communities of simpler organisms that once lived independently. At first she was almost alone in this view, but today it is generally accepted. Most of the great upward steps in evolution have involved cooperation.*



Figure 8.7: *A colony of sponge cells living in a tidal pool. Sponges and slime molds are on the borderline between single celled organisms and multicellular ones. The single cells of these species can live independently, but they can also function as members of a cooperating colony.*

wandering about independently, but when challenged by a shortage of food, the slime mold cells join together into an entity which closely resembles a multicellular organism. The cells even seem to exhibit altruism, since those forming the stalk have little chance of survival, and yet they are willing to perform their duty, holding up the sphere at the top so that the spores will survive and carry the genes of the community into the future.

Multicellular organisms often live in a symbiotic relationship with other species. For example, in both animals and humans, bacteria are essential for the digestion of food. Fungi on the roots of plants aid their absorption of water and nutrients. Communities of bacteria and other organisms living in the soil are essential for the recycling of nutrients. Insects are essential to many plants for pollination.



Figure 8.8: *Two honey bees collecting pollen. The almost perfectly altruistic behavior of bees towards members of their own hive is a consequence of their special method of reproduction, which insures that all the members of the hive are more closely related to each other than they would be to a potential offspring. A hive of bees can be regarded as a superorganism, with the individuals playing roles that are analogous to the roles played by individual cells in a multicellular organism. The degree of cooperation in human society is so great that it too can to some extent be regarded as a superorganism.*

Cooperation in groups of animals and human groups

The social behavior of groups of animals, flocks of birds and communities of social insects involves cooperation as well as rudimentary forms of language. Various forms of language, including chemical signals, postures and vocal signals, are important tools for orchestrating cooperative behavior.

The highly developed language of humans made possible an entirely new form of evolution. In cultural evolution (as opposed to genetic evolution), information is passed between generations not in the form of a genetic code, but in the form of linguistic symbols. With the invention of writing, and later the invention of printing, the speed of human cultural evolution greatly increased. Cooperation is central to this new form of evolution. Cultural advances can be shared by all humans.

The evolution of human cooperation

Intertribal aggression in prehistoric humans

In his book *War Before Civilization* (Oxford University Press, 1996), Professor Lawrence H. Keeley of the University of Illinois states that 87% of all prehistoric tribal societies were at war at least once per year, with 65% fighting continuously with neighboring tribes. Keeley cites as an example a massacre at Crow Creek, South Dakota, where “archaeologists found the remains of more than 500 men, women and children, who had been slaughtered, scalped and mutilated a century and a half before the arrival of Columbus (ca. AD 1325).” Other examples include a 12,000 year old Nubian cemetery, where half of the bodies apparently died by violence. Also cited is a nineteenth century study of intertribal warfare among Australia’s indigenous Murgin people showing that over a twenty-year period, a quarter of the men died in war. Many more examples are given by Harvard archaeologist Stephen A. LeBlanc in *Constant Battles*, (St. Martin’s Press, 2003). Commenting on such studies, Nicolas Wade wrote (in *Before the Dawn*, Penguin Group, 2007), “Had the same casualty rate been suffered by the population of the twentieth century, its war deaths would have totaled two billion people.” Thus, despite the terrifying effectiveness of modern weapons, the percentage of the population killed by war seems to be much smaller today than it was in prehistoric times. However, we need to abolish nuclear weapons before a catastrophic thermonuclear war changes this hopeful statistic.



Figure 8.9: A skull of *Homo sapiens neanderthalensis*. It shows heavy bone ridges above the eyes, which were of value to a species involved in frequent combat. During the evolution of modern humans such “robust” features were lost, and both skulls and bones became thinner (more “gracile”) in proportion to height. This indicates that combat became less frequent as modern humans evolved.

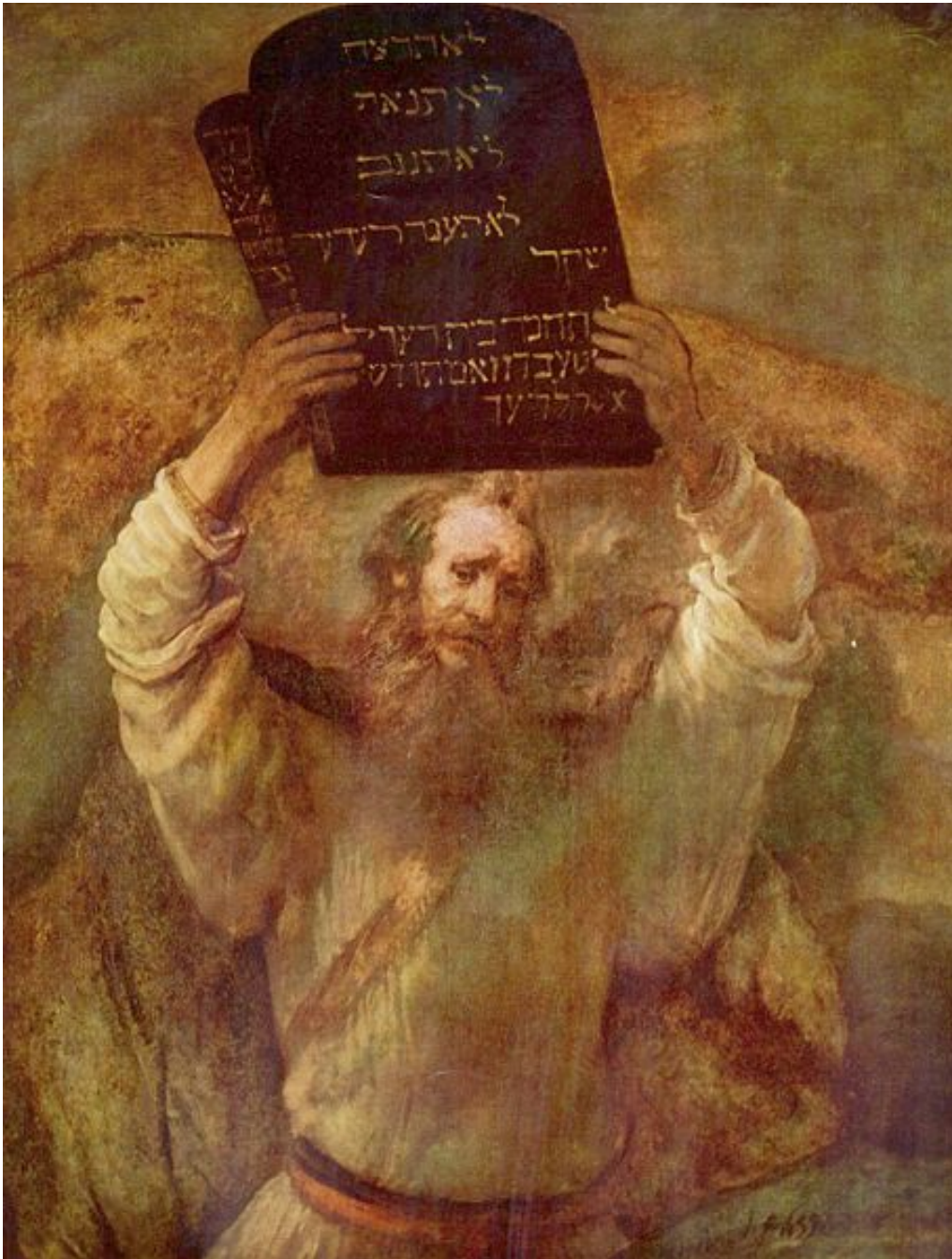


Figure 8.10: *Moses depicted in a painting by Rembrandt. Many of the great ethical teachers of history lived at a time when the social unit was increasing in size - when tribalism needed to be replaced by a wider ethic.*

Trading in primitive societies

Although primitive societies engaged in frequent wars, they also cooperated through trade. Peter Watson, an English historian of ideas, believes that long-distance trade took place as early as 150,000 before the present. There is evidence that extensive trade in obsidian and flint took place during the stone age. Evidence for wide ranging prehistoric obsidian and flint trading networks has been found in North America. Ancient burial sites in Southeast Asia show that there too, prehistoric trading took place across very large distances. Analysis of jade jewelry from the Phillipines, Thailand, Maylasia and Viet Nam shows that the jade originated in Taiwan.

The invention of writing was prompted by the necessities of trade. In prehistoric Mesopotamia, clay tokens marked with simple symbols were used for accounting as early as 8,000 BC. Often these tokens were kept in clay jars, and symbols on the outside of the jars indicated the contents. About 3,500 BC, the use of such tokens and markings led to the development of pictographic writing in Mesopotamia, and this was soon followed by the cuneiform script, still using soft clay as a medium. The clay tablets were later dried and baked to ensure permanency. The invention of writing led to a great acceleration of human cultural evolution. Since ideas could now be exchanged and preserved with great ease through writing, new advances in technique could be shared by an ever larger cooperating community of humans. Our species became more and more successful as its genius for cooperation developed.

Gracilization and decreasing sexual dimorphism

Early ancestors of modern humans had a relatively heavy (robust) bone structure in relation to their height. This robust bone structure seems to have been favored by frequent combat. During their evolution, modern humans became less robust and more gracile. In other words, their skeletons became lighter in relation to their height. Simultaneously the height and weight of males became less different from the height and weight of females. These trends are generally interpreted as indicating that combat became less important as present-day humans evolved.

Ethics and growth of the social unit

Early religions tended to be centered on particular tribes, and the ethics associated with them were usually tribal in nature. However, the more cosmopolitan societies that began to form after the Neolithic agricultural revolution required a more universal code of ethics. It is interesting to notice that many of the great ethical teachers of human history, for example Moses, Socrates, Plato, Aristotle, Lao Tzu, Confucius, Buddha, and Jesus, lived at the time when the change to larger social units was taking place. Tribalism was no longer appropriate. A wider ethic was needed.

Today the size of the social unit is again being enlarged, this time enlarged to include the entire world. Narrow loyalties have become inappropriate and there is an urgent need for a new ethic - a global ethic. Loyalty to one's nation needs to be supplemented by a higher loyalty to humanity as a whole.

Interdependence in modern human society

All of the great upward steps in the evolution of life on earth have involved cooperation: Prokaryotes, the first living cells, can be thought of as cooperative communities of autocatalysts; large, complex eukaryote cells are now believed to have evolved as cooperative communities of prokaryotes; multicellular organisms are cooperative communities of eukaryotes; multicellular organisms cooperate to form societies; and different species cooperate to form ecosystems. Indeed, James Lovelock has pointed out that the earth as a whole is a complex interacting system that can be regarded as a huge organism.

The enormous success of humans as a species is due to their genius for cooperation. The success of humans is a success of cultural evolution, a new form of evolution in which information is passed between generations, not in the form of DNA sequences but in the form of speech, writing, printing and finally electronic signals. Cultural evolution is built on cooperation, and has reached great heights of success as the cooperating community has become larger and larger, ultimately including the entire world.

Without large-scale cooperation, modern science would never have evolved. It developed as a consequence of the invention of printing, which allowed painfully gained detailed knowledge to be widely shared. Science derives its great power from concentration. Attention and resources are brought to bear on a limited problem until all aspects of it are understood. It would make no sense to proceed in this way if knowledge were not permanent, and if the

results of scientific research were not widely shared. But today the printed word and the electronic word spread the results of research freely to the entire world. The whole human community is the repository of shared knowledge.

The achievements of modern society are achievements of cooperation. We can fly, but no one builds an airplane alone. We can cure diseases, but only through the cooperative efforts of researchers, doctors and medicinal firms. We can photograph and understand distant galaxies, but the ability to do so is built on the efforts of many cooperating individuals.

An isolated sponge cell can survive, but an isolated human could hardly do so. Like an isolated bee, a human would quickly die without the support of the community. The comfort and well-being that we experience depends on far-away friendly hands and minds, since trade is global, and the exchange of ideas is also global.

Finally, we should be conscious of our cooperative relationships with other species. We could not live without the bacteria that help us to digest our food. We could not live without the complex communities of organisms in the soil that convert dead plant matter into fertile topsoil. We could not live without plants at the base of the food chain, but plants require pollination, and pollination frequently requires insects. An intricate cooperative network of inter-species relationships is necessary for human life, and indeed necessary for all life. Competition plays a role in evolution, but the role of cooperation is greater.

