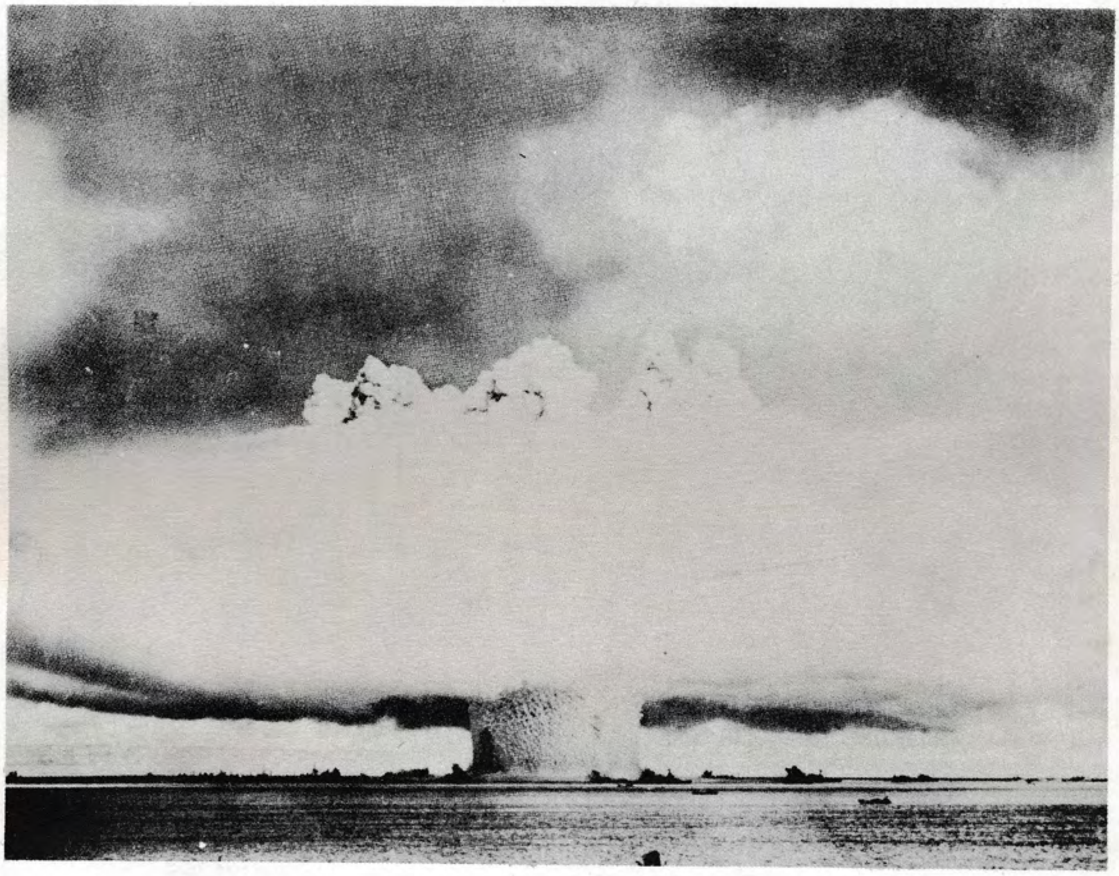
ISBN-0-477-06226-1

FUTURE CONTINGENCIES

4. NUCLEAR DISASTER



A REPORT TO THE

COMMISSION FOR THE FUTURE

March 1982

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F U T U R E   C O N T I N G E N C I E S

4. NUCLEAR DISASTER

A Report to the

COMMISSION FOR THE FUTURE

by a Study Group on Nuclear Disaster

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March 1982
Wellington, New Zealand

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THE MESSAGE OF THIS REPORT

1. The possibility of nuclear war cannot be ignored by New Zealanders (part 1).

2. Its occurrence could visit unprecedented destruction on human civilization (part 2).

3. New Zealand's position in the world gives it the opportunity to avoid the worst consequences of a Northern Hemisphere nuclear war (part 3).

4. The impacts on New Zealand of a Northern Hemisphere nuclear war are unlikely to result from fallout or other weapon effects (part 3).

5. The most serious impacts would result from the loss of trading partners (part 3).

This report is available from libraries or any Government Bookshop. Any communication on this Report should be sent to G.F. Preddey, Commission For the Future, P.O. Box 5053, Wellington, New Zealand. Supplementary information on individual contingency planning prepared by N.A. Wilson and others is available from P.O. Box 6117, Auckland, but is not necessarily endorsed by the Study Group. A microfiche version of this Report is also available from P.O. Box 6117, Auckland.

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The authors warmly thank the following individuals who have contributed to the preparation of this Report (but who do not necessarily agree with its conclusions):

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(1) "Global Future : Time to Act", Report to the President on Global Resources, Environment, and Population, p ix (Council on Environmental Quality, US Department of State, 1981).

(2) "The Global 2000 Report to the President : Entering the Twenty-First Century", vol 1, pl (Council on Environmental Quality, US Department of State, 1980).

(3) Lester Brown in <u>The Futurist</u>, vol 9, 1975, pl22.

(4) Rt. Hon. B. Talboys Speech to the United Nations General Assembly, 10 October, 1977.

(5) This is recognized, for example, in the NZ National Party's 1975 General Election Policy (Para 3, Policy number 32, on National Development).

(6) Heinemann New Zealand Dictionary (Heinemann, 1979).

(7) "Yearbook of World Problems and Human Potential", ref. 3561 (Brussels : Union of International Associations - Mankind 2000, 1976).

PREFACE TO THE 'FUTURE CONTINGENCIES' SERIES

The next few decades are a period about which it is much easier to be cautious and reserved rather than welcoming. Recent reports from a number of major institutions including the United Nations and the World Bank have persistently sounded a warning. The 'Global Future' Report has summed up the position as follows:

> Severe stresses on the earth's resources and environment are apparent. With the persistence of human poverty and misery, the staggering growth of human population, and ever-increasing human demands, the possibilities of further stress and permanent damage to the planet's resource base are very real. To reverse the present trends, to restore and protect the earth's capacity to support life and meet human needs, is an enormous challenge(1).

The world in 2000 is depicted by most futurists as being significantly more crowded, more polluted, less ecologically stable, and more vulnerable to disruption than the world we live in now - if present trends continue(2). But future resource impoverishment, environmental degradation, and soaring population growth are not a new discovery. What the recent reports have emphasized, however, are the accelerating pace and scale of the problems, and their interrelationships.

Accumulating evidence from around the world suggests that "we may be on the edge of one of the greatest discontinuities in human history - economic, demographic, political"(3). The New Zealand Foreign Minister has commented that "All of us, I think, can feel in our bones that in its economic, no less than its political condition, the world is not many steps away from chaos"(4).

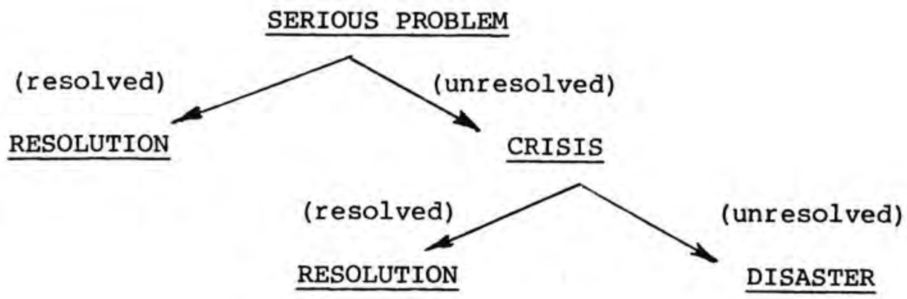
One of the most important functions of the emerging discipline of futures studies is to call attention to possible future disasters(5). The intention is of course to alert policy makers and others so that mitigating steps can be taken.

What is a disaster? A New Zealand dictionary (6) defines a disaster as "a greatly unfortunate accident or event" (DIS = 'not or without' + Italian ASTRO = 'a lucky star'). This is a useful starting point, but more helpful is the detailed definition in the Yearbook of World Problems and Human Potential(7) which describes a disaster as:

> ... an event concentrated in time and space, in which a society or a relatively self-sufficient subdivision of a society undergoes severe danger and incurs such losses to its members and physical appurtenances that the social structure is disrupted and the fulfillment of all or some of the essential functions of the society is prevented. Thus a disaster disturbs the vital functioning of a society. It affects the system of biological survival (subsistence, shelter, health, reproduction), the system of order (division of labour, authority patterns, cultural norms, social roles), the system of meaning (values, shared definitions of reality, communication mechanism), and the motivation of the actors within all these systems.

A useful distinction can be drawn between 'crisis' and 'disaster', although these terms are often taken as synonymous. A crisis is "a crucial time or turning point in any series of events" (Greek KRISIS = decision). It results from an unresolved serious problem. If the crisis itself is not resolved, a disaster ensues, as illustrated below.

(8) "Anticipating World Crises : Five Overarching Crises in Prospect" by Theodore J. Gordon, in Current, No.168, 1974, p48.



It is not enough that there is a range of potential disasters lying before us in the future. There is also the possibility of 'megacrisis' - a number of crises occurring simultaneously. When these crises are interrelated, the potential for megacrisis is greatly increased. Its overall impact may greatly exceed the individual impacts of the contributing crises. Its consequences may well be beyond an administration's ability to cope. A nuclear holocaust could be an example.

The taxonomy of disaster can be treated in various ways. For instance, Theodore Gordon identified what he called 'five overarching crises' confronting mankind (8) viz.

- nuclear war
- severe food shortage
- deterioration of the biosphere
- imbalance in the distribution of wealth
- material shortages

For the 'Future Contingencies' reports, the taxonomy is derived from the predominant discipline invoked: natural science, social science, economics. Nuclear war, because of the potential magnitude of its impact, is considered as a separate issue. Wherever possible, a New Zealand perspective is adopted. The 'Future Contingencies' series includes the following reports:

1.	Natural Disaster	ISBN-0-477-06222-9
2.	Societal Disaster	ISBN-0-477-06225-3
3.	World Economic Disaster	under preparation*
4.	Nuclear Disaster	ISBN-0-477-06226-1
5.	Summary Report for wider dissemination	under preparation*

These reports are from ad hoc study groups working under the auspices of the Commission for the Future. The views expressed in them are those of the contributing authors, and do not necessarily represent the views of the Commission, nor any other organizations with which the authors are associated.

* The publication of reports 3 and 5 may be precluded by the abolition of the Commission For the Future in 1982.

(9) Headlines such as 'Fears grow of a Third World War' are commonplace (The Evening Post, 4 June 1980).

(10) The first nuclear explosion took place at Alamogordo, USA, in 1945.

(11) L.S. Taylor, Proceedings of Nuclear Civil Defence Symposium (Geneva, 1968). A device seeded with (say) cobalt, designed to kill the entire human race by long-lived fallout, would require a yield of 3,000,000Mt - about 100 times the total yield of present weapons stocks (D.W. Posener in Pacific Defence Reporter, Sept 1981, p42).

(12) In this context, three quarters of the work force unemployed could be construed as a manageable contingency, in comparison with three quarters of the work force killed or incapacitated by a nuclear attack.

(13) L.S. Taylor, op cit.

(14) For instance, the essay 'Apocalypse 1989', published in the collection 'Pictures of the Future' (Mallinson Rendell, 1980) and reproduced as Section 14 of this CFF report, was criticized along these lines by the New Zealand Foundation for Peace Studies (Inc) in a letter sent to all Members of Parliament in 1980.

(15) Carl Sagan, 'Cosmos', (McDonald, 1980), p345.

(16) From the Preamble to the Constitution of UNESCO.

1. NUCLEAR DISASTER: AN INTRODUCTION

In the Preface to the 'Future Contingencies' series, a distinction was drawn between 'crisis' and 'disaster' viz. a 'disaster' results from an unresolved 'crisis' (p.9).

It is becoming increasingly feared, especially by Europeans, that humanity is facing a nuclear 'crisis'(9). The resolution of this crisis seems to become more remote as the fortieth anniversary of the first nuclear explosion approaches(10). While the 'crisis' exists, the possibility of 'disaster' also exists, and appears to be increasing.

Regardless of what is done, or not done, in advance of a nuclear disaster: "there would be large areas of total annihilation, large areas of total survival, and large areas with all gradations of mixtures between the two ... however disastrous nuclear warfare might be at its worst, there would be large numbers of survivors, and however altered and inconvenienced, civilization would survive. The idea of the elimination of man is nonsense"(11).

The first part of this report explores the possible causes and effects of nuclear war, and what must be done to prevent it eventuating, by a resolution of the present nuclear 'crisis'.

New Zealand, being remote, relatively self-sufficient, strategically insignificant, and in the Southern Hemisphere, may have as much reason as any other country to ponder the implications of a nuclear 'disaster'. New Zealanders, like all other populations, may experience great hardships resulting from it.

Yet, in New Zealand, hardships may result from a lack of preparedness for quite manageable contingencies(12), compared with those conveyed by popular images of death and destruction rained upon targeted countries in the North.

The concluding parts of the report explore the contingencies New Zealand might experience in the aftermath of a nuclear war fought mainly in the Northern Hemisphere, and what could be done now to mitigate its effect.

"All of the effort and planning that goes into our effort for survival is really directed toward easing the sorry plight of those of us who survive"(13). In all probability, "those of us who survive" will include most New Zealanders.

Some may argue that to plan for nuclear war makes it more likely, and that a continuing effort towards a resolution of the nuclear 'crisis' is the only sane option(14). This argument must seem persuasive for those in the targeted countries of the North. But New Zealand, by circumstance of its location in the South, has another option: to plan for survival in case the efforts for peace prove fruitless.

In the present global political climate, it would seem prudent to pursue both options.

NOTE CONCERNING ITALICIZED QUOTATIONS

These have been selected to present a range of views on various issues, and do not necessarily represent the views of the authors.

Who speaks for Earth?

"How would we explain the global arms race to a dispassionate extraterrestrial observer? ... Would we argue that ten thousand targeted nuclear warheads are likely to enhance the prospects for our survival? What account would we give of our stewardship of the planet Earth?. We have heard the rationales offered by the nuclear superpowers. We know who speaks for the nations. But who speaks for the human species? Who speaks for Earth?"(15).

"Since wars begin in the minds of men, it is in the minds of men that the defences of peace must be constructed"(16).

Part One : Nuclear Crisis

"There are no good or bad nuclear weapons: all are extremely horrible"(17)

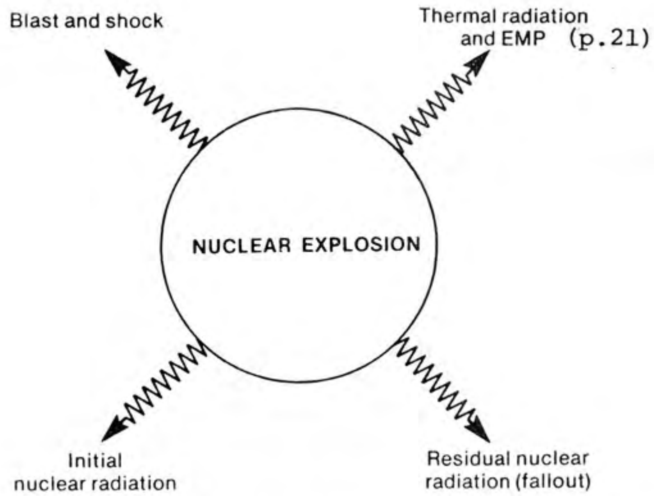


Fig. 2.1 Effects of a Nuclear Explosion

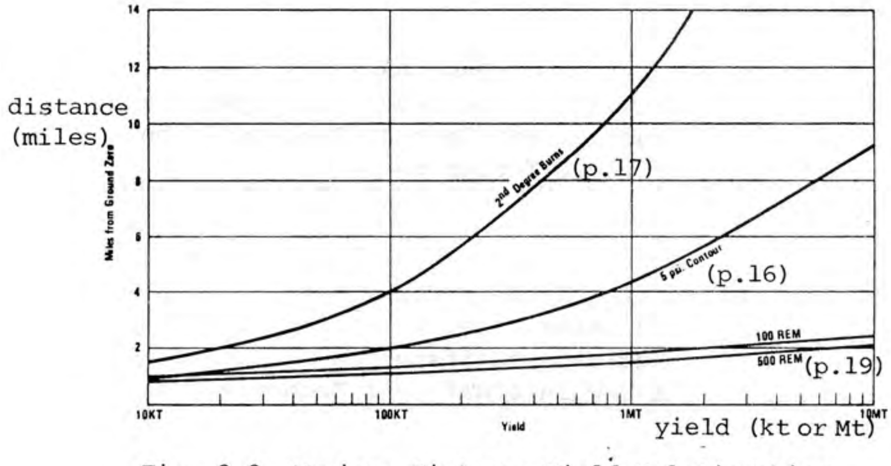


Fig. 2.2 Various Distance-Yield Relationships

(17) L. Freedman, 'The neutron bomb returns', The World Today, March, 1981, p81.
(18) Office Of Technology Assessment, 'The Effects of Nuclear War', (OTA-NAS-89, 1979) p16.
(19) Joint Committee on Defense Production, US Congress, 'Economic and Social Consequences of Nuclear Attacks on the United States', (US Govt Printing Office, 1979), p36.
(20) National Academy of Sciences, 'Effects of Multiple Nuclear Weapons Detonations Worldwide', (NAS, 1975) p25.

2. THE IMPLEMENTS OF MASS DESTRUCTION

The effects of weapons of mass destruction are extensive in both space and time, and are somewhat unpredictable. They discriminate very poorly between combatants and non-combatants, and are highly disruptive of the environment.

2.1 How Nuclear Weapons Work

An explosion occurs whenever there is a very rapid release of a large amount of energy within a limited space. The energy release in a nuclear explosion is produced in a different way from conventional explosions, e.g. TNT. This leads to basic differences between nuclear and conventional weapons:

- Nuclear explosions can be thousands or millions of times more powerful than conventional explosions: viz. 1 kt (kiloton), 1 Mt (megaton) devices are equivalent to 1,000 tonnes, 1,000,000 tonnes of TNT respectively.
- For the release of equivalent amounts of energy, the mass of a conventional explosive is much greater than that of a nuclear explosive.
- Much higher temperatures are produced by nuclear explosions and a significant proportion of the energy is emitted as heat and light - 'thermal radiation'.
- Nuclear explosions emit highly penetrating and harmful invisible rays - 'initial nuclear radiation'.
- Radioactive substances remain after a nuclear explosion, and also emit harmful radiation over an extended period of time - 'residual nuclear radiation' or 'fallout'.

A review of weapons physics is presented as an Appendix to this section. It provides a basic understanding of nuclear weapons - useful, but not essential, for subsequent sections: (see p. 27)

2.2 The Effects of Nuclear Weapons

The energy of a nuclear explosion is released in a number of forms, illustrated in Figure 2.1(18). The explosion energy received in each of these different forms depends on the nature and yield of the weapon, and particularly on the height of the 'burst'. For a low air burst, 35% of the energy is in thermal radiation and 50% in air blast. With increasing height of burst, the proportion emitted as thermal radiation increases while the proportion converted into blast decreases. However, regardless of the height of burst, approximately 85% of the explosive energy of a nuclear fission weapon produces air blast, thermal radiation and heat. The remaining 15% is released as various nuclear radiations - 5% as initial nuclear radiation and 10% as residual radiation. In a thermonuclear device, residual nuclear radiation represents 5% of the energy release in the explosion.

The distances to which the various harmful effects of nuclear weapons extend depend on the yield of the explosion, as shown in Figure 2.2(19).

If large numbers of nuclear weapons were detonated there could be global impacts. The production of oxides of nitrogen in nuclear fireballs and their injection into the stratosphere (by bombs in the Mt range) could lead to a depletion of the ozone layer, and an increase in harmful ultraviolet radiation reaching the earth's surface(20).

Table 2.1 Blast Effects of 1 Mt Airburst at 2,400m

Distance from ground zero (stat. miles)	Distance from ground zero (kilometers)	Peak overpressure	Peak wind velocity (mph)	Typical blast effects
.8	1.3	20 psi	470	Reinforced concrete structures are leveled.
3.0	4.8	10 psi	290	Most factories and commercial buildings are collapsed. Small wood-frame and brick residences destroyed and distributed as debris.
4.4	7.0	5 psi *	160	Lightly constructed commercial buildings and typical residences are destroyed; heavier construction is severely damaged.
5.9	9.5	3 psi	95	Walls of typical steel-frame buildings are blown away; severe damage to residences. Winds sufficient to kill people in the open.
11.6	18.6	1 psi	35	Damage to structures; people endangered by flying glass and debris.

*(see Fig. 2.2)

Effects of 5 psi overpressure

(21) Office of Technology Assessment, op cit, p18.

Blast

Blast has one of the least variable and most damaging effects on urban areas. It produces sudden changes in air pressure ('static overpressure') that can crush buildings, and high winds that can blow them down. The magnitude of the blast effect decreases with the distance from the centre of the explosion. There is an optimum burst height for maximising blast damage. Raising the burst height reduces the overpressure below the bomb, but widens the area in which a lesser over-pressure produces blast damage.

When a nuclear weapon is detonated on or near the surface of the earth, a crater is formed and a proportion of the material returns to the earth as fallout. If the fireball from the explosion does not touch the earth's surface, cratering does not occur and there is minimal immediate fallout.

Table 2.1 indicates the blast effects of a 1 Mt explosion at a burst height of 2,400 m (optimal for damage to factories), and the vulnerability of people in various overpressure zones(21).

Thermal Radiation

Thermal radiation from the fireball can produce flashblindness, burn skin and ignite combustible materials.