Two sides of human nature

Looking at human nature, both from the standpoint of evolution and from that of everyday experience, we see the two faces of Janus; one face shines radiantly; the other is dark and menacing. Two souls occupy the human breast, one warm and friendly, the other murderous. Humans have developed a genius for cooperation, the basis for culture and civilization; but they are also capable of genocide; they were capable of massacres during the Crusades, capable of genocidal wars against the Amerinds, capable of the Holocaust, of Hiroshima, of the killing-fields of Cambodia, of Rwanda, and of Darfur

As an example of the two sides of human nature, we can think of Scandinavia. The Vikings were once feared throughout Europe. The Book of Common Prayer in England contains the phrase “Protect us from the fury of the Northmen!”. Today the same people are so peaceful and law-abiding

that they can be taken as an example for how we would like a future world to look. Human nature has the possibility for both kinds of behavior depending on the circumstances. This being so, there are strong reasons to enlist the help of education and religion to make the bright side of human nature win over the dark side. Today, the mass media are an important component of education, and thus the mass media have a great responsibility for encouraging the cooperative and constructive side of human nature rather than the dark and destructive side. In the next chapter we will explore the question of how the media can better fulfill this responsibility.

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Chapter 9

UNFULFILLED RESPONSIBILITIES OF THE MEDIA

“All’s quiet here. There will be no war”

“You supply the pictures. I’ll supply the war”

(exchange of telegrams between illustrator Frederick Remington and newspaper proprietor William Randolph Hearst prior to the Spanish-American War)

Failure of the media to help

Throughout history, art was commissioned by rulers to communicate, and exaggerate, their power, glory, absolute rightness etc, to the populace. The pyramids gave visual support to the power of the Pharaoh; portraits of rulers are a traditional form of propaganda supporting monarchies; and palaces were built as symbols of power. Modern powerholders are also aware of the importance of propaganda. Thus the media are a battleground where reformers struggle for attention, but are defeated with great regularity by the wealth and power of the establishment. This is a tragedy because today there is an urgent need to make public opinion aware of the serious problems facing civilization, and the steps that are needed to solve these problems. The mass media could potentially be a great force for public education, but in general their role is not only unhelpful - it is often negative.

War and conflict are blatantly advertised by television and newspapers. Think, for example, of television programs like the National Geographic Channel's "Battleground" series or the Discovery Channel and National Geographic Channel's enthusiastic programs praising the deadliness and efficiency of various modern weapons systems. Such outright advertisements for the institution of war seem to have the wholehearted support of the networks. Meanwhile the peace movement has almost no access to the mainstream media.

Newspapers and war

There is a true story about the powerful newspaper owner William Randolph Hearst that illustrates the relationship between the mass media and the institution of war: When an explosion sank the American warship USS Maine in the harbor of Havana, Hearst anticipated (and desired) that the incident would lead to war between the United States and Spain. He therefore sent his best illustrator, Fredrick Remington, to Havana to produce drawings of the scene. After a few days in Havana, Remington cabled to Hearst, "All's quiet here. There will be no war." Hearst cabled back, "You supply the pictures. I'll supply the war." Hearst was true to his words. His newspapers inflamed American public opinion to such an extent that the Spanish-American War became inevitable. During the course of the war, Hearst sold many newspapers, and Remington many drawings. From this story one might almost conclude that newspapers thrive on war, while war thrives on newspapers.



Figure 9.1: *“Charge of the Rough Riders”, a painting by Frederick Remington showing a scene from the Spanish-American War. During the war, Remington sold many paintings and Hearst sold many newspapers.*

Before the advent of widely-read newspapers, European wars tended to be fought by mercenary soldiers, recruited from the lowest ranks of society, and motivated by financial considerations. The emotions of the population were not aroused by such limited and decorous wars. However, the French Revolution and the power of newspapers changed this situation, and war became a total phenomenon that involved emotions. The media were able to mobilize on a huge scale the communal defense mechanism that Konrad Lorenz called “militant enthusiasm” - self-sacrifice for the defense of the tribe. It did not escape the notice of politicians that control of the media is the key to political power in the modern world. For example, Hitler was extremely conscious of the force of propaganda, and it became one of his favorite instruments for exerting power.

With the advent of radio and television, the influence of the mass media became still greater. Today, state-controlled or money-controlled newspapers, radio and television are widely used by the power elite to manipulate public opinion. This is true in most countries of the world, even in those that pride themselves on allowing freedom of speech. For example, during the US-led invasion of Iraq in 2003, the official version of events was broad-

cast by CNN, and criticism of the invasion was almost absent from their transmissions.

The role of the mass media in creating values

In the mid-1950's, television became cheap enough so that ordinary people in the industrialized countries could afford to own sets. During the infancy of television, its power was underestimated. The great power of television is due to the fact that it grips two senses simultaneously, both vision and hearing. The viewer becomes an almost-hypnotized captive of the broadcast. In the 1950's, this enormous power, which can be used both for good and for ill, was not yet fully apparent. Thus insufficient attention was given to the role of television in education, in setting norms, and in establishing values. Television was not seen as an integral part of the total educational system.

It is interesting to compare the educational systems of traditional cultures with those of modern industrial societies. In traditional societies, multigenerational families often live together in the same dwelling. In general, there is a great deal of contact between grandparents and grandchildren, with much transmission of values and norms between generations. Old people are regarded with great respect, since they are considered to be repositories of wisdom, knowledge, and culture.

By contrast, modern societies usually favor nuclear families, consisting of only parents and children. Old people are marginalized. They live by themselves in communities or homes especially for the old. Their cultural knowledge and norms are not valued because they are "out of date". In fact, during the life of a young person in one of the rapidly-changing industrial societies of the modern world, there is often a period when they rebel against the authority of their parents and are acutely embarrassed by their parents, who are "so old-fashioned that they don't understand anything".

Although the intergenerational transmission of values, norms, and culture is much less important in industrial societies than it is in traditional ones, modern young people of the west and north are by no means at a loss over where to find their values, fashions and role models. With every breath, they inhale the values and norms of the mass media, the norms of pop culture. Totally surrounded by a world of television and film images, they accept this world as their own. Unfortunately the culture of television, films and computer games is more often a culture of violence than a culture of peace, more often a culture of self-indulgence than an ethical culture, more often a

culture of materialism than a culture of respect for nature. Literature, art, architecture and music are capable of transmitting humanism and internationalism to our young people, but these values are being lost today, and replaced by a culture of power worship, violence and consumerism.

Computer games designed for young boys often give the strongest imaginable support to our present culture of violence. For example, a game entitled "Full Spectrum Warrior" was recently reviewed in a Danish newspaper. According to the reviewer, "...An almost perfect combination of graphics, sound, band design, and gameplay makes it seem exactly like the film *Black Hawk Down* - with the player as the main character. This is not just a coincidence, because the game is based on an army training program... Full Spectrum Warrior is an extremely intense experience, and despite the advanced possibilities, the controls are simple enough so that young children can play it... The player is completely drawn into the screen, and remains there until the end of the mission." The reviewer gave the game six stars (the maximum).

If entertainment is evaluated only on the basis of immediate fascination and popularity, what might be called "the pornography of violence" gets high marks. However, there is another way of looking at entertainment. It is a part, and a very important part, of our total educational system.

Even animals undergo education, and often the playing of young animals is a part of the educational process. For example, when lion cubs play, they are learning skills that are useful to them in hunting. The same can be said of kittens playing with bits of yarn. Books of adventures read by young humans also have an educational value, and on a higher level, works of literature expand our ability to understand our fellow humans and to sympathize with them. Each culture, by means of oral traditions, songs, poems, and stories, as well as by means of formal education, tries to modify raw human nature and to mould it to the ideal of that particular society. In this process, entertainment and formal education go hand in hand, each contributing ethical values and norms that are desirable for the way of life of a particular group.

In modern industrial societies, this important educational function has been given by default to commercial interests. Instead of supporting socially desirable behavior, the entertainment industry, driven by the quest for higher popularity ratings and higher profits, explores increasingly murky depths in the swamp of popular taste. We would not want Coca Cola to run our schools, but entertainment is just as important as the school or home environment in forming values and norms, and entertainment is in the hands of commerce.

The mass media and our present predicament

Today we are faced with the task of creating a new global ethic in which loyalty to family, religion and nation will be supplemented by a higher loyalty to humanity as a whole. In case of conflicts, loyalty to humanity as a whole must take precedence. In addition, our present culture of violence must be replaced by a culture of peace. To achieve these essential goals, we urgently need the cooperation of the mass media.

The predicament of humanity today has been called “a race between education and catastrophe”: Human emotions have not changed much during the last 40,000 years. As we saw in Chapter 8, human nature still contains an element of tribalism to which nationalistic politicians successfully appeal. The completely sovereign nation-state is still the basis of our global political system. The danger in this situation is due to the fact that modern science has given the human race incredibly destructive weapons. Because of these weapons, the tribal tendencies in human nature and the politically fragmented structure of our world have both become dangerous anachronisms.

After the tragedies of Hiroshima and Nagasaki, Albert Einstein said, “The unleashed power of the atom has changed everything except our way of thinking, and thus we drift towards unparalleled catastrophes.” We have to learn to think in a new way. Will we learn this in time to prevent disaster? When we consider the almost miraculous power of our modern electronic media, we can be optimistic. Cannot our marvelous global communication network be used to change anachronistic ways of thought and anachronistic social and political institutions in time, so that the system will not self-destruct as science and technology revolutionize our world? If they were properly used, our instantaneous global communications could give us hope.

As we saw in Chapter 8, the success of our species is built on cultural evolution, the central element of which is cooperation. Thus human nature has two sides, tribal emotions are present, but they are balanced by the human genius for cooperation. The case of Scandinavia - once war-torn, now cooperative - shows that education is able to bring out either the kind and cooperative side of human nature, or the xenophobic and violent side. Which of these shall it be? It is up to our educational systems to decide, and the mass media are an extremely important part of education. Hence the great responsibility that is now in the hands of the media.

How do the media fulfill this life-or-death responsibility? Do they give us insight? No, they give us pop music. Do they give us an understanding

of the sweep of evolution and history? No, they give us sport. Do they give us an understanding of need for strengthening the United Nations, and the ways that it could be strengthened? No, they give us sit-coms and soap operas. Do they give us unbiased news? No, they give us news that has been edited to conform with the interests of the military-industrial complex and other powerful lobbys. Do they present us with the need for a just system of international law that acts on individuals? On the whole, the subject is neglected. Do they tell of the essentially genocidal nature of nuclear weapons, and the need for their complete abolition? No, they give us programs about gardening and making food.

A consumer who subscribes to the “package” of broadcasts sold by a cable company can often search through all 35 or 45 channels without finding a single program that offers insight into the various problems that are facing the world today. What the viewer finds instead is a mixture of pro-establishment propaganda and entertainment. Meanwhile the neglected global problems are becoming progressively more severe.

In general, the mass media behave as though their role is to prevent the peoples of the world from joining hands and working to change the world and to save it from thermonuclear and environmental catastrophes. The television viewer sits slumped in a chair, passive, isolated, disempowered and stupefied. The future of the world hangs in the balance, the fate of children and grandchildren hang in the balance, but the television viewer feels no impulse to work actively to change the world or to save it. The Roman emperors gave their people bread and circuses to numb them into political inactivity. The modern mass media seem to be playing a similar role.

The dilemma of freedom and responsibility

One is faced with a dilemma, because on the one hand artistic freedom is desirable and censorship undesirable, but on the other hand some degree of responsibility ought to be exercised by the mass media because of their enormous influence in creating norms and values.

Even today, there exists some degree of self-restraint on the part of the entertainment industry. There is a self-imposed code according to which incitement to racial prejudice is not allowed. Today, when a figure of authority, for example a judge, is shown in a film or on a television program, the judge is likely to be a member of a minority group.

To do justice to the mass media, one also has to say that in recent years

they have made efforts to educate the public about global warming and other environmental problems. Furthermore, today's heroes and heroines are not shown with cigarettes hanging from their lips. In fact we are a little shocked to see old Humphrey Bogart films where scenes of smoking are constantly on the screen. If the mass media can accept the degree of responsibility needed to delegitimize racism, to delegitimize unnecessary CO₂ emissions, and to delegitimize smoking, can they not also delegitimize nuclear weapons? One can hope for future restraint in the depiction of violence and war, and in the depiction of international conflicts. One can hope for future support for cross-cultural understanding.

Of course we cannot say to the entertainment industry, "From now on you must not show anything but David Attenborough and the life of Gandhi". However, it would be enormously helpful if every film or broadcast or computer game could be evaluated not only for its popularity and artistic merit, but also in terms of the good or harm that it does in the task of building a stable and peaceful future world. Of course, there must be entertainment and escapism - but there should also be insight. This must be made available for people who care about the fate of the world. At present it is not available.

Some years ago, when CNN was still owned by Ted Turner, the network introduced a global weather forecast. This feature is still continued by CNN even though its new owners are much less idealistic than Ted Turner. Furthermore, the BBC has also adopted the global weather forecast. When we see a map of the world with temperatures and storms, we receive much more information than we need to decide whether to take an umbrella with us tomorrow. For planning picnics, it is not necessary for us to know that in Beijing it will be warm and slightly overcast. Ted Turner was aware of this, and we are aware of it, but all of us realize that the global weather forecast is a simple and beautiful means for creating global consciousness.

A United Nations television channel?

Why doesn't the United Nations have its own global television network? Such a network could produce an unbiased version of the news. It could broadcast documentary programs on global problems. It could produce programs showing viewers the music, art and literature of other cultures than their own. It could broadcast programs on the history of ideas, in which the contributions of many societies were adequately recognized. At New Year, when people are in the mood to think of the past and the future, the Secretary General of the

United Nations could broadcast a “State of the World” message, summarizing the events of the past year and looking forward to the new year, with its problems, and with his recommendations for their solution. A United Nations television network would at least give viewers a choice between programs supporting militarism and consumerism, and programs supporting a global culture of peace and sustainability. At present they have little choice.

Responsibility

Whose responsibility is it to save the world by changing it? Whose responsibility is it to replace our anachronistic social, political and economic institutions by new institutions that will harmonize with the realities of the new world that modern science has created? If you ask politicians they say it is not their responsibility. They cannot act without popular support if they want to be re-elected. If you ask ordinary people they say it is not their responsibility. What can one person do? If you ask journalists, they say that if they ever reported the news in a way that did not please their employers, they would lose their jobs. But in reality, perhaps all three actors - politicians, ordinary people, and journalists - have a responsibility to be more courageous and far-sighted, and to act together. No one acting alone can achieve the changes that we so desperately need; but all of us together, joining hands, can do it.

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Chapter 10

ABOLITION OF WAR

“We have to extend our loyalty to the whole of the human race.... A war-free world will be seen by many as Utopian. It is not Utopian. There already exist in the world large regions, for example the European Union, within which war is inconceivable. What is needed is to extend these...”

Sir Joseph Rotblat, Nobel Peace Prize Acceptance Speech, 1995.

The growth of global consciousness

Besides a humane, democratic and just framework of international law and governance, we urgently need a new global ethic, - an ethic where loyalty to family, community and nation will be supplemented by a strong sense of the brotherhood of all humans, regardless of race, religion or nationality. Schiller expressed this feeling in his “Ode to Joy”, a part of which is the text of Beethoven’s Ninth Symphony. Hearing Beethoven’s music and Schiller’s words, most of us experience an emotion of resonance and unity with the message: All humans are brothers and sisters - not just some - all! It is almost a national anthem of humanity. The feelings that the music and words provoke are similar to patriotism, but broader. It is this sense of a universal human family that we need to cultivate in education, in the mass media, and in religion. We already appreciate music, art and literature from the entire world, and scientific achievements are shared by all, regardless of their country of origin. We need to develop this principle of universal humanism so that it will become the cornerstone of a new ethic.

Reformed teaching of history

Educational reforms are urgently needed, particularly in the teaching of history. As it is taught today, history is a chronicle of power struggles and war, told from a biased national standpoint. Our own race or religion is superior; our own country is always heroic and in the right.

We urgently need to replace this indoctrination in chauvinism by a reformed view of history, where the slow development of human culture is described, giving adequate credit to all who have contributed. Our modern civilization is built on the achievements of many ancient cultures. China, Japan, India, Mesopotamia, Egypt, Greece, the Islamic world, Christian Europe, and the Jewish intellectual traditions all have contributed. Potatoes, corn, squash, vanilla, chocolate, chili peppers, pineapples, quinine, etc. are gifts from the American Indians. Human culture, gradually built up over thousands of years by the patient work of millions of hands and minds, should be presented as a precious heritage - far too precious to be risked in a thermonuclear war.

The teaching of history should also focus on the times and places where good government and internal peace have been achieved, and the methods by which this has been accomplished. Students should be encouraged to think

about what is needed if we are to apply the same methods to the world as a whole. In particular, the histories of successful federations should be studied, for example the Hanseatic League, the Universal Postal Union, the federal governments of Australia, Brazil, Germany, Switzerland, the United States, Canada, and so on. The recent history of the European Union provides another extremely important example. Not only the successes, but also the problems of federations should be studied in the light of the principle of subsidiarity¹. The essential features of federations should be clarified², as well as the reasons why weaker forms of union have proved to be unsuccessful.

Reformed education of economists and businessmen

The education of economists and businessmen needs to face the problems of global poverty - the painful contrast between the affluence and wastefulness of the industrial North and the malnutrition, disease and illiteracy endemic in the South. Students of economics and business must look for the roots of poverty not only in population growth and war, but also in the history of colonialism and neocolonialism, and in defects in global financial institutions and trade agreements. They must be encouraged to formulate proposals for the correction of North-South economic inequality.

The economic impact of war and preparation for war should be included in the training of economists. Both direct and indirect costs should be studied. An example of an indirect cost of war is the effect of unimaginably enormous military budgets in reducing the amount of money available for solving the serious problems facing the world today.

Law for a united world

Law students should be made aware of the importance of international law. They should be familiar with its history, starting with Grotius and the Law

¹The principle of subsidiarity states that within a federation, decisions should be taken at the lowest level at which there are no important externalities. Thus, for example, decisions affecting air quality within Europe should be taken in Bruxelles because winds blow freely across national boundaries, but decisions affecting only the local environment should be taken locally.

²One of the most important of these features is that federations have the power to make and enforce laws that are binding on individuals, rather than trying to coerce their member states.

of the Sea. They should know the histories of the International Court of Justice and the Nuremberg Principles. They should study the United Nations Charter (especially the articles making war illegal) and the Universal Declaration of Human Rights, as well as the Rome Treaty and the foundation of the International Criminal Court. They should be made aware of a deficiency in the present United Nations - the lack of a legislature with the power to make laws that are binding on individuals.

Students of law should be familiar with all of the details of the World Court's historic Advisory Opinion on Nuclear Weapons, a decision that make the use or threat of use of nuclear weapons illegal. They should also study the Hague and Geneva Conventions, and the various international treaties related to nuclear, chemical and biological weapons. The relationship between the laws of the European Union and those of its member states should be given high importance. The decision by the British Parliament that the laws of the EU take precedence over British law should be a part of the curriculum.

Teaching global ethics

Professors of theology should emphasize three absolutely central components of religious ethics: the duty to love and forgive one's enemies, the prohibition against killing, and the concept of universal human brotherhood. They should make their students conscious of a responsibility to give sermons that are relevant to the major political problems of the modern world, and especially to relate the three ethical principles just mentioned to the problem of war. Students of theology should be made conscious of their responsibility to soften the boundaries between ethnic groups, to contribute to interreligious understanding, and to make marriage across racial and religious boundaries more easy and frequent.

The social responsibility of scientists

In teaching science too, reforms are needed. Graduates in science and engineering should be conscious of their responsibilities. They must resolve never to use their education in the service of war, nor for the production of weapons, nor in any way that might be harmful to society or to the environment.

Science and engineering students ought to have some knowledge of the history and social impact of science. They could be given a course on the

history of scientific ideas; but in connection with modern historical developments such as the industrial revolution, the global population explosion, the development of nuclear weapons, genetic engineering, and information technology, some discussion of social impact of science could be introduced. One might hope to build up in science and engineering students an understanding of the way in which their own work is related to the general welfare of humankind, and a sense of individual social and ethical responsibility. These elements are needed in science education if rapid technological progress is to be beneficial to society rather than harmful.

The changes just mentioned in the specialized university training of historians, economists, businessmen, lawyers, theologians, scientists and engineers should have a counterpart in elementary education. The basic facts about peace and war should be communicated to children in simple language, and related to the everyday experiences of children. Teachers' training colleges ought to discuss with their student-teachers the methods that can be used to make peace education a part of the curriculum at various levels, and how it can be related to familiar concepts. They should also discuss the degree to which the painful realities of war can be explained to children of various ages without creating an undesirable amount of anxiety.

Peace education can be made a part of the curriculum of elementary schools through (for example) theme days or theme weeks in which the whole school participates. This method has been used successfully in many European schools. During the theme days the children have been encouraged to produce essays, poems and drawings illustrating the difference between peace and war, and between negative peace and positive peace³. Another activity has been to list words inspired by the concept "peace", rapidly and by free association, and to do the same for the concept "war". Drama has also been used successfully in elementary school peace education, and films have proved to be another useful teaching aid.

The problems of reducing global inequalities, of protecting human rights, and of achieving a war-free world can be introduced into grade school courses in history, geography, religion and civics. The curriculum of these courses is frequently revised, and advocates of peace education can take curriculum revisions as opportunities to introduce much-needed reforms that will make

³Negative peace is merely the absence of war. In positive peace, neighboring nations are actively engaged in common projects of mutual benefit, in cultural exchanges, in trade, in exchanges of students and so on.

the students more international in their outlook. The argument (a true one) should be that changes in the direction of peace education will make students better prepared for a future in which peace will be a central issue and in which they will interact with people of other nations to a much greater extent than was the case in previous generations. The same can be said for curriculum revisions at the university level.

Local elimination of war

Large nations compared with global government

The problem of achieving internal peace over a large geographical area is not insoluble. It has already been solved. There exist today many nations or regions within each of which there is internal peace, and some of these are so large that they are almost worlds in themselves. One thinks of China, India, Brazil, Australia, the Russian Federation, the United States, and the European Union. Many of these enormous societies contain a variety of ethnic groups, a variety of religions and a variety of languages, as well as striking contrasts between wealth and poverty. If these great land areas have been forged into peaceful and cooperative societies, cannot the same methods of government be applied globally?

But what are the methods that nations use to achieve internal peace? Firstly, every true government needs to have the power to make and enforce laws that are binding on individual citizens. Secondly the power of taxation is a necessity. These two requirements of every true government have already been mentioned; but there is a third point that still remains to be discussed:

Within their own territories, almost all nations have more military power than any of their subunits. For example, the US Army is more powerful than the State Militia of Illinois. This unbalance of power contributes to the stability of the Federal Government of the United States. When the FBI wanted to arrest Al Capone, it did not have to bomb Chicago. Agents just went into the city and arrested the gangster. Even if Capone had been enormously popular in Illinois, the government of the state would have realized in advance that it had no chance of resisting the US Federal Government, and it still would have allowed the “Feds” to make their arrest. Similar considerations hold for almost all nations within which there is internal peace. It is true that there are some nations within which subnational groups have more

power than the national government, but these are frequently characterized by civil wars.

Of the large land areas within which internal peace has been achieved, the European Union differs from the others because its member states still maintain powerful armies. The EU forms a realistic model for what can be achieved globally in the near future by reforming and strengthening the United Nations. In the distant future, however, we can imagine a time when a world federal authority will have much more power than any of its member states, and when national armies will have only the size needed to maintain local order.