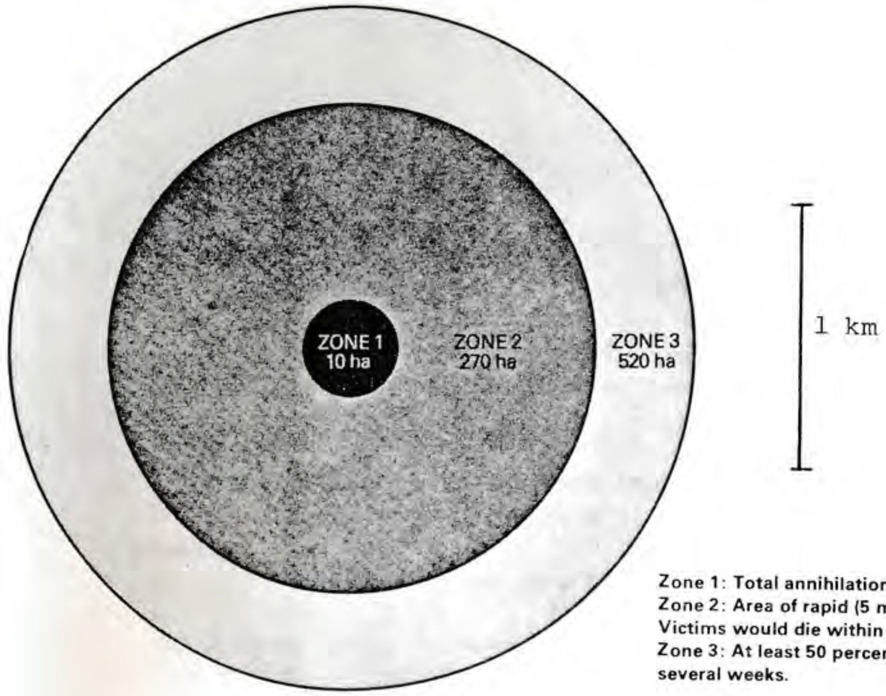
A 1 Mt explosion could cause flashblindess at a distance of 21 km on a clear day, or 85 km on a clear night. Flashblindess can last for several minutes, after which recovery is total. The temporary blinding of motorists could cause accidents and injury, hampering an attempted evacuation.

Skin burns require higher intensities of light, and would be inflicted closer to the explosion. For weapons in the megaton range, the thermal pulse lasts long enough that, if a temporary refuge was reached promptly, burns would be reduced. A 1 Mt explosion could cause first-degree burns (equivalent to a bad sunburn) at a distance of 11 km, second degree burns (producing blisters and permanent scars) at 10 km, and third-degree burns (which destroy skin tissue) at a distance of 8 km. Third-degree burns over 24% of the body, or second-degree burns over 30% of the body, result in serious shock and generally prove fatal, unless prompt specialized medical aid is available. The distance at which burns are dangerous depends on the weather. Particles and moisture in the air reduce thermal radiation, whereas snow on the ground or cloud over the fireball increase the distance by reflection.

Fires could be started by thermal radiation passing through the windows of buildings, and igniting combustible material. Blast damage could also produce fires indirectly. Separate fires may coalesce into a mass fire, which consumes all structures over a large area. Mass fires can be of two kinds: a 'firestorm' in which violent inrushing winds create extremely high temperatures (but prevent further spread), and a 'conflagration' in which a fire spreads along a front.

Direct Nuclear Radiation

For larger nuclear weapons, the range of lethal direct radiation is less than that of blast and thermal radiation effects. However, in the case of small weapons, direct radiation may have the greatest lethal range. Direct radiation did substantial injury to the people of Hiroshima and Nagasaki. There is a great deal of uncertainty over the effects of ionising radiation on humans at low levels. Radiation produces both short term and long term effects.



Zone 1: Total annihilation and site disruption.
Zone 2: Area of rapid (5 minute) incapacitation of personnel in the open. Victims would die within 4 to 6 days.
Zone 3: At least 50 percent of personnel exposed in the open will die within several weeks.

Fig. 2.3 Effects of 1 kt Neutron Bomb

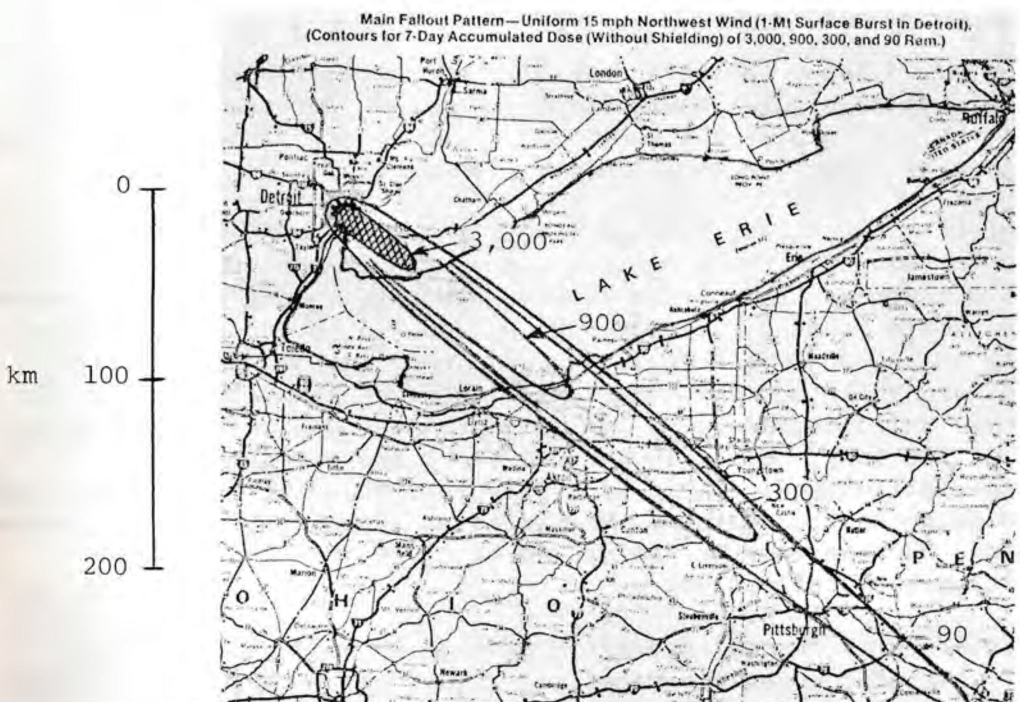


Fig. 2.4 Fallout from 1 Mt Surface Burst

(22) A 'rem' is a measure of biological damage, a 'rad' measures radiation energy absorbed by tissue, and a 'roentgen' is a measure of radiation intensity. As a rough approximation, these three quantities are numerically equal for nuclear radiation in this context.

(23) A.H. Westing, 'Neutron Bombs and the Environment', Ambio, Vol 7, No.3, 1978, p95.

(24) H. York, 'The Nuclear Balance of Terror in Europe', Ambio, Vol 4, No.5-6, 1975, p203.

(25) Office of Technology Assessment, op cit, p25.

(26) S.A. Fetter and K. Tsipis, 'Catastrophic Releases of Radioactivity', Scientific American, Vol 244, No.4, April 1981, p33.

A prompt dose of 600 rem(22) has a 90% chance of causing death within a few weeks. The precise shape of the curve showing the relation between death rate and radiation dose is not known for doses between 300 and 600 rem, but a dose of 450 rem within a short time is estimated to create a fatal illness in half the people exposed to it; the other half would get very sick, but would recover. A dose of 300 rem would kill about 10 percent of those exposed. A dose of 200 to 450 rem would cause a severe illness from which most people would recover; however, this illness would render people highly susceptible to other diseases or infections. A dose of 50 to 200 rem would cause nausea and would reduce resistance to other disease, but medical treatment would not be required. A dose less than 50 rem would not cause noticeable effects immediately but would nevertheless cause long-term damage.

Sublethal doses of radiation have long term effects measured in a statistical way. Assuming that total exposure is what counts (e.g. a dose of one rem each to a million people will produce the same effects as a dose of 10 rem each to 100,000 people), the incidence of fatal cancers has been estimated to be 50-500 per million person rem. A similar incidence of genetic effects could be expected. A more detailed discussion is given in section 10.1.

The only weapons where the effects of direct radiation are likely to predominate are low yield, or enhanced radiation, weapons. A low yield explosion could result from a terrorist weapon or from the use of tactical nuclear weapons. A 1kt explosion would give a dose of 600 rems out to 800 m, while the damaging effects of blast would only extend to 450 m. The effects of a 1 kt enhanced radiation weapon (neutron bomb) are illustrated in Figure 2.3(23). To give some perspective to the area involved, the population density of a residential area in New Zealand is about 20 persons/ha, and a typical section is 0.1 ha in area.

Fallout

For local fallout to occur, the burst must be at ground level or low enough for the fireball to touch the ground. Radioactive material is carried up into the atmosphere by the rising fireball and deposited downwind in a long plume. Some of the radioactive material rises to the troposphere, and is subsequently distributed in a broad band (mainly confined to the latitude of the burst) and is delayed in its arrival at the earth's surface. Some radioactive particles reach the stratosphere, and may not return to earth for some years. This fallout is distributed globally, but not uniformly, and does not present an acute radiation hazard, since the activity has decayed considerably by the time the fallout arrives. Significant numbers of people may nevertheless die prematurely from the long-term effects of global fallout. One estimate puts the number of deaths at about 1000 per megaton (24).

The biological effects of fallout are essentially the same as those for direct nuclear radiation. The fallout contours from a 1 Mt surface burst are shown in Figure 2.4(25). Areas exposed to about 100 rem would become 'safe' in 2 to 3 years, while 10 years would be required for areas exposed to about 100 rem. If a nuclear weapon ruptured a nuclear power plant, the fallout would be about the same for the first few days, but would remain hazardous for a considerably longer period(26).