Today there is a pressing need to enlarge the size of the political unit from the nation-state to the entire world. The need to do so results from the terrible dangers of modern weapons and from global economic interdependence. The progress of science has created this need, but science has also given us the means to enlarge the political unit: Our almost miraculous modern communications media, if properly used, have the power to weld all of humankind into a single supportive and cooperative society.

Federations and international law

Reform of the United Nations

It is becoming increasingly clear that the concept of the absolutely sovereign nation-state is a dangerous anachronism in a world of thermonuclear weapons, instantaneous communication, and economic interdependence. Probably our best hope for the future lies in developing the United Nations into a World Federation. The strengthened United Nations should have a legislature with the power to make laws that are binding on individuals, and the ability to arrest and try individual political leaders for violations of these laws. The world federation should also have the military and legal powers necessary to guarantee the human rights of ethnic minorities within nations.

The Charter should not be thought of as cast in concrete for all time. It needs instead to grow with the requirements of our increasingly interdependent global society. We should remember that the Charter was drafted and signed before the first nuclear bomb was dropped on Hiroshima; and it also could not anticipate the extraordinary development of international trade and communication which characterizes the world today.

Among the weaknesses of the present U.N. Charter is the fact that it does not give the United Nations the power to make laws which are binding on individuals. At present, in international law, we treat nations as though they were persons: We punish entire nations by sanctions when the law is broken, even when only the leaders are guilty, even though the burdens of the sanctions fall most heavily on the poorest and least guilty of the citizens, and even though sanctions often have the effect of uniting the citizens of a country behind the guilty leaders. To be effective, the United Nations needs a legislature with the power to make laws which are binding on individuals, and the power to arrest individual political leaders for flagrant violations of international law.

The present United Nations Charter contains guarantees of human rights, but there is no effective mechanism for enforcing these guarantees. In fact there is a conflict between the parts of the Charter protecting human rights and the concept of absolute national sovereignty. Recent history has given us many examples of atrocities committed against ethnic minorities by leaders of nation-states, who claim that sovereignty gives them the right to run their internal affairs as they wish, free from outside interference.

One feels that it ought to be the responsibility of the international community to prevent gross violations of human rights, such as the use of poison gas against civilians (to mention only one of the more recent political crimes). If this is in conflict with the notion of absolute national sovereignty, then sovereignty must yield. In fact, the concept of the absolutely sovereign nation-state as the supreme political entity is already being eroded by the overriding need for international law. Recently, for example, the Parliament of Great Britain, one of the oldest national parliaments, acknowledged that laws made by the European Union take precedence over English common law.

Today the development of technology has made global communication almost instantaneous. We sit in our living rooms and watch, via satellite, events taking place on the opposite side of the globe. Likewise the growth of world trade has brought distant countries into close economic contact with each other. Financial tremors in Tokyo can shake New York. The impact of contemporary science and technology on transportation and communication has effectively abolished distance in relations between nations. This close contact and interdependence will increasingly require effective international law to prevent conflicts. However, the need for international law must be balanced against the desirability of local self-government. Like biological

diversity, the cultural diversity of humankind is a treasure to be carefully guarded. A balance or compromise between these two desirable goals could be achieved by granting only a few carefully chosen powers to a strengthened United Nations with sovereignty over all other issues retained by the member states.

Federations, past, present and future

A federation of states is, by definition, a limited union where the federal government has the power to make laws that are binding on individuals, but where the laws are confined to interstate matters, and where all powers not expressly delegated to the federal government are retained by the individual states. In other words, in a federation each of the member states runs its own internal affairs according to its own laws and customs, but in certain agreed-on matters, where the interests of the states overlap, authority is specifically delegated to the federal government.

For example, if the nations of the world considered the control of narcotics to be a matter of mutual concern; if they agreed to set up a commission with the power to make laws preventing the growing, refinement and distribution of harmful drugs, and the power to arrest individuals for violating those laws, then we would have a world federation in the area of narcotics control.

If, in addition, the world community considered terrorism to be a matter of mutual concern; if an international commission were also set up with the power to make global antiterrorist laws, then we would have a world federation with somewhat broader powers.

If the community of nations decided to give the federal authority the additional power to make laws defining the rights and obligations of multinational corporations, and the power to arrest or fine individuals violating those laws, then we would have a world federation with even broader powers; but these powers would still be carefully defined and limited. In setting up a federation, the member states can decide which powers they wish to delegate to it; and all powers not expressly delegated are retained by the individual states.

Since the federal structure seems well suited to a world government with limited and carefully-defined powers that would preserve as much local autonomy as possible, it is worthwhile to look at the histories of a few of the federations. There is much that we can learn from their experiences.

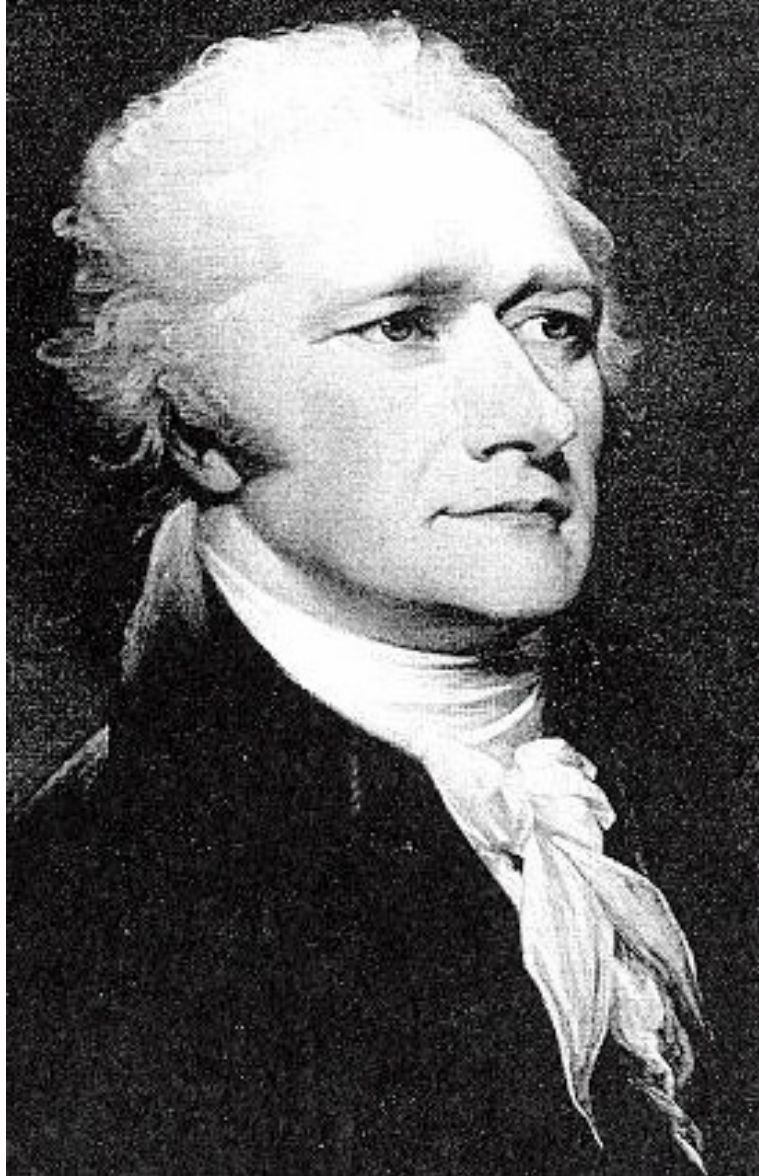


Figure 10.1: *Alexander Hamilton (1755-1804), author of the “Federalist Papers”. Commenting on the weakness of the Articles of Confederation, Hamilton said, “To coerce states is one of the maddest projects that was ever devised!”*

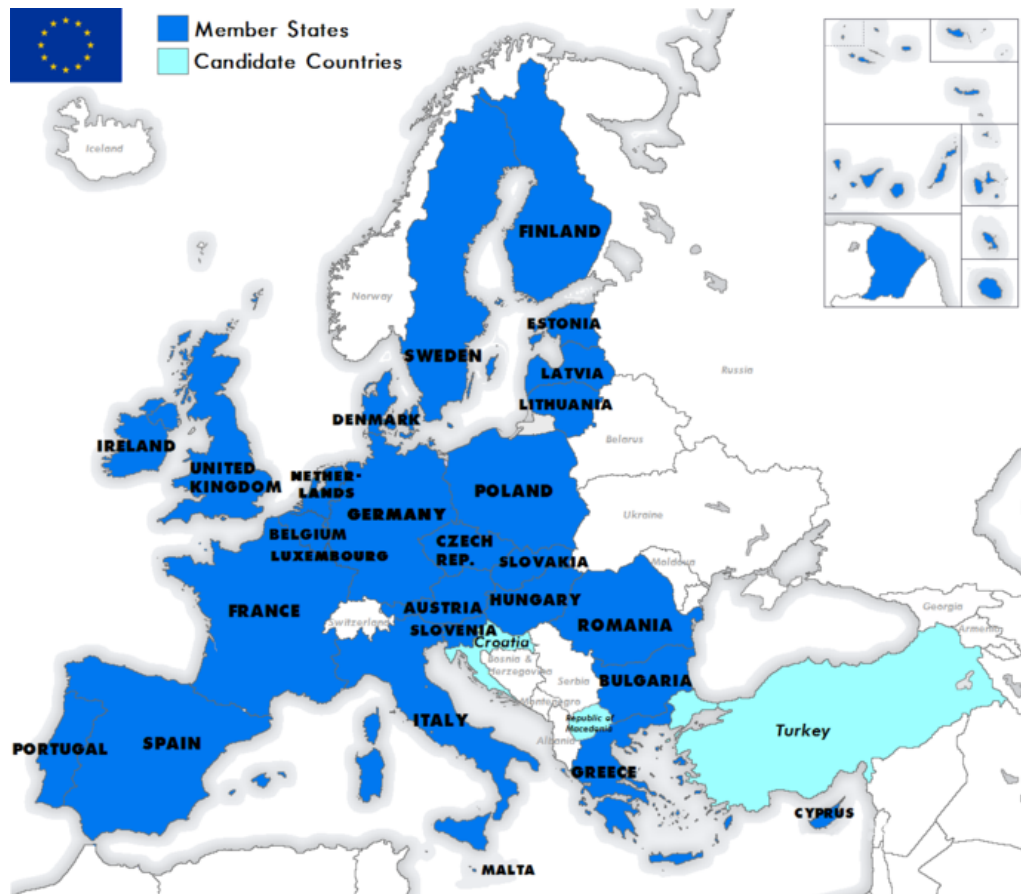


Figure 10.2: *The history of the European Union is of extreme importance to the problem of UN reform.*

As an example of a special-purpose federation, we can think of the Universal Postal Union. Prior to the IPU, countries that wished to cooperate with each other in postal matters did so through bilateral treaties. However, this was a clumsy solution, and in 1863 an international postal congress was held at the request of the United States. As a result of the congress, the Treaty of Berne was signed in 1874, creating the General Postal Union. In 1878 it was renamed, and it became the Universal Postal Union. The UPU introduced several innovations:- a more or less uniform flat rate to mail a letter anywhere in the world; equal treatment of foreign and domestic mail; and the retention by each country of the money collected for international postage. After the formation of the UPU, it was no longer necessary for a letter or package to bear the stamps of all the countries through which it would pass, as had previously been the case. The Universal Postal Union has proved to be incredibly robust, and it has usually continued to function well despite the political upheavals and animosities of its constituent members.

From this example we can see that it is possible to limit the authority of a federation to a small domain of activities.

The Federal Constitution of United States of America is one of the most important and influential constitutions in history. It later formed a model for many other governments, especially in South America. The example of the United States is especially interesting because the original union of states formed by the Articles of Confederation in 1777 proved to be too weak, and it had to be replaced eleven years later by a federal constitution. Additional lessons can be learned from the tragedy of the American Civil War.

During the revolutionary war against England the 13 former colonies sent representatives to a Continental Congress, and on May 10, 1776, the Congress authorized each of the colonies to form its own local provincial government. On July 4, 1776 it published a formal Declaration of Independence. The following year, the Congress adopted the Articles of Confederation defining a government of the new United States of America. The revolutionary war continued until 1783, when the Treaty of Paris was signed by the combatants, ending the war and giving independence to the United States. However, the Articles of Confederation soon proved to be too weak. The main problem with the Articles was that laws of the Union acted on its member states rather than on individual citizens.