Synergism

The major effects of nuclear weapons (blast, nuclear radiation, and thermal radiation) can individually cause death and injury to humans. In any real situation involving the detonation of a nuclear weapon these effects are likely to occur together, and could prove fatal even though the individual effects were sublethal. Exposure to more than 100 rems of radiation will impair recovery

	Launcher	Number	Warheads per launcher	(Mid-1980's force) Total warheads	Yield in megatons	Total megatons	Equivalent megatons
USA	Minuteman II	450	1	450	1.0	450.0	450
	Minuteman III	550	3	1,650	0.17	280.5	512
	(with MK-12A)	(550)	(3)	(1,650)	(0.35)	(572.5)	(825)
	Titan II	54	1	54	9.0	486.0	232
	Total ICBMs	1,054		2,154		1,216.5 (1,508.5)	1,194 (1,507)
	Poseidon	336	10	3,360	0.04	134	403
	Poseidon C-4	160	8	1,280	0.10	128	282
	Trident I	240	8	1,920	0.10	192	422
	Total SLBMs	736		6,560		454	1,107
	B-52 G/H	165	6 SRAM	990	0.2	198	337
			4 bombs	660	1.0	660	660
	B-52CM	165	20 ALCM	3,300	0.2	660	1,122
	FB-111	60	2 SRAM	120	0.2	24	41
			2 bombs	120	1.0	120	120
	Total bombers	390		5,190		1,662	2,280
	Grand total	2,180		13,904		3,332.5 (3,629.5)	4,581 (4,894)
USSR	SS-11	330	1	330	1.5	495	432
	SS-17	200	4	800	0.6	480	560
	SS-18	308	8	2,464	1.5	3,696	3,228
	SS-19	500	6	3,000	0.8	2,400	2,580
	SS-16	60	1	60	1.0	60	60
	Total ICBMs	1,398		6,654		7,131	6,860
	SS-N-6, SS-N-8	600	1	600	1.0	600	600
	SS-N-17, SS-N-18	300	3	900	0.2	180	306
	Total SLBMs	900		1,500		780	906
	Bear	100	1	100	20	2,000	740
	Bison	40	1	40	5	200	116
	(Backfire)	(250)	(2)	(500)	(0.2)	(100)	(170)
	Total bombers	140 (390)		140 (640)		2,200 (2,300)	856 (1,026)
	Grand total	2,438 (2,688)		8,294 (8,794)		10,111 (10,211)	8,622 (8,792)

Table 2.2 Estimated Strategic Forces for 1985

Table 2.3 Eurostrategic Weapons

State	Weapon designation	Year first deployed	Max. range (km)	No. of RVs	Yield	CEP (m)	No. deployed in 1979
Missiles							
USSR	SS-4	1959	2 000	1	1 Mt	2 400	390
	SS-5	1961	3 700	1	1 Mt	1 250	80
	SS-12	1969	~800	1	1 Mt	..	72
	SS-20	1977	~4 000	3	150 kt	400	~120
	SS-N-5	1964	~1 200	1	1–2 Mt	..	18
USA	Pershing IA	1962	~750	1	60–400 kt	450	108
	Pershing IA	1962	~750	1	60–400 kt	450	72
	Pershing II	(1983)	~1 600	1	10–20 kt	45	0
	GLCM	(1983)	2 500	1	200 kt	90	0
UK	Polaris A-3	1967	4 600	1	3 × 200 kt	800	64
France	S-2	1971	3 000	1	150 kt	..	18
	M-20	1977	5 000	1	1 Mt	..	64

State	Weapon designation	Year first deployed	Range (km)	Weapon load (t)	Nuclear weapons per aircraft	Speed (Mach)	No. deployed in 1979
Aircraft							
USSR	Tu-16 Badger	1955	6 500	9.1	2	0.8	318
	Tu-22M Backfire	1974	9 000	8.0	4	2.5	50
USA	FB-111A	1969	10 000	17.0	6	2.5	66
	F-111E/F	1967	4 900	12.7	2	2.2/2.5	156
UK	Vulcan B2	1960	6 500	9.6	2	0.95	48
France	Mirage IVA	1964	3 000	7.3	1	2.2	33

from thermal burns. Higher radiation doses have a similar effect when combined with physical injuries.

Electromagnetic Pulse (EMP)

Electromagnetic pulse (EMP) is an electromagnetic wave similar to radio waves, generated by surface bursts and by high altitude bursts in which the fireball is not symmetrical. It is similar to the pulse generated by lightning. Modern developments in electronic componentry is increasing vulnerability to EMP. It is possible that a single high altitude detonation could damage or destroy communications and electric power systems over the entire United States(27). It is also possible that EMP could cause meltdown accidents in nuclear power plants(28). EMP has serious implications for the command, communication, and control structures needed to fight a nuclear war. These are vulnerable to its effects and may not be easy to protect against it.

2.3 Weapons and Delivery Systems

'Strategic' nuclear weapons are defined as nuclear warheads delivered by ICBMs (Intercontinental Ballistic Missiles), SLBMs (Submarine Launched Ballistic Missiles), long-range heavy bombers, fractional-orbital space-borne systems, and ABMs (Anti-Ballistic Missiles). 'Tactical' nuclear weapons include all other nuclear weapons and are often thought of as nuclear weapons for battlefield use. 'Eurostrategic' nuclear weapons are located in Europe, but are capable of hitting targets located a significant distance inside the Soviet Union.

No absolute criteria distinguish between 'tactical' and 'strategic' nuclear weapons. Criteria such as weapon yield and range, location of delivery systems and target, and 'alert' (or readiness) status reveal much overlap(29).

Strategic Nuclear Weapons System

There have been continual 'improvements' in range and accuracy of strategic weapons. The introduction of MIRVs (Multiple Independently targetable Re-entry Vehicles) allowed multiple warheads to be fitted to individual missiles. The further development of MARVs (MAnoeverable Re-entry Vehicles) will make possible the destruction of blast-resistant (hardened) targets such as missile silos. Missile accuracy is measured in terms of the CEP (Circular Error Probability), which is the radius within which half the shots will fall. CEP may not provide an adequate indicator of accuracy because of a systematic 'bias' error(30).

The United States is upgrading Minuteman III missiles by improved guidance and the Mark-12A warhead with a yield of 350 kt. The Soviet Union is deploying SS-18 and SS-19 ICBMs with similar capabilities to Minuteman III. Strategic nuclear submarines are also being upgraded with the introduction of new missiles and submarines by both sides. The most modern Soviet SLBM is the 7400 km range SS-N-18, with three 200 kt MIRVs. The Trident I SLBM has a similar range, and carries eight 100 kt MIRVs. The US strategic bomber force is to be upgraded with the introduction of air launched cruise missiles (ALCMs) and new B1 and Stealth bombers.

Estimates of present strategic nuclear forces are contained in the SIPRI yearbook(31). Estimated strategic forces for 1985 are given in Table 2.2(32). The total 'megatonnage' (10,211) is equivalent to 5t of TNT for each person on earth. Table 2.3 gives the characteristics of the major Eurostrategic weapons. New systems including the Soviet SS-20 missile and Backfire bomber are already operational. The ground launched cruise missiles (GLCMs) and Pershing II missiles are to be deployed by NATO in the mid 1980s.

Name of system	Number deployed[a]	Range (nautical miles)	Yield (kilotons)	Dual-capable	Initial operational capability
Honest John	36	4.5– 22.0	20.0	Yes	1953
Sergeant	36	2.4– 84.0	Low	Yes	1962
Lance	36	2.6– 70.0	1.0–100.0	No	1973
Pershing	108	96.0–390.0	60.0–400.0	No	1962
Nike Hercules	144	1.0– 20.0	1.0	Yes	1958
M109 155 mm howitzer	326[b]	9.0	Low	Yes	1962
M-110 8 in howitzer	360	8.0	Low	Yes	1964
ADM	Unknown	1.0– 3.0	Low	No	1950s

[a] Nominal estimates, based on the number of units deployed.
[b] Combined US and allied deployments.

Table 2.4 US Tactical Nuclear Weapons in Europe

AGENTS[1]	TYPE OF WEAPON: NUCLEAR	CHEMICAL	BIOLOGICAL
AREA AFFECTED	UP TO 300 SQUARE KILOMETERS	UP TO 60 SQUARE KILOMETERS	UP TO 100 000 SQUARE KILOMETERS
TIME TO EFFECTIVENESS	SECONDS	MINUTES	DAYS
DAMAGE TO STRUCTURES	WIDESPREAD DESTRUCTION	NONE	NONE
OTHER EFFECTS	PROLONGED RADIOACTIVITY IN AREA OF 2,500 SQUARE KILOMETERS	CONTAMINATION FOR DAYS OR WEEKS	POSSIBLE EPIDEMIC OR NEW FOCI OF DISEASE
NORMAL USE OF AREA	3 TO 6 MONTHS	LIMITED FOR DAYS OR WEEKS	VARIABLE
EFFECT ON MAN	90 PERCENT DEATHS	50 PERCENT DEATHS	50 PERCENT MORBIDITY

Table 2.5 Nuclear, Chemical, and Biological Weapons

(27) W.J. Broad, 'Nuclear Pulse (I),(II), and (III)', Science, Vol 212, 29 May, 5 June, 12 June, 1981.
(28) IEEE Spectrum, June 1981, p48.
(29) SIPRI, 'Tactical Nuclear Weapons: European Perspectives', (Taylor and Francis, 1978) p4. (SIPRI = Stockholm International Peace Research Institute).
(30) E. Marshal, 'A Question of Accuracy', Science Vol 213, 1981, p1231.
(31) SIPRI, 'Yearbook 1980' (Taylor and Francis, 1980), Introduction.
(32) Office of Technology Assessment, op cit, p122-123.
(33) SIPRI, 'Tactical Nuclear Weapons: European Perspectives', (Taylor and Francis, 1978), p132.
(34) Defence Monitor, Vol 4, No.2, 1975, p2.
(35) Ibid, p4.
(36) SIPRI, 'Tactical Nuclear Weapons: European Perspectives', (Taylor and Francis, 1978) p223.
(37) F.M. Kapla, 'Enhanced-Radiation Weapons', Scientific American, May 1978.
(38) P.F. Walker, 'Precision-guided Weapons', Scientific American, Vol 245, No.2, August 1981, p21.
(39) M.S. Meselson, 'Chemical and Biological Weapons', Scientific American, May 1970.
(40) 'Teratogenic' = causes birth defect; 'carcinogenic' = causes cancer. See B. Holmberg, 'Biological Aspects of Chemical and Biological Weapons', Ambio, Vol 4, No.5-6, 1975, p211.
(41) Ibid.
(42) B.M. Jasami, 'Environmental Modifications - New Weapons of War?' Ambio Vol 4, No.5-6, 1975, p191.
(43) SIPRI, 'Outer Space - Battlefield of the future?' (Taylor and Francis, 1978).
(44) K. Sipis, 'Laser Weapons', Scientific American, Vol 245, No.6, 1981, p35.
(45) R.L. Garwin, 'Charged Particle Beam Weapons?' Bulletin of the Atomic Scientists, Oct 1978, p54.
(46) R.L. Garwin and H.A. Bethe, 'Anti-Ballistic Missile Systems', Scientific American, March 1968.

Tactical Nuclear Weapons

Nuclear weapons have been integrated with conventional forces at all levels, and include nuclear artillery, torpedoes, and depth charges. Table 2.4 lists some of the tactical nuclear weapons deployed with US forces in Europe(33). Nuclear weapons are also stationed in the Philippines and in South Korea(34). The US Navy is equipped with tactical nuclear weapons (see page 26(35)). Some other developments include enhanced-radiation weapons(36) and weapons with selectable yields.

Future Developments

Enhanced radiation weapons or neutron bombs have been discussed on p19(see also (37)). Precision-guided weapons, which actively seek their targets, may provide an effective counter to massed tanks, thus undermining the rationale for (nuclear) enhanced radiation weapons, and may give the military advantage to defensive forces(38), without requiring a nuclear response.