In 1787, a Constitutional Convention was held in Philadelphia with the aim of drafting a new and stronger constitution. In the same year, Alexander Hamilton began to publish the Federalist Papers, a penetrating analysis of

the problems of creating a workable government uniting a number of semi-independent states. The key idea of the Federalist Papers is that the coercion of states is neither just nor feasible, and that a government uniting several states must function by acting on individuals. This central idea was incorporated into the Federal Constitution of the United States, which was adopted in 1788. Another important feature of the new Constitution was that legislative power was divided between the Senate, where the states had equal representation regardless of their size, and the House of Representatives, where representation was proportional to the populations of the states. The functions of the executive, the legislature and the judiciary were separated in the Constitution, and in 1789 a Bill of Rights was added.

George Mason, one of the architects of the federal constitution of the United States, believed that “such a government was necessary as could directly operate on individuals, and would punish those only whose guilt required it,” while James Madison, another drafter of the U.S. federal constitution, remarked that the more he reflected on the use of force, the more he doubted “the practicability, the justice and the efficacy of it when applied to people collectively, and not individually.” Finally, Alexander Hamilton, in his Federalist Papers, discussed the Articles of Confederation with the following words: “To coerce the states is one of the maddest projects that was ever devised. ... Can any reasonable man be well disposed towards a government which makes war and carnage the only means of supporting itself - a government that can exist only by the sword? Every such war must involve the innocent with the guilty. The single consideration should be enough to dispose every peaceable citizen against such a government. ... What is the cure for this great evil? Nothing, but to enable the... laws to operate on individuals, in the same manner as those of states do.”

The United Nations has a charter analogous to the Articles of Confederation. It acts by attempting to coerce states, a procedure which Alexander Hamilton characterized as “one of the maddest projects that was ever devised.” Whether this coercion takes the form of economic sanctions, or whether it takes the form of military intervention, the practicability, the justice and the efficacy of the U.N.’s efforts are hampered because they are applied to people collectively and not one by one. What is the cure for this great evil? “Nothing”, Hamilton tells us, “but to enable the laws to act on individuals, in the same manner as those of states do.”

In looking at the history of the Articles of Confederation, it is important to remember that the present United Nations Charter is similar to this fatally

weak union, that lasted only eleven years, from 1777 to 1788. Like it, the UN attempts to act by coercing states. Although the United Nations Charter has lasted almost sixty years and has been enormously valuable, its weaknesses are also apparent, like those of the Articles. One can conclude that the proper way to reform the United Nations is to make it into a full federation, with the power to make and enforce laws that are binding on individuals.

Because the states were initially distrustful of each other and jealous of their independence, the powers originally granted to the US federal government were minimal. However, as it evolved, the Federal Government of the United States gradually became stronger, and bit by bit it became involved in an increasingly wide range of activities.

The history of the European Union is of extreme importance to the problem of UN reform. Because of the terrible destruction and loss of life produced by the World Wars I and II, many European leaders had become convinced that the only way to avoid such tragedies in the future would be to unite the countries of Europe both economically and politically. As a first step, the French Foreign Minister Robert Schuman proposed in 1950 that the European coal and steel industries should be integrated. In 1951, Schumann's proposal became a reality, and the European Coal and Steel Community (ECSC) was established, with Belgium, the Netherlands, West Germany, Luxembourg, France and Italy as members. A supernational body called the "High Authority" was given the power to make decisions about coal and steel production in these countries. Thus the ECSC was an example of a special-purpose federation.

In 1973, the original six countries of the EEC were joined by Denmark, Ireland and the United Kingdom, followed by Greece in 1981 and by Spain and Portugal in 1986. The Treaty of Maastricht, signed in 1992, introduced additional forms of political integration, for example intergovernmental cooperation in defense and in justice and home affairs. After the Maastricht Treaty, the EEC became known as the European Union (EU). What had initially been an economic community had become a political union. This is the same pattern that was followed by the Hanseatic League, which originated as an organization of merchants, but gradually acquired a political dimension.

Ever since 1992, the EU had been aiming at establishing a single currency, managed by by a European Central Bank. The aim became a reality on January 1, 2002 when the euro was introduced in twelve of the fifteen member countries - Belgium, Germany, Greece, Spain, France, Ireland, Italy, Luxembourg, the Netherlands, Austria, Portugal and Finland. The United

Kingdom, Denmark and Sweden have for the moment retained their own currencies, but it is possible that they will go over to the euro at a later date.

The European Convention on Human Rights was signed in Rome on the 4th of November, 1950, and five protocols of the convention were adopted in Paris and Strasbourg during the years 1952-1966. The Council of Europe's Directorate General of Human Rights addresses such issues as basic human rights, economic and social rights, preventing torture, national minorities, combating racism, equality between men and women and protecting media freedom.

The European Social Charter is a Council of Europe Treaty safeguarding economic and social rights. It was originally signed in 1961. A revised version of the European Social Charter was signed in Strasbourg in 1996, and it came into force in 1999. The revised version is gradually replacing the original treaty. The Charter establishes norms in such fields as housing, health, education, employment, social protection, movement of persons and non-discrimination. The provisions of the Charter are enforced by the European Committee of Social Rights, whose members are elected by the Council of Europe's Committee of Ministers for a period of six years, renewable once. Citizens of the European Union know that if their rights under the Social Charter are violated, they are able to complain to Committee, and many do.

In 2004, the European Union welcomed ten new members: Cyprus, the Czech Republic, Estonia, Hungary, Latvia, Lithuania, Malta, Poland, Slovakia and Slovenia. Bulgaria and Romania are expected to follow in a few years, and Turkey is also a candidate for EU membership. Not only has the EU grown in membership; it also has widened its range of activities to include culture, the environment, agriculture, consumer affairs, competition, energy, transport and trade. Boundaries between EU countries have also been opened, so that a passport is no longer required to cross them.

The successes and problems of the European Union provide invaluable experience as we consider the measures that will be needed to strengthen and reform the United Nations. On the whole, the EU has been an enormous success, demonstrating beyond question that it is possible to begin with a very limited special-purpose federation and to gradually expand it, judging at each stage whether the cautiously taken steps have been successful. The European Union has today made war between its member states virtually impossible. This goal, now achieved, was in fact the vision that inspired the leaders who initiated the European Coal and Steel Community in 1950.

The European Union is by no means without its critics or without prob-

lems, but, as we try to think of what is needed for United Nations reform, these criticisms and problems are just as valuable to us as are the successes of the EU.

Countries that have advanced legislation protecting the rights of workers or protecting the environment complain that their enlightened laws will be nullified if everything is reduced to the lowest common denominator in the EU. This complaint is a valid one, and two things can be said about it: Firstly, diversity is valuable, and therefore it may be undesirable to homogenize legislation, even if uniform rules make trade easier. Secondly, if certain rules are to be made uniform, it is the most enlightened environmental laws or labor laws that ought to be made the standard, rather than the least enlightened ones. Similar considerations would hold for a reformed and strengthened United Nations.

Another frequently heard complaint about the EU is that it takes decision-making far away from the voters, to a remote site where direct political will of the people can hardly be felt. This criticism is also very valid. Often, in practice, the EU has ignored or misunderstood one of the basic ideas of federalism: A federation is a compromise between the desirability of local self-government, balanced against the necessity of making central decisions on a few carefully selected issues. As few issues as possible should taken to Bruxelles, but there are certain issues that are so intrinsically transnational in their implications that they must be decided centrally. This is the principle of subsidiarity, so essential for the proper operation of federations - local government whenever possible, and only a few central decisions when absolutely necessary. In applying the principle of subsidiarity to a world government of the future, one should also remember that UN reform will take us into new and uncharted territory. Therefore it is prudent to grant only a few carefully chosen powers, one at a time, to a reformed and strengthened UN, to see how these work, and then to cautiously grant other powers, always bearing in mind that wherever possible, local decisions are the best.

We are faced with the challenge of constructing a world government which will preserve the advantages of local self-government while granting certain carefully chosen powers to larger regional or global authorities. Which things should be decided locally, or regionally, and which globally?

In the future, overpopulation and famine are likely to become increasingly difficult and painful problems in several parts of the world. Since various cultures take widely different attitudes towards birth control and family size, the problem of population stabilization seems to be one which should be

decided locally; and if this is the case, the extent of immigration should also be decided locally. At the same time, aid for local family planning programs, as well as famine relief, might appropriately come from global agencies, such as WHO and FAO.

Security, and controls on the manufacture and export of armaments will require an effective authority at the global level. It should also be the responsibility of the international community to prevent gross violations of human rights.

Looking towards the future, we can perhaps foresee a time when the United Nations will have been converted to a federation and given the power to make international laws which are binding on individuals. Under such circumstances, true police action will be possible, incorporating all of the needed safeguards for lives and property of the innocent.

One can hope for a future world where public opinion will support international law to such an extent that a new Hitler or Saddam Hussein or a future Milosevic will not be able to organize large-scale resistance to arrest - a world where international law will be seen by all to be just, impartial and necessary - a well-governed global community within which each person will owe his or her ultimate loyalty to humanity as a whole.

Laws binding on individuals

In 1998, in Rome, representatives of 120 countries signed a statute establishing a International Criminal Court, with jurisdiction over the crime of genocide, crimes against humanity, war crimes, and the crime of aggression. Four years were to pass before the necessary ratifications were gathered, but by Thursday, April 11, 2002, 66 nations had ratified the Rome agreement - 6 more than the 60 needed to make the court permanent.

It would be impossible to overstate the importance of the International Criminal Court. At last international law acting on individuals has become a reality! The only effective and just way that international laws can act is to make individuals responsible and punishable, since (in the words of Alexander Hamilton), "To coerce states is one of the maddest projects ever devised." In an increasingly interdependent world, international law has become a necessity. We cannot have peace and justice without it. But the coercion of states is neither just⁴ nor feasible, and therefore international laws must act

⁴because it punishes the innocent as well as the guilty



Figure 10.3: *Dr. Daisaku Ikeda, President of SGI International, a 12 million strong Buddhist movement for education, peace and nuclear disarmament, has said: “I believe that we are beginning to see a major historical trend in world public opinion in favor of a world without war. This is something that must happen.”*

on individuals.

The jurisdiction of the ICC is at present limited to a very narrow class of crimes. In fact, the ICC does not at present act on the crime of aggression, although this crime is listed in the Rome Statute, and although there are plans for its future inclusion in the ICC's activities. The global community will have a chance to see how the court works in practice, and in the future the community will undoubtedly decide to broaden the ICC's range of jurisdiction.

The Tobin Tax

A strengthened UN would need a reliable source of income to make the organization less dependent on wealthy countries, which tend to give support only to those interventions of which they approve. A promising solution to this problem is the so-called "Tobin tax", named after the Nobel-laureate economist James Tobin of Yale University. Tobin proposed that international currency exchanges should be taxed at a rate between 0.1 and 0.25 percent. He believed that even this extremely low rate of taxation would have the beneficial effect of damping speculative transactions, thus stabilizing the rates of exchange between currencies. When asked what should be done with the proceeds of the tax, Tobin said, almost as an afterthought, "Let the United Nations have it."

The volume of money involved in international currency transactions is so enormous that even the tiny tax proposed by Tobin would provide the United Nations with between 100 billion and 300 billion dollars annually. By strengthening the activities of various UN agencies, such as WHO, UNESCO and FAO, the additional income would add to the prestige of the United Nations and thus make the organization more effective when it is called upon to resolve international political conflicts.

Besides the Tobin tax, other measures have been proposed to increase the income of the United Nations. For example, it has been proposed that income from resources of the sea bed be given to the UN, and that the UN be given the power to tax carbon dioxide emissions. All of the proposals for giving the United Nations an adequate income have been strongly opposed by a few nations that wish to control the UN through its purse strings. However, it is absolutely essential for the future development of the United Nations that the organization be given the power to impose taxes. No true government can exist without this power. It is just as essential as is the power to make

and enforce laws that are binding on individuals.