Chemical and biological weapons are difficult to assess but may provide non-nuclear nations with weapons of mass destruction. Table 2.5 compares the damaging effects of chemical, biological and nuclear weapons(39). It is likely that many chemical warfare agents have long term teratogenic and carcinogenic effects which may be exploited(40). Genetic engineering may enable the manipulation of the virulence and toxicity of pathogens(41). This has already been used to increase the resistance of plague bacteria to antibiotics.

The modification of the environment as an effective weapon of war seems unlikely(42). (Geophysical modification possibly could involve weather and climate, earthquakes, and electromagnetic radiation reaching the earth).

Outer space has increasingly important military uses, including reconnaissance, communication, navigation, meteorological, and hunter killer satellites(43). Lasers have received attention as a possible defence against ICBMs. They could also be used in the atmosphere against missiles and aircraft. However, the technological obstacles to a space-based anti-ballistic missile (ABM) system using lasers appear insurmountable(44), and such weapons are vulnerable to simple countermeasures. Laser weapons operated in the atmosphere are technically feasible but offer little advantage over existing defensive weapons.

Charged-particle beam weapons have been suggested as a means of destroying missiles. There has been concern expressed that the Soviet Union is close to deploying an effective particle beam ABM system. Such a weapon faces major technical difficulties and would be vulnerable to simple countermeasures(45). Nevertheless, military planners in both the United States and the Soviet Union continue to authorize large budgets for the development of ineffective ABM weapon systems(46).

2.4 Illustrative Attack Scenarios for New Zealand

The primary purpose of these scenarios is to put the effects of nuclear weapons into a New Zealand perspective. The attacks described are considered unlikely (but not implausible) at the present time. Over the 30 year time horizon adopted for this CFF report, changes in New Zealand's strategic significance, and improvements in delivery systems, may change this assessment. (New Zealand is presently out of range of Soviet land-based systems).

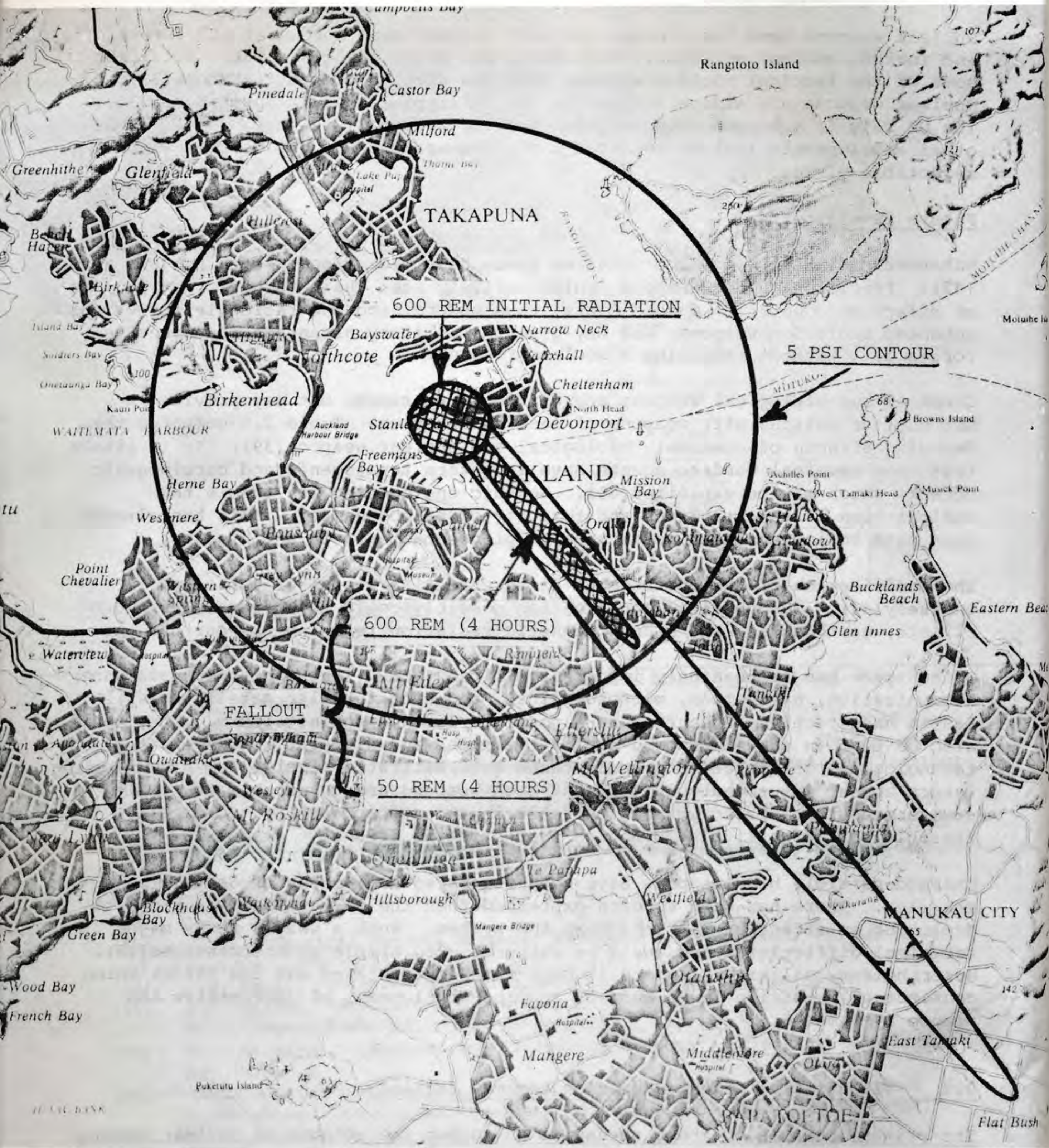


Fig. 2.5 Effect of 1 kt Tactical Weapon (shaded circle) and 1 Mt Airburst (5 psi cont 600 and 50 rem fallout plumes, over 4 hours)

(47) Office of Technology Assessment, op cit, p45.
(48) R.C. Chester, Biological Dose and Radiological Activity from Nuclear Reactor or Nuclear Weapon Fission Products, Oak Ridge National Laboratory ORNL-4996, Dec 1974, p4.

1-kt Tactical Warhead onto Nuclear Powered Vessel

A guided missile cruiser (eg. US "Long Beach") berthed at the Devonport Naval Base, is attacked by a hostile vessel using a 1 kt tactical nuclear weapon. Lethal nuclear radiation (600 rem) reaches out to a distance of 800m, while extensive blast damage (5psi) occurs out to 450m(47). The core of the 430 MW reactor is vaporised and combines with the radiactivity derived from the weapon itself; both rise with the fireball and return to earth in the manner characteristic of fallout from the explosion of a weapon alone. The plutonium from the nuclear weapons carried on board adds to strike weapon and reactor fission products.

The areas covered by prompt initial nuclear radiation and fallout (for the weapon alone) are shown in Figure 2.5. Reactor fission products enlarge the lethal zone for fallout considerably, and also increase the long term hazard. The short-lived isotopes in the reactor core are equivalent to the amount released by a 5 kt bomb, while the long-lived components after one month of reactor operation are the equivalent of 150 kt. The small area inside which the dose rate is unacceptably high one week after detonation (due to bomb debris alone) remains uninhabitable for another 25 years, due to the contamination by reactor fission products(48). The attack causes thousands, or a few tens of thousands, of civilian casualties.

1-Mt Air Burst

A submarine-launched ballistic missile (e.g. SS-N-6) with a single 1-Mt warhead is detonated 2,400m above the Devonport Naval Base - an unlikely target, but assumed for purposes of comparison with the 1 kt 'tactical' attack above. The target area (about 7,200 ha) which receives 10 psi or more of overpressure is maximized for this altitude. The fireball does not touch the ground, even at its maxiumum radius of 1000m and there is consequently no significant fallout. An air burst increases the number of fatalities from blast and thermal effects to about double those that would result from an equivalent ground burst.

Figure 2.5 also shows the outer limits of the 5 psi overpressure zone for this detonation. This can be interpreted in terms of damage to people and structures by reference to Table 2.1. For a visibility of 16 km, burns are experienced by survivors of the blast effect at the 2 psi contour.

Flashblindness is experienced at 21 km distance on a clear day, (approximately the 1 psi contour) and at 85 km distance on a clear night (over an area including most of the Coromandel Peninsula).

The attack results in extensive damage to the urban area, and causes 100,000-300,000 prompt deaths, with a similar number of significant injuries. With greater visibility, the range for thermal effects is increased by as much as 50%; correspondingly, the number of people exposed and the extent of bare skin are also increased. These factors would cause a substantial increase in burn casualties.

Contamination by radioactive material would not be a long-term problem, apart from induced radioactivity directly under the burst point. However, if the explosion had occurred on the ground, extensive fallout would have resulted. The region receiving a lethal dose (600 rem) in 24 hours would represent an area of approximately 1000 sq km.

U.S. Attack Aircraft Carriers. 14 U.S. carriers carry fighter bombers configured for attack roles and capable of launching nuclear air-to-surface missiles or dropping nuclear bombs. An estimated 100 nuclear weapons are aboard each U.S. carrier.

Forward-based aircraft. Fighter-bombers, nuclear capable, are deployed at bases in Europe and Asia and aboard 14 U.S. Carriers. Combat radiuses vary between 400 and 1100 miles. U.S. aircraft include F4s, F111s, A4s, A6s, A7s, F8s, and F14s.

Mark 57 and Mark 101 Nuclear Depth Bombs. Used in anti-submarine warfare (ASW) and delivered by P-3 and S-3 aircraft and ASW helicopters. Estimated yield of 5-10 kilotons.

Terrier Surface-to-Air Missile. Yield of warhead is about one kiloton. Found aboard U.S. destroyers and cruisers to defend against air attack Range of 25 miles.

Talos Surface-to-Air Missile. Yield of warhead is 5 kilotons Found aboard U.S. cruisers to defend against air attack. Range of 70 miles.

SUBROC Missile. Anti-submarine rockets, fired below water by submarines and travel in the air before reentering water. Yield of one kiloton. Range of 30 miles.

Anti-Submarine Rocket. ASROC weapons carry an explosive of 1 kiloton and are aboard U.S. cruisers, destroyers, and destroyer escorts. ASROCs are fired by 8-celled "Pepperbox" launchers. Range of 6 miles.

Tactical Nuclear Weapons Systems, US Navy (see p. 23)

(49) The U235 nucleus contains 92 protons and 143 neutrons viz. 235 nucleons in all, the 'mass number'. U238 has 3 extra neutrons viz. 238 nucleons in all.

2.5 Appendix

A review of weapons physics is presented here to provide a basic understanding of nuclear weapons - useful, but not essential, for subsequent sections.

All substances are made from 'elements'. The 'atom' is the smallest part of any element retaining the characteristics of that element. Every atom consists of a relatively heavy central region, or 'nucleus', surrounded by a number of very light particles called 'electrons'.