Voting reforms

A serious weakness of the present United Nations Charter is the principle of “one nation one vote” in the General Assembly. This principle seems to establish equality between nations, but in fact it is very unfair: For example it gives a citizen of China or India less than a thousandth the voting power of a citizen of Malta or Iceland. A reform of the voting system is clearly needed.

Among the proposals for reform is the idea of having final votes cast by blocks. For example, Europe could form a block, Africa another, and so on. A second proposal is that the General Assembly might be supplemented by a People’s Assembly.

The veto right in the Security Council is clearly a fault in the present structure of the U.N.. It has been suggested that the rules should be changed so that a veto in the Security Council could be over-ruled by a two thirds majority vote of the General Assembly. Other reform proposals call for the abolition of the veto in the Security Council, or even for the abolition of the Security Council itself.

Analogies between war and slavery

It is useful to consider the analogy between the institution of war and the institution of slavery. We might be tempted to say, “There has always been war, throughout human history; and war will always continue to exist.” As an antidote to this kind of pessimism, we can think of slavery, which, like war, has existed throughout most of recorded history. The cultures of ancient Egypt, Greece and Rome were all based on slavery, and, in more recent times, millions of Africans were captured and forced into a life of slavery in the New World and the Middle East. Slavery was as much an accepted and established institution as war is today. Many people made large profits from slavery, just as arms manufacturers today make enormous profits. Nevertheless, despite the weight of vested interests, slavery has now been abolished throughout most of the world.

Today we look with horror at drawings of slave ships, where human beings were packed together like cordwood, and we are amazed that such cruelty

could have been possible. Can we not hope for a time when our descendants, reading descriptions of the wars of the twentieth century, will be equally amazed that such cruelty and stupidity could have been possible? If we use them constructively, the vast resources now wasted on war can initiate a new era of happiness and prosperity for the family of man. It is within our power to let this happen. The example of the men and women who worked to rid the world of slavery can give us courage as we strive for a time when war will exist only as a dark memory fading into the past.

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Chapter 11

FACING A SET OF LINKED PROBLEMS

“Man lives in a new cosmic world for which he was not made. His survival depends on how well and how fast he can adapt himself to it, rebuilding all his ideas, all his social and political institutions. ...Modern science has abolished time and distance as factors separating nations. On our shrunken globe today, there is room for one group only - the family of man.”

Albert Szent-Györgyi

Interconnectedness of the problems facing us

During the 21st century, the world will be facing a number of extremely pressing problems. Instead of debating which of them is the most serious, we should recognize that the problems are interconnected and that we must solve them simultaneously. Here are some of the links:

Links between human rights and climate change

The earth's atmosphere and climate are shared by all nations. At the United Nations summit meeting on climate in Copenhagen in December 2009 (COP15), leaders of the developing countries rightly stated that the huge per-capita greenhouse gas emissions of industrialized nations constitute a violation of human rights. In many developing countries, millions of lives are already threatened by climate changes produced by carbon emissions from the industrialized countries. Examples of this are famine-producing droughts in Africa, and rising ocean levels that threaten the existence of island nations. The future will hold much more severe threats unless the citizens of industrialized nations are willing to change their life-styles. However, China, still classified as a developing country, has now become the world's largest emitter of CO₂. In general, the developing countries too have a responsibility to respect the human rights of others by restricting greenhouse gas emissions.

Links between poverty and population growth

This link was explored in Chapter 4. In countries where population is growing rapidly, it is impossible for governments to create the necessary infrastructure rapidly enough to keep up with growth. Schools, health care, transportation, housing, sanitation, and job creation all lag behind the relentless growth in numbers. Thus population growth produces poverty and misery.

There is also a reciprocal link that leads to a vicious circle: Poverty is observed to produce rapid population growth. When the level of education is low, many women are unaware of the techniques that can be used to control family size, or they cannot afford them, or the women have no jobs outside their homes and their status is so low that it is their husbands who decide the number of children. Furthermore, in many poor countries, child labor is not effectively prohibited, and there is no social security system or pension system to take care of old people. The children are expected to do this. Thus

many couples produce large numbers of children because they believe that they will gain an economic advantage from them. The vicious circle driven by the reciprocal links between population growth and poverty is called the “demographic trap”, a name given to it by the demographer J.L. Kayfetz.

Links between energy scarcity, population growth, climate change and famine

At present a child dies from starvation every five seconds - six million children die from hunger every year. If adults are included, the number is much larger. It is estimated that hunger is involved, directly or indirectly, in the deaths of 35 million people each year. Over a billion people in today's world are chronically undernourished. There is a threat that unless prompt and well-informed action is taken by the international community, the tragic loss of life that is already being experienced will increase to unimaginable proportions.

As glaciers melt in the Himalayas, threatening the summer water supplies of India and China; as ocean levels rise, drowning the fertile rice-growing river deltas of Asia; as aridity begins to decrease the harvests of Africa, North America and Europe; as populations grow; as aquifers are overdrawn; as cropland is lost to desertification and urban growth; and as energy prices become prohibitively high, making modern energy-intensive agricultural methods impossible, the billion people who now are undernourished but still survive, might not survive. They might become the victims of a famine whose proportions could exceed anything that the world has previously experienced.

The threat of severe future food shortages can only be avoided by prompt and well-informed policy changes. These include stabilization of populations, stabilization of climate; stabilization of aquifers; conservation of soils; protection of cropland; restriction of the use of grain for motor fuels; investment in agriculture and agricultural research; and establishment of a global food bank. It will also be helpful to avoid transportation of food over long distances, since this requires large inputs of energy. Finally, the consumption of meat will need to be reduced, since meat production is a very inefficient way of utilizing food calories from grain. (Livestock production is also a major source of greenhouse gases, accounting for more emissions than the entire transportation sector. See “Livestock's Long Shadow”, Food and Agricultural Organization of the United Nations, Rome, 2006).

Links between population growth and war

Population growth is placing increasing pressure on global resources. Many of today's conflicts in the Middle East, Central Asia, Latin America and Africa can be seen in this light. There is a danger that the era of resource scarcity that the world is now entering will be characterized by bitter wars for the possession of increasingly scarce oil, water and metals.

In his book, *Resource Wars: The New Landscape of Global Conflict* (2002), Michael T. Klare¹ shows that many recent wars can be interpreted as struggles for the control of natural resources. In order that such conflicts should not become more frequent in the future, a cooperative attitude towards resources is needed. The global community must face resource scarcity with solidarity. Furthermore, it is vital that the global population be rapidly stabilized.

Links between poverty, disease and war

Another problem facing the world today is the resurgence of infectious disease. Examples of this are pandemics of HIV/AIDS, malaria, and drug-resistant tuberculosis.

Clearly these pandemics are linked to poverty, both as causes of poverty and as its effects. They are also linked to the problem of war.

Today, the world spends roughly 1.5 trillion (million million) US dollars each year on armaments. This amount of money is almost too large to imagine, and if we instead used it constructively, almost all of the problems facing the world today could be solved. In particular, a tiny fraction of the money wasted (or worse than wasted) on armaments could drastically reduce the number of deaths from malnutrition and preventable disease.

Links between war and environmental degradation

Warfare during the 20th century has not only caused the loss of 175 million lives (primarily civilians) - it has also caused the greatest ecological catastrophes in human history. The damage takes place even in times of peace. Studies by Joni Seager, a geographer at the University of Vermont, conclude

¹Michael Klare is the Five College Professor of Peace and World Security Studies, based at Hampshire College in Amherst Massachusetts, but also lecturing at Amherst, Mount Holyoke, Smith and the University of Massachusetts.

that “a military presence anywhere in the world is the single most reliable predictor of ecological damage”.

Modern warfare destroys environments to such a degree that it has been described as an “environmental holocaust.” For example, herbicides use in the Vietnam War killed an estimated 6.2 billion board-feet of hardwood trees in the forests north and west of Saigon, according to the American Association for the Advancement of Science. Herbicides such as Agent Orange also made enormous areas of previously fertile land unsuitable for agriculture for many years to come². In Vietnam and elsewhere in the world, valuable agricultural land has also been lost because land mines or the remains of cluster bombs make it too dangerous for farming.

During the Gulf War of 1990, the oil spills amounted to 150 million barrels, 650 times the amount released into the environment by the notorious Exxon Valdez disaster. During the Gulf War an enormous number of shells made of depleted uranium were fired. When the dust produced by exploded shells is inhaled it often produces cancer, and it will remain in the environment of Iraq for decades.

Radioactive fallout from nuclear tests pollutes the global environment and causes many thousands of cases of cancer, as well as birth abnormalities. Most nuclear tests have been carried out on lands belonging to indigenous peoples.

The danger of a catastrophic nuclear war casts a dark shadow over the future of our species. It also casts a very black shadow over the future of the global environment. Here the dark shadow can be interpreted literally: It is the shadow cast by smoke from burning cities, which would rise to the stratosphere, spread globally, and remain for a decade, destroying not only agriculture, but also normal vegetation and the ozone layer. In the case of a large-scale nuclear war, the resulting famine would mean that most humans and animals would die from starvation. Details of this threat to terrestrial life are given in the references at the end of Chapter 6.

Links between climate change and nuclear weapons

Climate change is linked to the danger of nuclear war because of the widespread (but false) belief that nuclear power generation is an answer to global

²Agent Orange also produced cancer, birth abnormalities and other serious forms of illness both in the Vietnamese population and among the foreign soldiers fighting in Vietnam

warming. If many nations throughout the world decide to build power-generating reactors, the number of countries possessing nuclear weapons will increase dramatically because it is almost impossible to distinguish between civilian and military nuclear programs.

By reprocessing spent nuclear fuel rods, using ordinary chemical means, a nation with a power reactor can obtain a weapons-usable isotope of plutonium, Pu-239. Even when such reprocessing is performed under international control, the uncertainty as to the amount of Pu-239 obtained is large enough so that the operation might superficially seem to conform to regulations while still supplying enough Pu-239 to make many bombs.

The enrichment of uranium³ is also linked to reactor use. Many reactors of modern design make use of low enriched uranium (LEU) as a fuel. Nations operating such a reactor may claim that they need a program for uranium enrichment in order to produce LEU for fuel rods. However, by operating their ultracentrifuges a little longer, they can easily produce highly enriched uranium (HEU), i.e., uranium containing a high percentage of the rare isotope U-235, and therefore usable in weapons.

The widely held belief that global warming can be avoided by switching to nuclear power is false. In a carefully documented book “Nuclear Power is Not the Answer to Global Warming or Anything Else”, the Australian physician Helen Caldicott points out that if a detailed accounting of CO₂ emissions is made during all the phases of nuclear power generation, including both construction and decommissioning of the plant, together with mining, transportation and refinement of the uranium ore, the CO₂ emissions are seen to be comparable with those produced by a coal-fired power plant.

Known reserves of uranium are only sufficient for the generation of 8×10^{20} joules of electrical energy⁴, i.e., about 25 TWy, i.e. less than enough to supply the world with power for two years. It is sometimes argued that a larger amount of electricity could be obtained from the same amount of uranium through the use of fast breeder reactors, but this would involve totally unacceptable proliferation risks. In fast breeder reactors, the fuel rods consist of highly enriched uranium. Around the core, is an envelope of natural uranium. The flux of fast neutrons from the core is sufficient to convert a part of the U-238 in the envelope into Pu-239, a fissionable isotope

³i.e. production of uranium with a higher percentage of U-235 than is found in natural uranium

⁴Craig, J.R., Vagn, D.J. and Skinner, B.J., *Resources of the Earth: Origin, Use and Environmental Impact, Third Edition*, page 210.

of plutonium.

Fast breeder reactors are prohibitively dangerous from the standpoint of nuclear proliferation because both the highly enriched uranium from the fuel rods and the Pu-239 from the envelope are directly weapons-usable. It would be impossible, from the standpoint of equity, to maintain that some nations have the right to use fast breeder reactors, while others do not. If all nations used fast breeder reactors, the number of nuclear weapons states would increase drastically.

In the countries where it is presently used, nuclear power generation is heavily subsidized, and were it not for these subsidies, it would not be able to compete with wind energy or solar energy. It is vital that the subsidies be shifted from nuclear power to the development of various forms of renewable energy.

The mass media have been much better in making the general public aware of threats from climate change than they have been in calling attention to the great threat posed by the continued existence of nuclear weapons. However, a discussion of nuclear dangers ought to be linked to the climate debate because a nuclear war, even a small one, would seriously affect the global climate for a period of approximately ten years. (See www.nucleardarkness.org).

Links between nuclear weapons and the rights of indigenous peoples

In a recent article, Alyn Ware⁵ has written:

“Indigenous peoples around the world have had their sovereignty infringed, their territories destroyed and their health impacted by the nuclear arms race. Uranium mining, nuclear weapons testing and nuclear waste dumping have all been done on indigenous territories, including the Shoshone lands in the United States, Maoha islands in French-occupied Polynesia, Ugi-hur lands in Lop Nor (China), Pitjantjatjara lands in Maralinga (Australia), Marshallese Islands in the Pacific, and the Arctic territories of the Kazakhs, Sami, Vepsians, Karalians, Aluet, Nentses and Komi...”

“The testing of nuclear weapons on indigenous territories has mostly stopped, but has left a legacy of environmental contamination and trans-

⁵Alyn Ware is the Global Coordinator for Parliamentarians for Nuclear Nonproliferation and Disarmament

generational health effects from the radiation released in nuclear activities. Meanwhile the deployment of nuclear weapons on submarines and the testing of nuclear weapons-carrying missiles continues.”

For example, between 1946 and 1958, the US carried out 67 nuclear tests in the Marshall Islands. The total power of the bombs exploded in these tests was equivalent to 7000 Hiroshima-size bombs. Even today the Marshall Islanders still suffer from exceptionally high rates of cancer and birth defects as a result of the tests. In Australia, UK nuclear tests were carried out in desert regions known to be inhabited by indigenous peoples, while Soviet nuclear tests were also carried out on tribal lands.

Links between sustainability, education and global citizenship

As the economist Richard Florida has pointed out (see Chapter 2), cultural activities do not make a heavy impact on the global environment. He sees the transition to a sustainable society as being linked with a shift of human efforts away from the manufacture of goods and towards creative non-industrial activities. This transition, which is already starting to take place, is linked with the development of global citizenship. The growth of human culture involves cooperation across national boundaries. Thus as we move towards sustainability we are simultaneously moving towards global citizenship and a global ethic. Among living organisms on earth, the evolution of a complex culture is unique to humans, and it is responsible for our success as a species. Human cultural evolution will increasingly become synonymous with global cooperation and a global ethic.

Links between poverty and war

The problem of eliminating global inequality and poverty is linked in several ways with the problem of eliminating war.

In the first place, war is one of the greatest sources of poverty. For example, much of the enormous third world debt is due to arms purchases, which make no constructive contribution to development. Indeed, the pervasiveness of small arms in parts of Africa makes armed conflict there so endemic that development is all but impossible. Wars also destroy infrastructure and damage ecology on a large scale. One can think, for example of the destruction of power plants and water purification plants in Iraq during the first

Gulf war or the use of defoliants during the Viet Nam War. The defoliants destroyed forests and made large areas of land unsuitable for agriculture.

Victims of land mines, poison gas, bombings or small arms can be crippled for life and can become economic burdens for their societies. Soldiers are taken away from useful occupations during wars, and if killed or severely wounded, they can no longer help their families. The treatment of war casualties imposes a great burden on medical facilities. Industries making munitions are diverted from useful activities. Thus, in a variety of ways, war is one of the most important sources of poverty.

A second link between poverty and the problem of war has to do with the contrasts between rich and poor nations as a hindrance to the development of international law and governance. If we survey the nations of the world, we can find many within which good government has been achieved, together with some measure of internal peace and happiness. Some very large countries function as coherent (although not ideal) social units, with freedom from internal wars. Each of these countries is so large and has such an inhomogeneous population that the problem of achieving internal peace within them is not qualitatively different from the problem of achieving peace throughout the entire world. The same methods that each of these enormous countries uses within itself could be used globally - for example education for social cohesion, and systems of laws that act on individuals. However, plans for strong government at a global level are blocked by enormous contrasts between rich and poor nations. Rich nations fear that with a strong world government, they would lose the advantages that they now have.

The European Union has already encountered the problem of economic inequality as a barrier to efforts to strengthen and enlarge the federation. The richer nations of the EU fear that they will have to pay high taxes to support economic progress in the poorer parts of the Union. Nevertheless, the EU is attempting to solve these problems, motivated by the conviction that whatever its defects, some degree of political union is needed to rule out the possibility that the horrors of World Wars I and II will ever be repeated. The EU is extremely interesting since it gives us a model of what needs to be done globally. Of course the global contrasts between rich and poor nations are far greater than those found within the EU, but these global North-South contrasts also can be and must be eliminated.

Market forces in ecology

Most analysts agree that our economic system needs to be modified in such a way that it will stop leading us towards ecological disaster, and instead encourage the development of a stable and sustainable global society. This theme is strongly presented in Paul Hawken's excellent book, *The Ecology of Commerce*, (Collins Business, 2005). It is also a central element in Lester Brown's far-sighted and eloquent book, *Plan B 3.0* (W.W. Norton, 2008). Both Brown and Hawken argue that income taxes should be reduced, and that taxes should instead be placed on ecologically damaging activities, such as burning fossil fuels.

The widely read book *Natural Capitalism* (1999), coauthored by Paul Hawken, Amory Lovins and Hunter Lovins, views the global economy as being a part of a larger economy that also includes natural ecosystems. The three authors believe that we should attribute value to human intelligence and culture, to hydrocarbons and minerals, as well as to such things as trees and microscopic fungi. Amory Lovins has advocated an approach that he calls the "feebate", in which taxes on unsustainable products such as Sports Utility Vehicles (SUV's) are pooled to support the development and purchase of sustainable alternatives, such as hybrid electric vehicles.

Pricing that includes externalities

The concept of externalities was developed by the English economist Arthur Cecil Pigou, (1877-1959), a Professor of Political Economics at Cambridge University. He invented the idea that the free market can fail to give the true price to a product or service because costs to society or to the environment are not included. For example, the price of a package of cigarettes might not include the cost to society of the illnesses and deaths that result from smoking. Similarly, the social and environmental costs of industrial activities that cause pollution are usually neglected. In his major book, *Wealth and Welfare* (1912, 1920), Pigou introduced the idea that such "market failures" could be corrected by governments through a combination of taxation and subsidies. Such taxes are called "Pigovian taxes" in his honor. Today they are also often called "green taxes".

Green taxes have already been introduced in many countries, for example in Denmark; but there is a need for the introduction of a greatly expanded and universalized system of green taxes throughout the world. This must be

done so thoroughly that the price of every item in the global economy will include its true environmental and social cost. Only then will we be able to rely on the free market to lead us in an intelligent and non-destructive direction.

Payment for tropical forests

We mentioned that rainforests are under assault. An area of tropical forest the size of Greece is lost each year. It is difficult for the governments of developing countries to resist economic pressures from beef or soybean farmers, from palm oil plantations and from logging companies. For this reason it has been proposed that the intact forests should be assigned a value commensurate with the services that they perform for the world by sequestering carbon and preserving biodiversity. According to this proposal, the wealthy industrial nations should pay a yearly fee to tropical nations that preserve their rainforests intact as a reward for the global services that the forests perform.

Reformed economics

Reform is urgently needed in the teaching of economics and business: Classical economics developed during the 18th and 19th centuries, when the global supply of land and raw materials seemed unlimited (at least within the foreseeable future), and when the only limitation to economic development was the shortage of capital. This might be called an “open world” situation, a situation in which growth became the Holy Grail of all economists. Today we are in a “closed world” situation. The possibility of development is limited, not by the availability of capital, but by shrinking supplies of arable land, water and non-renewable resources, and by the finite carrying capacity of the global environment. Nevertheless economics continues to be taught along classical lines and for this reason, economists continue to worship growth. We urgently need to introduce biology and ecology into the education of economists. The economics of growth must be replaced by equilibrium economics, where considerations of ecology, carrying capacity, and sustainability are given their proper weight, and where the quality of life of future generations has as much importance as present profits.

Throughout the history of industrialism, there have been individual leaders of industry who have shown a strong sense of social responsibility. For example, Robert Owen (1771-1858) was not only a successful factory owner but also a pioneer of the Cooperative Movement and of trade unions. Andrew Carnegie (1835-1919) kept very little of his vast fortune for himself and used by far the greater part to establish universities and libraries. More recently, Ted Turner gave exactly one billion dollars (about a third of his fortune) to the United Nations. When asked to comment, he said “It’s only money.” He then added “I hope that Bill Gates is watching”. Bill Gates was indeed watching, and Gates has since become a public benefactor on an extremely large scale, establishing a program aimed at vaccinating every child in Africa. He presently spends only part of his time on Microsoft, and devotes the remainder to his many philanthropies.

In 2006, the Nobel Peace Prize was awarded to Grameen Bank and to its founder Prof. Muhammad Yunus for making small loans available to rural populations, first in Bangladesh and later in many other countries. The borrowers are too poor to qualify for credit from conventional banks.

Yunus’ experiments with microcredit began in 1974, during a famine, when he lent 27 dollars to a group of 42 families to allow them to make small items for sale. Today Grameen Bank (literally “Bank of the Villages”) has more than 2000 branches. It makes loans without collateral to solidarity and self-help groups, relying on a collective sense of honor to enforce repayment. Yunus and Grameen Bank have especially concentrated on making microcredit available to women, believing that loans to groups of women will give greater benefits to families than loans made to men.

Grameen Bank is an example of a business whose purpose is not to make a profit but rather to provide a social service. Recently Grameen combined with the French firm Groupe Danone to form a corporation called “Grameen Danone Foods Social Business Enterprise in Bangladesh”. The new corporation is run along business lines, but rather than making a profit, it aims at a social goal - providing affordable healthy daily nutrition to low-income, nutritionally deprived populations in Bangladesh. Here, as in Grameen Bank, the driving force is not individual self-interest (as recommended by Adam Smith) but rather a social goal.

These examples are not completely isolated. There is today a general movement towards corporate social responsibility (CSR). Several major oil companies now have divisions devoted to renewable energy technologies. It is to be hoped that this is not just “window dressing”, and that