The atomic nucleus consists of particles called 'protons' and 'neutrons', collectively referred to as 'nucleons'. Atoms of different elements differ in the number of protons (positive charges) they contain in the nucleus. The nuclei of a given element all contain the same number of protons, but the number of neutrons can differ, the resulting atoms being called 'isotopes' of that element. They have different masses due to their different numbers of neutrons. For example, uranium consists of two isotopes with mass numbers of 235 and 238(49), referred to as respectivley as U 235 and U 238.

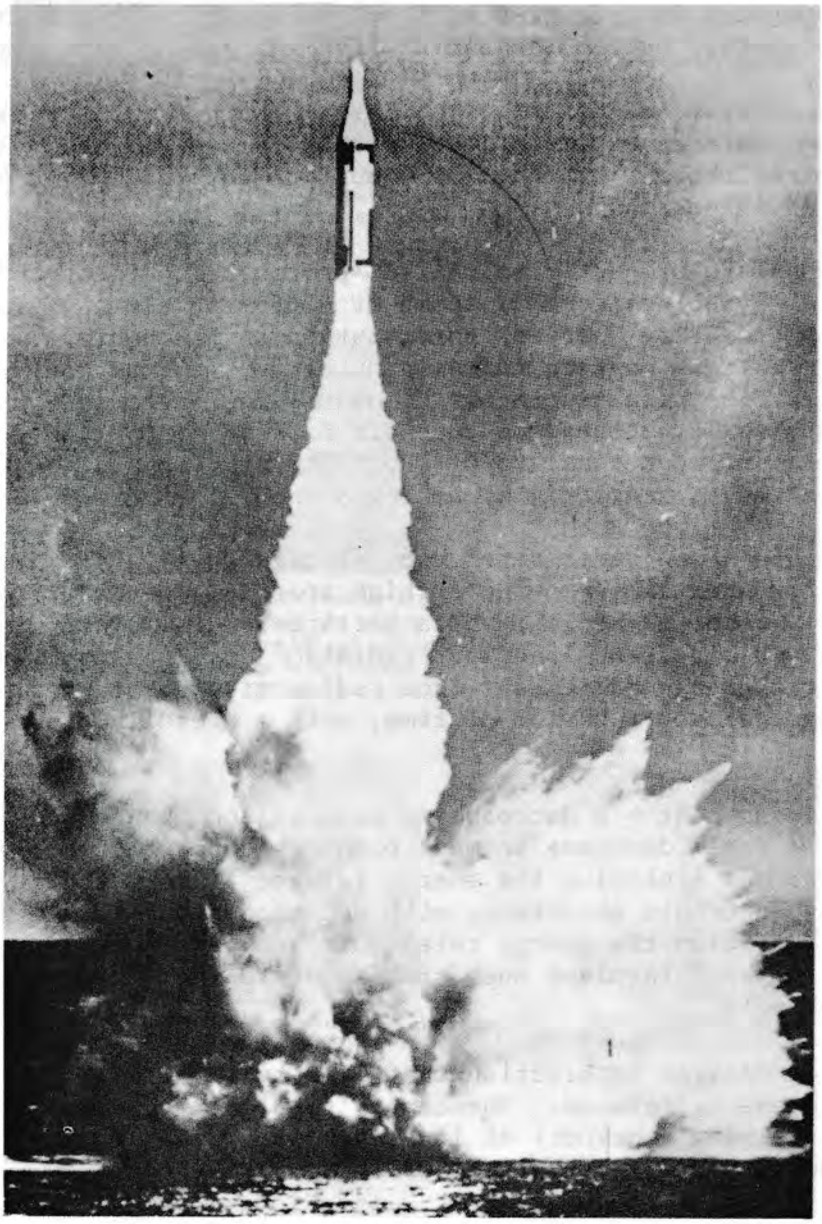
Nuclear radiation consists of 'gamma rays' viz. electromagnetic radiation of high energy, and various particles moving at high speeds. The particles consist of alpha particles (i.e. helium nuclei), beta particles (i.e. electrons), and high energy neutrons, while residual nuclear radiation involves the spontaneous emission of beta particles and gamma rays from radioactive substances. The residual radiation decays over a period of time, with a steadily decreasing rate of emission.

Energy and mass are equivalent - a decrease in mass is accompanied by an emission of energy. A small decrease in mass produces an enormous release of energy. In a conventional explosion the energy release arises from a rearrangement of the electronic structure, with an unobservably small change in mass. In a nuclear explosion the energy release arises from a rearrangement of the nuclear structure, which involves such tremendous forces that the mass differences are observable.

There are two kinds of nuclear interaction that lead to an overall decrease in mass and therefore an energy release. These are 'fission' (splitting) of heavy nuclei and 'fusion' (joining together) of light nuclei. Both of these processes can be made to produce an explosive release of energy.

The materials used to produce nuclear explosions by fission are certain isotopes of the elements uranium and plutonium. Natural uranium consists mainly of two isotopes. The readily-fissionable one commonly used in nuclear weapons is U 235 which represents about 0.7% of naturally occurring uranium. U 233 is also fissile and can be made artificially from thorium 232. Plutonium 239 is another fissile material suitable for nuclear weapons, and is made artificially in nuclear reactors from U 238, the most abundant isotope of naturally occurring uranium.

When a neutron enters the nucleus of a fissile atom, it causes it to split into two smaller nuclei, with the release of a large amount of energy. The process is accompanied by the instantaneous emission of two or more neutrons which can induce fission in further nuclei, creating a chain reaction in which the liberated energy increases rapidly. The complete fission of 57 grams of fissile material releases the energy equivalent of 1000 tonnes of TNT (1 kt). A bomb relying on the fission of U 235 is about 5% efficient, and thus contains about



Submarine-Launched-Ballistic-Missile

(50) Stockholm International Peace Research Institute (SIPRI), 'Nuclear Energy and Nuclear Weapon Proliferation', (Taylor and Francis, 1979) p400.

1.14 kg per kt of fission yield, whereas one relying on Pu 239 is about 15% efficient, and so contains 380 grams per kt of fission yield.

To produce a self-sustaining fission chain reaction, at least one neutron must be available to cause further fission for each neutron absorbed. As the mass of the fissile material is increased (or the volume decreased by compression), the loss of neutrons at its surface is decreased and a point is reached at which the chain reaction can proceed. This represents the 'critical mass' under the existing conditions, and depends on the shape of the fissile material, its composition and density, and the presence of impurities. The critical mass can be decreased by surrounding the fissile material with a suitable neutron 'reflector' or 'tamper' which reduces the loss of neutrons and provides inertia, thereby delaying the expansion of the exploding material. The 'tamper' also maintains the chain reaction until an appreciable fraction of the fissile material has undergone fission.

With pure fissile material surrounded by a reflector of natural uranium 15 cm thick, the critical masses are 5.8 kg for U 235, and 4.4 kg for Pu 239(50). This mass of Pu 239 could be contained in a sphere 7.5 cm in diameter; at the higher density achieved by implosion the critical mass for plutonium might be less than 2 kg. The time interval between successive fissions in a chain reaction is known as the 'generation time' and is approximately one-hundred-millionth of a second. For U 235 it requires about 54 and 58 generations to release 2 kt and 100 kt of energy respectively; therefore (98% of the energy of a 100 kt explosion is released during the last four generations.

A quantity of fissile material exceeding the critical mass would melt or explode spontaneously. It is therefore necessary that nuclear weapons contain subcritical assemblies of fissile material which can be quickly made 'supercritical'. Two types of weapon are used to rapidly convert a subcritical assembly into a critical one. The first is known as the 'gun' type and uses an explosive propellent to blow one subcritical mass into another subcritical mass. The second is known as the 'implosion' type and attains a supercritical mass by compression of a subcritical mass. This is achieved by surrounding a subcritical sphere of fissionable material with high explosive capable of producing an inwardly directed implosion wave which compresses the sphere to a supercritical condition.

The fission reaction products of a nuclear bomb constitute a considerable radiation hazard. Most are short lived and their combined radioactivity reduces from the level one hour after detonation by 90% after 7 hours, by 99% after two days, and by 99.9% after two weeks.

Thermonuclear (fusion) weapons or H-bombs can also be constructed. There is no theoretical limit to the yield which can be achieved with these, but it is generally in the megaton (Mt) range (compared with fission bombs which have yields in the kiloton (kt) range). The development of thermonculear bombs has enabled a 1000-fold increase in yield over fission bombs, which in turn represent a 1000-fold increase over the largest conventional bombs.

Energy production in the sun and stars is due to fusion reactions involving the nuclei of various light atoms. The fusion reactions of interest in the design of thermonuclear weapons involve the isotopes of hydrogen, deuterium (H 2) and tritium (H 3). The high energy required for these reactions to proceed is supplied by raising the temperature to several tens of millions of degrees. A nuclear fission bomb can achieve the required temperatures and acts as a trigger

(51) The principal reactions are

tritium + deuterium $\rightarrow$ helium + neutron + energy

lithium 6 + neutron $\rightarrow$ helium + tritium + energy for thermonuclear reactions. Another reaction utilised in thermonuclear weapons involves lithium 6, an isotope which makes up 7.4% of naturally occurring lithium. Lithium 6 is incorporated in the weapon as lithium deuteride. These reactions are self sustaining and can be propagated rapidly through the thermonuclear fuel(51).

The neutrons produced in thermonuclear reactions can cause fission in U 238 nuclei. It is possible to make use of the thermonuclear neutrons by surrounding the fusion weapon with a 'blanket' of ordinary uranium. When this is done the weapon is a fission/fusion/fission bomb.

In 'boosted' fission weapons, thermonuclear neutrons serve to enhance the fission process; energy released in the thermonuclear reaction is then a small fraction of the total yield.

In enhanced radiation weapons (neutron bombs) the fusion yield is maximised (along with fast neutron emission) and the fission yield is minimised (along with blast and thermal effects). This is achieved by eliminating the U 238 blanket, and by using a small fission trigger in a configuration which minimises the boosting of the fission process by thermonuclear neutrons.

"The World has, in the 35 years of the Bulletin's existence, been extremely lucky in avoiding any further use of a nuclear weapon"(54).

"The search for a politically stable country that could survive a nuclear holocaust, prompted the inventor of a computer language translation service to base his business in New Zealand ..."(55).

NOSTRADAMUS(66) (Sixteenth century prediction of World War 3)

"The gods will make it appear to mankind that they are the authors of a great war. Before the sky was seen to be free of weapons and rockets: the greatest damage will be inflicted on the left."(I.91)

Nostradamus declares that we will not know which side starts the next world war although in later quatrains he places blame for the start of the war upon China. After a peaceful interlude (I.63) the air will be full of weapons and fighting, rockets pointing like lances to the skies. The left hand side of the world on a map is America and the country will suffer great losses. However in IV.95, he states that the victor will be born in America.

"At sunrise a great fire will be seen, noise and light extended towards the North. Within the globe death and cries are heard, death awaiting them through weapons, fire and famine." (II.91)

This is a frightening quatrain if one applies it to the future. It seems to imply that a Northern Country, Russia or the U.S.A. will be bombed suddenly at sunrise, and this will be followed by a period of great devastation. In I.92 Nostradamus states that America will suffer the greatest destruction. If we link this quatrain with I.91, II.5, 41 and 46, we are facing a very gloomy prospect.

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(52) 'New Zealand Yearbook 1981', p272 (Government Printer, 1981).
(53) For example: see Professor Bernard Feld, General Secretary of the Pugwash International Conference on Science and Public Affairs, in New Scientist vol 78, (1974); also (Australian) Office of National Assessment, cited in The National Times, July 26, 1981.
(54) B.T. Feld, 'The Hands Move Closer to Midnight', Bulletin of the Atomic Scientists, January, 1980, pl.
(55) Financial page, The Evening Post, 23 January, 1982.
(56) Robert Mann in 'New Zealand 2001' (ed. George Bryant) p52 (Cassell, 1981).
(57) L.R. Beres, 'Apocalypse : Nuclear Catastrophe in World Politics', pl (University of Chicago Press, 1980).
(58) John Hinchcliff, 'Peace is Possible', pl (Pacific Publishers, 1976).
(59) Heinemann New Zealand Dictionary (Heinemann Educational Books, 1979).
(60) John Hinchcliff, op cit.
(61) Cited in Richard Pipes, Commentary, July 1977, p21.
(62) L.R. Beres, op cit, p7.
(63) John Hinchcliff, op cit, pl.
(64) Ibid.
(65) "God's final intervention will follow, not prevent, this great tribulation that will be World War 3. But I repeat, you can escape all this... God will protect His own from it..." (The Plain Truth, Vol 47, No.1, 1982).
(66) Erika Cheetham, 'The Prophecies of Nostradamus', (Corgi, 1980).

3. THE PROGNOSIS FOR PEACE

3.1 The Neglected Expectation

During the seventies, the more visible environmental hazards such as pollution and resource depletion were foci of public concern. New Zealand established a Commission For the Environment in 1972. One of its major reponsibilities is to audit environmental impact reports(52) - written appraisals of the environmental consequences expected from new developments and policies. But the prime threat to the human environment is presented by nuclear war. It dwarfs all other threats in the potential magnitude of its destructive consequences, and its likelihood is greater than most of us care to admit. According to some informed opinion overseas, there is an even chance of a devastating nuclear war in the next two decades(53). That this judgement is not an issue for most New Zealanders seems to be a case of "ostrichism by a whole society"(56).

The point has been reached "where the catastrophic possibilities that lie latent in nuclear weapons are very likely to be exploited, either by design or by accident, by misinformation or miscalculation, by states or by subnational groups, by lapse from rational decision or by unauthorized decision"(57). The Norwegian Academy of Science has calculated that there have been 1656 major arms races since 500 BC. Sixteen of these ended in economic collapse and the rest were ended by wars(58). The outcome of the present arms race is unknown, but has historical precedents.

'War' has been variously defined as "the use of armed forces in conflict, especially between countries"(59) and "the struggle to achieve victory through the force of arms"(60). To Clauswitz, war is "nothing more than the continuation of politics by other means"(61). But what the nuclear powers are arming for today is a thermonuclear holocaust. It is not war, because a victory cannot be won. Weapons of mass destruction reduce Clauswitz's 'continuation' to annihilation for the participants.

The argument that a nuclear war is simply too terrible ever to be fought is not supported by past events. In previous wars, "the only constraints on human barbarism have been the available implements needed for the task .... Auschwitz and Hiroshima provide vivid examples of man's ability to perpetrate savagery upon his fellow men. It would be the height of folly to believe that this could not happen again and on an even larger scale"(62).

'Peace', too, can be defined in different ways. A useful distinction can be drawn between 'peace' as "the absence of organized violence ... the state of non-war" and 'peace' as "the achievement of justice, co-operation, and harmony in a society"(63). Both definitions are crucial. The achievement of a peaceful society where there is no war requires "peace where there is justice, freedom, and a harmonious society. The concerns are interdependent"(64).

Although nuclear war might be the neglected expectation of contemporary society, strong images of a final apocalypse - 'Armageddon' - are found in much prophetic and religious writings and traditions(65). These images are significant in a secular age, if only for the recognized potential of prophecies to become self-fulfilling. Thus the threat of nuclear war could be more acceptable to a society familiar with the admonishment of "wars and rumours of wars: see that ye

"According to both precedent and prophecy, the Hopis would lose their land by secular law. Then the higher forces would inexorably mete out justice. World War III would break out. The United States would be destroyed by a foreign nation just as it, as a foreign nation, had destroyed the Hopi nation. Land and people would be contaminated and destroyed by atomic bombs. Only the Hopis, on the homeland granted them by the Creator, would be saved to make an emergence to the future Fifth World"(67).

"You hear the Christian neo-fascists and madmen talking of the Armageddon, the anti-Christ in Russia and the need to rise again. I think the odds are about 90-10 in favour of nuclear war during Reagan's administration"(68)

A First Strike?

"What shall make thee to understand how terrible the striking shall be? On that day, men shall be like moths scattered abroad, and the mountains shall become like carded wool of various colours driven by the wind."(71)

"Mankind is confronted with a choice : we must halt the arms race and proceed to disarmament, or face annihilation."(73)

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(67) Frank Waters, "Book of the Hopi" (Penguin, 1963).
(68) Madalyn O'Hair (founder of American Atheists) quoted in The Listener, 13 February, 1982, p12.
(69) Matthew 24 : v 6.
(70) Galatians 5 : v 15.
(71) The Koran, stanza 588.
(72) Frank Barnaby, 'Prospects for Peace' (Pergamon, 1980).
(73) From the Final Document, First Special Session of the United Nations General Assembly on Disarmament, para 18 (30 June, 1978).
(74) Frank Barnaby, op cit, p75.
(75) For instance, Theodore Gordon, in his important review paper 'Anticipating World Crises : Five Overarching Crises in Prospect' (Current, no. 168, 1974, p48), rated the probability of nuclear war as "very low".
(76) Reported in The Evening Post, 4 June, 1980.

be not troubled for all these things must come to pass"(69). Yet, St Paul might have been expounding upon mutually assured destruction when he wrote - "If you go on fighting one another, tooth and nail, all you can expect is mutual destruction."(70)

The world arsenals contain tens of thousands of nuclear weapons, perhaps as many as 60,000. Every city in the Northern Hemisphere could be targeted to receive the equivalent of 2,000 Hiroshima-type bombs. The escalation of a regional conflict to a nuclear world war is perhaps more likely than a first strike by one superpower on the other, although the danger of superpower conflict by accident or miscalculation is ever present. Given the frequency of conflicts in Third World countries - a new outbreak every three months, 140 since 1945 - the chance for escalation is very real. Another concern is the thrust of technology towards new weapons more suited for fighting rather than deterring nuclear wars. Two fifths of global research and development expenditure (about $50,000 million) and two fifths of all scientists are committed to military purposes. In the next thirty years, technological revolutions in space warfare, in anti-submarine warfare, ballistic missile defence systems and other fields will contribute to perceptions that a nuclear war can be fought and won, and that a first strike is feasible and even essential(72).

Nuclear weapons proliferation is a growing threat. 'Vertical' proliferation is represented by an accelerating arms race. The superpowers are beginning the process of the deployment of cruise and SS-20 missiles, B1 and Backfire bombers, Trident and Typhoon ballistic missile submarines and other advanced weapons systems to maintain deterrence. 'Horizontal' proliferation becomes more likely with the widening opportunities for diversion of weapons material from 'civilian' power reactor programmes in Third World countries. By the turn of the century, the production of plutonium is projected to be sufficient for the fabrication of 30,000 Nagasaki-type bombs every year.

"Awareness of the catastrophic destructiveness of nuclear war seems to have become so deep in man's consciousness that he no longer actively worries about the ever-present danger that nuclear war could, in an instant, end our lives and our society ... Can we ... really believe that these weapons, with their almost incomprehensible destructive power, will never be used?"(74)

3.2 Public Perceptions

In the proliferation of books and articles on the 'future' which began in the late 1960s and continued through the 1970s, most studies of the period lying ahead give little space and less sophistication to assessments of the possibilities for nuclear war. Reflecting Western public opinion that nuclear war was 'unthinkable', the general conclusion at that time was that the likelihood was slight(75).

More recently, with the decline of 'detente' in the wake of the Soviet intervention in Afghanistan, and the non-ratification of the SALT 2 treaty by the United States, there has been a dramatic shift in public opinion. Europeans in particular are moving increasingly towards the belief that the globe will be plunged into a Third World War within the next few decades. A major public opinion survey conducted in 1980 by the Brussels-based EEC Commission showed that more than a third of Europeans believed nuclear war within the next 10 years is either certain or probable(76). These concerns have been given emphasis by unprecedented 'peace' demonstrations in many cities in late 1981.

Table 3.1 Opinion Surveys

	Probability in Next 20 Years 0.01	0.1	0.5	0.9	0.99
A. leading 'futurists' (11 responses)					
(i) full-scale nuclear war		4	7		
(ii) limited nuclear war		1	4	6	
(iii) nuclear terrorism		1	2	7	1
B. CFF Secretariat (8 responses)					
(i) full-scale nuclear war			6	1	1
(ii) limited nuclear war			3	5	
(iii) nuclear terrorism		1		7	

Table 3.2 Synopsis of Results of Public Opinion Survey conducted in Auckland, February, 1982.

1. Questionnaire number sent out - 451
   replies - 142 (31%)

2. Respondents male - 56% female - 44%

15-24	25-34	35-44	45-54	55-64	65-74	75+
6%	13%	27%	17%	18%	16%	3%

Close relatives overseas - 55% (Australia 35%, Europe 29%, North America 14%)
Close friends overseas - 34%

3. The likelihood of a nuclear war within the next 20 years is:

almost impossible	unlikely	even chance	likely	almost certain	don't know
3%	28%	24%	24%	10%	8%

4. The effect on NZ of a Northern Hemisphere war would be:

	none	slight	severe	catastrophic	don't know
- on health	6%	35%	27%	9%	23%
- on lifestyle	3%	23%	40%	14%	20%

		yes	no	don't know
5.	In a nuclear war between the US and the USSR, is it likely Auckland will be attacked with nuclear weapons?	13%	68%	19%
6.	Do vessels carrying nuclear weapons in NZ ports:			
	- increase New Zealand's security	37%	50%	13%
	- increase the likelihood of nuclear attack?	42%	40%	17%
	Do you approve of such visits?	49%	41%	8%
7.	Does New Zealand's membership in ANZUS improve its security against nuclear attack?	44%	35%	21%
	Should New Zealand remain in ANZUS	66%	13%	21%
8.	Should New Zealand be making preparations to reduce the effects of a nuclear war?	64%	30%	6%
	Do you want further information that may help protect yourself?	65%	30%	5%

(77) Reported in Newsweek, 5 Oct, 1981, p9.

(78) This work, by T.E. Kjellström and N.A. Wilson, was part of the latter's elective study of medical implications of nuclear war.