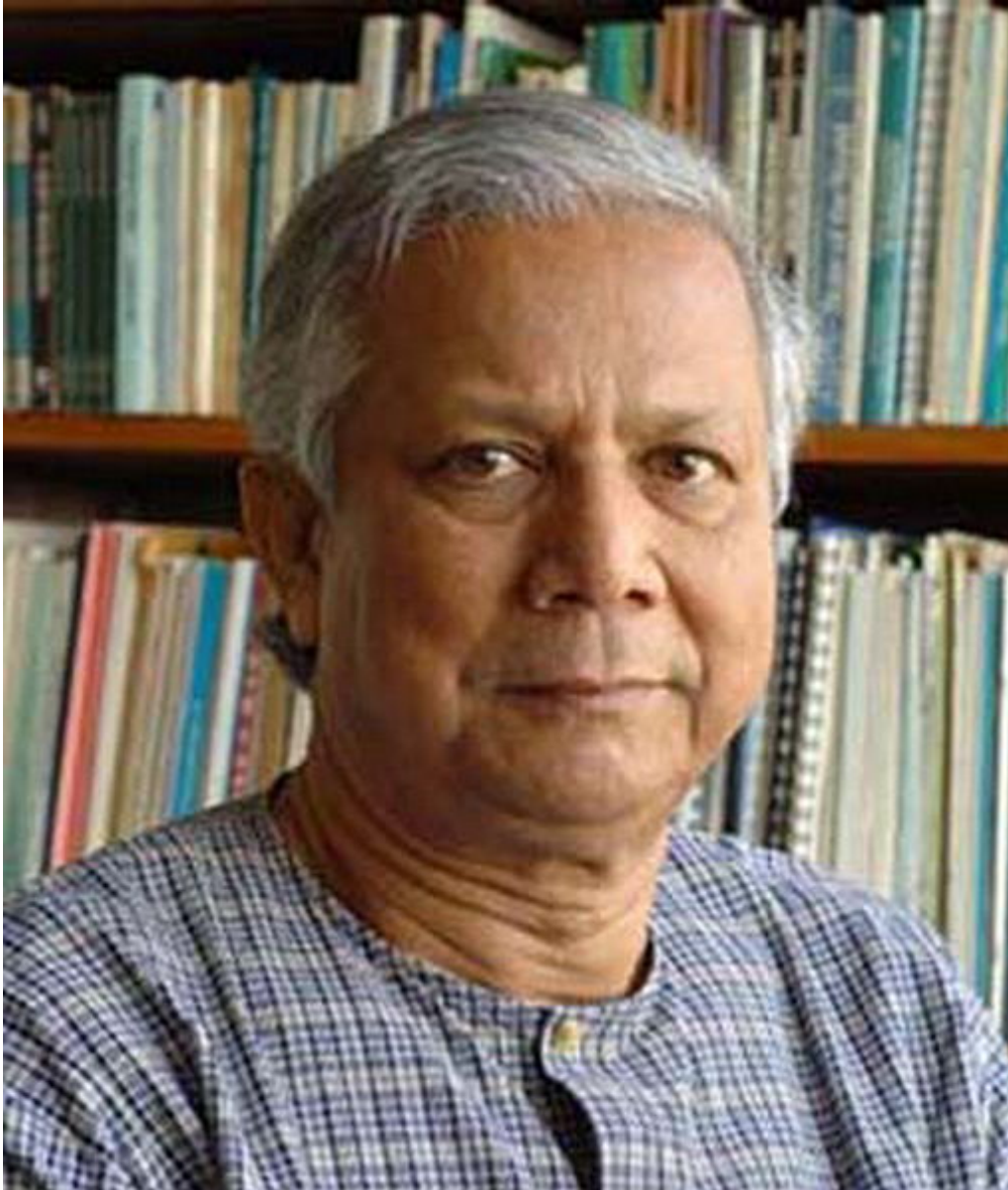


Figure 11.1: *Prof. Muhammad Yunus, who shared the 2006 Nobel Peace Prize with Grameen Bank. He pioneered the concept of businesses that aim at social goals rather than profit.*

the oil companies will devote a significant fraction of their profits to developing renewable energy. It would be very desirable for large pharmaceutical companies to exhibit social responsibility by giving tropical diseases more attention, and by making medicines (for example against AIDS) available in the developing world at affordable prices.

Some of the ideals of CSR were formalized in the ten principles of the UN Global Compact (a forum of corporations and NGO's launched by UN Secretary General Kofi Annan in 2000). Today the Global Compact has more than 3000 corporate members and includes more than 1000 NGO's. Its ten principles are as follows:

- **Human Rights:** Businesses should
 - 1) support and respect the protection of internationally proclaimed human rights and
 - 2) make sure that they are not complicit in human rights abuses.

- **Labor Standards:** Businesses should uphold
 - 3) the freedom of association and the effective recognition of the right to collective bargaining.
 - 4) the elimination of all forms of forced or compulsory labor.
 - 5) the effective abolition of child labor; and
 - 6) the elimination of discrimination in employment and occupation.

- **Environment:** Businesses should
 - 7) support a precautionary approach to environmental challenges.
 - 8) undertake initiatives to promote environmental responsibility; and
 - 9) encourage the development and diffusion of environmentally friendly technologies.

- **Anti-Corruption:** Businesses should
 - 10) work against corruption in all its forms, including extortion and bribery.

Of course, the fact that a corporation has added its name to the UN Global Compact does not mean that it always follows the ten principles,

any more than membership in the Boy Scouts guarantees that a young man is trustworthy, loyal, helpful, friendly, courteous, kind,...etc. Nevertheless, the ten principles have a normative value, and one can hope that they will someday be incorporated into the education of economists and businessmen.

Economists, industrialists and business leaders have a duty to the peoples of the world and to the global environment in much the same way that physicians have a sacred duty to the welfare of their patients. Therefore the education of economists and industrialists ought to emphasize ethical and ecological principles. Like doctors, economists and industrialists carry matters of life and death in their hands: Think of the 10 million children who die each year from poverty-related causes; think of the wholesale extinction of species; think of global warming; think of the risk of a catastrophic future famine caused by population growth, by energy shortages, by climate change and by ecological degradation. We urgently need to introduce biology, ecology and ethics into the education of economists. The economics of growth must be replaced by equilibrium economics, where considerations of ecology, carrying capacity, and sustainability are given proper weight, and where the quality of life of future generations has as much importance as present profits.

Not only economists, but also students of business administration should be made conscious of the negative effects of globalization as well as the positive ones, and they should consider the measures that will be needed to correct the negative effects. Students of business administration should be helped to develop an attitude of responsibility towards the less developed countries of the world, so that if they later become administrators in multinational corporations, they will choose generous and enlightened policies rather than exploitative ones.

The economic impact of war and preparation for war should be included in the training of economists. Both the direct and indirect costs of war should be studied, for example the effect of unimaginably enormous military budgets in reducing the money available to solve pressing problems posed by the resurgence of infectious disease (e.g. AIDS, and drug-resistant forms of malaria and tuberculosis); the problem of population stabilization; food problems; loss of arable land; future energy problems; the problem of finding substitutes for vanishing nonrenewable resources, and so on. Many of these problems were discussed at a recent conference of economists in Copenhagen, but the fact that all such global emergencies could be adequately addressed with a fraction of the money wasted on military budgets was not discussed.

Finally, economics curricula should include the problems of converting



Figure 11.2: *The distinguished economist Herman E. Daly pioneered the concept of economics without growth in his books “Steady-State Economics” (1977) and “For the Common Good”, (1989).*

war-related industries to peaceful ones - the problem of beating swords into plowshares. It is often said that our economies are dependent on arms industries. If this is so, it is an unhealthy dependence, analogous to drug addiction, since arms industries do not contribute to future-oriented infrastructure. The problem of conversion is an important one. It is the economic analog of the problem of ending a narcotics addiction, and it ought to be given proper weight in the education of economists.

The present recession seen as an opportunity

The economic recession that began with the US subprime mortgage crisis of 2007 and 2008 can be seen as an opportunity. It is thought to be temporary, but it is a valuable warning of irreversible long-term changes that will come later in the 21st century when the absolute limits of economic growth are reached. Already today we are faced with the problems of preventing unemployment and simultaneously building the infrastructure of an ecologically sustainable society.

Today's economists believe that growth is required for economic health; but at some point during this century, growth will no longer be possible. If no changes have been made in our economic system when this happens, we will be faced with massive unemployment. Two changes are needed to prevent



Figure 11.3: *The Chinese symbol for “crisis” consists of two characters, one meaning “danger” and the other “opportunity”. The present economic crisis presents us with the danger of unemployment, but it also gives us the opportunity to move towards sustainability.*

this:

1. Labor must be moved to tasks related to ecological sustainability. These include development of renewable energy, reforestation, soil and water conservation, replacement of private transportation by public transport. Health and family planning services must also be made available to all.
2. Opportunities for employment must be shared among those in need of work, even if this means reducing the number of hours that each person works each week and simultaneously reducing the use of luxury goods, unnecessary travel, conspicuous consumption and so on. Perhaps it will be necessary for governments to introduce laws reducing the length of the working week, thus ensuring that opportunities for employment are shared equally.

We have the chance, already today, to make these changes in our economic system. The completely unregulated free market alone has proved to be inadequate in a situation where economic growth has slowed or halted, as is very apparent in the context of the present financial crisis. But halfway through the 21st century, economic growth will be halted permanently by



Figure 11.4: *Professor Tim Jackson is the Economics Commissioner for Britain's Sustainable Development Commission. In March, 2009, he published a book entitled "Prosperity without growth? The transition to a sustainable economy". "Questioning growth is deemed the act of lunatics, idealists and revolutionaries", Jackson states, "But question it we must. The myth of growth has failed us. It has failed the billion people who still live on less than \$2 a day. It has failed the fragile ecological systems on which we depend for survival. It has failed spectacularly, in its own terms, to provide economic stability and to secure people's jobs." Jackson lists the challenges facing the world today - the end of the era of cheap oil; the degradation of forests, lakes and soils; the challenge of stabilizing concentrations of carbon in the atmosphere - and he says: "We face these challenges with an economy that is fundamentally broken, in desperate need of renewal." Nevertheless, his book is optimistic, and it offers solutions to the problem of recasting our economic system so that it will be able to achieve prosperity without growth.*

ecological constraints and vanishing resources. We must construct a steady-state economic system - one that can function without growth. Our new economic system needs to have a social and ecological conscience, it needs to be responsible, and it needs to have a farsighted global ethic. We have the opportunity to anticipate and prevent future shocks by working today to build a new economic system.

The introduction of Pigovian taxes by one country may make it less able to compete with other countries that do not include externalities in their pricing. Until such reforms become universal, free trade may give unfair advantages to countries which give the least attention to social and environmental ethics. Thus free trade and globalization will become fair and beneficial only when ethical economic practices become universal.

New ethics to match new technology

Modern science has, for the first time in history, offered humankind the possibility of a life of comfort, free from hunger and cold, and free from the constant threat of death through infectious disease. At the same time, science has given humans the power to obliterate their civilization with nuclear weapons, or to make the earth uninhabitable through overpopulation and pollution. The question of which of these paths we choose is literally a matter of life or death for ourselves and our children.

Will we use the discoveries of modern science constructively, and thus choose the path leading towards life? Or will we use science to produce more and more lethal weapons, which sooner or later, through a technical or human failure, may result in a catastrophic nuclear war? Will we thoughtlessly destroy our beautiful planet through unlimited growth of population and industry? The choice among these alternatives is ours to make. We live at a critical moment of history - a moment of crisis for civilization.

No one living today asked to be born at such a moment, but by an accident of birth, history has given us an enormous responsibility, and two daunting tasks: If civilization is to survive, we must not only stabilize the global population but also, even more importantly, we must eliminate the institution of war. We face these difficult tasks with an inherited emotional nature that has not changed much during the last 40,000 years. Furthermore, we face the challenges of the 21st century with an international political system based on the anachronistic concept of the absolutely sovereign nation-state. However,

the human brain has shown itself to be capable of solving even the most profound and complex problems. The mind that has seen into the heart of the atom must not fail when confronted with paradoxes of the human heart.

The problem of building a stable, just, and war-free world is difficult, but it is not impossible. The large regions of our present-day world within which war has been eliminated can serve as models. There are a number of large countries with heterogeneous populations within which it has been possible to achieve internal peace and social cohesion, and if this is possible within such extremely large regions, it must also be possible globally.

We must replace the old world of international anarchy, chronic war and institutionalized injustice, by a new world of law. The United Nations Charter, the Universal Declaration of Human Rights and the International Criminal Court are steps in the right direction, but these institutions need to be greatly strengthened and reformed.

We also need a new global ethic, where loyalty to one's family and nation will be supplemented by a higher loyalty to humanity as a whole. The Nobel laureate biochemist Albert Szent-Györgyi once wrote:

"The story of man consists of two parts, divided by the appearance of modern science.... In the first period, man lived in the world in which his species was born and to which his senses were adapted. In the second, man stepped into a new, cosmic world to which he was a complete stranger.... The forces at man's disposal were no longer terrestrial forces, of human dimension, but were cosmic forces, the forces which shaped the universe. The few hundred Fahrenheit degrees of our flimsy terrestrial fires were exchanged for the ten million degrees of the atomic reactions which heat the sun."

"This is but a beginning, with endless possibilities in both directions - a building of a human life of undreamt of wealth and dignity, or a sudden end in utmost misery. Man lives in a new cosmic world for which he was not made. His survival depends on how well and how fast he can adapt himself to it, rebuilding all his ideas, all his social and political institutions."

"...Modern science has abolished time and distance as factors separating nations. On our shrunken globe today, there is room for one group only - the family of man."

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