A 1981 Gallup poll conducted in the United States indicated(77)

- 65% of Americans were "frequently worried" or "concerned" about the chances of nuclear war.
- 50% of Americans believe any war between the superpowers would escalate to an "all-out nuclear war".
- 30% of Americans believe there was certainty or a "good chance" of an "all-out nuclear war" with the Soviet Union.

Three different surveys of opinion taken for this CFF report are consistent with the pessimism implicit above. Table 3.1 (facing page) gives some estimates of the likelihood in the next 20 years of

(i) full-scale nuclear war (10,000 Mt exchange)
(ii) limited nuclear war
(iii) nuclear terrorism (single 1 kt 'device')

Probabilities are expressed using an incremental scale viz.

probability	interpretation
0.01	almost impossible
0.1	unlikely
0.5	even chance
0.9	likely
0.99	almost certain

Responses were elicited from two groups:

A. A panel of leading 'futurists' viz.

Clement Bezold	Hughes de Jouvenal
Edward Cornish	Eleonore Masini
Johan Galtung	Magda McHale
Edward Goldsmith	Burt Nanus
Theodore Gordon	Murray Turoff
John Harris	

B. CFF Secretariat (professionals with various skills in 'futures' studies).

The two sets of responses are reasonably consistent, and reinforce the public concerns outlinedabove.

In February, 1982 New Zealand public opinion was tested by a quasi-random survey conducted in Auckland for this CFF report(78). Significant results are set out in Table 3.2 (facing page), and further reinforce the concerns expressed above - 58% considered there was at least an even chance of nuclear war within the next 20 years (63% of those with a firm opinion). The sample was evenly divided over issues relating to visits by vessels carrying nuclear weapons, and on security afforded by ANZUS, but favoured continuing membership, and preparation for mitigation of a nuclear war. (Although the sample was (necessarily) small, the indicated support for ANZUS (66%) is consistent with results of a larger 1979 survey (61% support) indicating this 1982 survey is reasonably reliable (see ref (211), pp. 66-67)).

One of Ehrlich's colleagues had returned from a meeting with scientists at the Livermore weapons laboratory in California and told Ehrlich: "It's worse than we think. They're insane." Ehrlich paused in his recounting of the story. "This friend, he's a very high-technology person himself, and he'd gone there expecting to meet really intelligent scientists. But they're not. They're crazy - and that means we're in deep, deep trouble... If we manage to keep the nuclear genie in the bottle, then I think we've got 10 to 15 years to turn the other things around - population, the defoliation of the tropics, the perturbation of the weather systems, the fouling up of the food chains. But the nuclear threat has to be acted on right now. Otherwise, we're unlikely to get through..."(79)

"The global balance of terror, pioneered by the United States and the Soviet Union, holds hostage the citizens of the Earth. Each side draws limits on the permissible behaviour of the other. The potential enemy is assured that if the limit is transgressed, nuclear war will follow. However, the definition of the limit changes from time to time. Each side must be quite confident that the other understands the new limits. Each side is tempted to increase its military advantage, but not in so striking a way as seriously to alarm the other. Each side continually explores the limits of the other's tolerance, as in flights of nuclear bombers over the Arctic wastes; the Cuban missile crisis; the testing of anti-satellite weapons; the Vietnam and Afghanistan wars - a few entries from a long and dolorous list. The global balance of terror is a very delicate balance. It depends on things not going wrong, on mistakes not being made, on the reptilian passions not being seriously aroused"(83).

"After some years of surveying the no man's land of strategic theory I have yet to find a better (fox) hole than our present balance of power"(84).

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(79) New Scientist, vol 92, 1981, p481.

(80) L.R. Beres, 'Apocalypse: Nuclear Catastrophe in World Politics' (University of Chicago Press, 1980).

(81) A 1980 Delphi study "of 32 leading authorities" suggested that the first nuclear war will most probably be Arab-Israeli, that a nuclear war between India and Pakistan is almost as likely, but that a surprise attack by one superpower on the other is one of the least probable cases in the next 10 years (Next, Sept/Oct 1980, p29).

(82) Information on global military expenditure is contained in 'World Armaments and Disarmament', the Yearbook of the Stockholm International Peace Research Institute (SIPRI).

(83) Carl Sagan, 'Cosmos', (McDonald, 1980), p325.

(84) Professor Lawrence Martin, 1981 BCC Reith lecture.

(85) P.H. Nitze, Foreign Affairs, vol 54, 1976, p211.

(86) This outcome was envisaged by General Sir John Hackett in 'The Third World War: August 1985' (McMillan, 1978).

(87) In 'The Strategy of Peace' (Harper and Row, 1960, p185), President Kennedy wrote "inevitably the use of small nuclear armaments will lead to larger and larger nuclear armaments on both sides, until the worldwide holocaust has begun." President Carter, on 7 April, 1978, for this reason chose to defer (temporarily) the production of enhanced radiation weapons.

(88) The Washington Post, August 30, 1981.

4. THE PATHS TO NUCLEAR WAR

In this age there are a number of potential paths to nuclear disaster. Each of them must be recognised if it is to be obstructed. Following Professor Louis Beres(80), this CFF report divides the potential paths into three categories : nuclear war between the superpowers, nuclear war through proliferation, and nuclear terrorism.

4.1 Nuclear War Between the Superpowers

The first path, perhaps the most obvious but not necessarily the most likely(81), is nuclear war between Russia and the United States, or between the two alliances associated with them - the Warsaw and NATO pacts.

Since 1945, the United States and the Soviet Union together have spent more than $4,000,000,000,000 on defence, and yet neither is secure against an attack by the other. Offensive nuclear-weapon technologies continue to outdistance defensive nuclear-weapon technologies. This expenditure, which has failed to produce a reliable defence for either side, is about equal to the total national income for the same period of the poorer half of humanity(82).

The defence strategies of the superpowers have, until recently, been based on nuclear deterrence - the belief that the costs of nuclear retaliation are so great that neither superpower would (rationally) strike first - aptly given the acronym MAD (for 'mutually assured destruction'). There may, however, be deficiencies in this reasoning. Nuclear deterrence requires that a potential aggressor actually believes that nuclear retaliation will take place. In the current world situation, this belief cannot necessarily be assumed. For instance, one side, having accepted a limited nuclear 'first strike' on vulnerable elements of its own missile force, may choose to forego retaliation to save further damage to its cities and civilian populations from the aggressor's 'second strike'. The plausibility of this scenario is underscored by the significant superiority of Soviet civil defence capability over its American counterpart(85).

Another deficiency might be the reluctance of one of the superpowers to retaliate in response to an attack by the other on its allies. For instance, in the event of a Warsaw pact invasion of Western Europe, the United States might choose not to engage in a strategic nuclear war with the Soviet Union, if the anticipated costs could include an overwhelmingly destructive counter-retaliation against itself(86). This realization has lead the United States to develop enhanced radiation weapons (the so-called 'neutron bomb'), to bolster nuclear war fighting capabilities short of the massive retaliation required by MAD. But NATO use of neutron weapons, designed to reduce collateral damage to friendly forces and territories, could initiate Soviet escalation to all-out (strategic) nuclear war. Presidents Kennedy and, initially, Carter appreciated this possibility(87).

An alternative stance is that the use of 'theatre' (tactical) nuclear weapons in response to aggression carries a lower risk of escalation to strategic nuclear war, because their use does not threaten the aggressor's homeland. The controversial 'Presidential Directive 59', enunciated by President Carter, visualizes nuclear exchanges between the superpowers short of Mutually Assured Destruction (MAD), which hitherto "had calmed the population of the world by its unthinkability"(88).

"NATO use of neutron weapons developed for limited deployment, discrete fire techniques, and pinpoint accuracy in defense of NATO is going to draw a Soviet response with tactical nuclear weapons; there should be no fuzzy thinking on that point. The asymmetry between Soviet nuclear weapons and the neutron bomb would be so great that the larger and less accurate Soviet weapons would be devastating to NATO forces using the small weapons"(90).

"Once the nuclear threshold has been broken, it is highly likely that the nuclear exchanges would escalate. Radio, radar, and other communications would be disrupted or cut. The pressures to destroy the adversary's nuclear force before they land a killing blow would lead to pre-emptive attacks. In the confusion, subtle peacetime distinctions between lower level tactical nuclear war and higher level tactical nuclear war, and all-out spasm nuclear war would vanish. Once the threshold is crossed, from conventional warfare to nuclear warfare, the clearest 'firebreak' on the path to complete nuclear holocaust will have been crossed".(91)

Asked whether anyone could win a nuclear war, Mr Weinberger replied: "I just don't know. I don't know whether anyone can answer a question like that. The course a war of that kind would take I don't think anyone can possibly say"(93).

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(89) See The Defense Monitor, vol 4, No.2, 1975, p3; also Bulletin of the Atomic Scientists, vol 32, No.5, 1976, p8.
(90) Deputy Commander in chief, US Army in Europe, General A.S. Collins in Arms Control Today, vol 8, No.6, 1978, p5.
(91) The Defense Monitor, vol 4, No.2, 1975, p3.
(92) L.R. Beres, op cit, p23.
(93) New York Times, 4 November, 1981.
(95) Ibid.
(96) See, for example, 'The computer that keeps on crying wolf' (New Scientist, vol 87, 1980, p375).
(97) James Schlesinger, Defence Secretary in the Nixon Administration, quoted in Time, 31 Aug, 1981, p18.

The full impact of 'counterforce strategy' (viz. limited nuclear exchanges directed at military targets, followed by an agreed stand-off) is only now being felt in Europe - on both sides of the border. Only in the context of a nuclear exchange confined to Western Europe (an engagement for which the enhanced radiation weapon is specifically designed) does counterforce strategy make sense - and then only to the Russians and the Americans.

The unease of the Europeans is understandable. The use of one tenth of the 7,000 tactical nuclear weapons deployed by the United States in Western Europe would destroy the entire area where such exchanges took place - "a policy to destroy Europe in order to save it"(89). A similar concern must relate to the Soviet deployment of the MIRVed 'intermediate range' SS-20 missile (which threatens Western Europe) - and the NATO response to its deployment. President Reagan is pushing ahead with the deployment of Pershing 2 and ground-launched cruise missiles. Unlike present tactical nuclear weapons, these new weapons present a threat to the Soviet Union itself, and so carry a much greater risk of escalation, perhaps equal to that of intercontinental (strategic) nuclear missiles. In spite of this risk, American NATO policy continues to emphasize the special role of theatre nuclear forces as a deterrent to conventional as well as to 'theatre nuclear' attacks(92).

This policy for the defence of Western Europe is based on an "awesome bluff"(94). Any significant attack, even if non-nuclear, may be countered with nuclear weapons. But this would set in motion events leading to the destruction of most European cities and their populations. No sane European leader would willingly initiate such events, but to so admit, publicly, would undermine the credibility of the deterrent.

"Nevertheless there doubtless are some irrational political and military leaders who actually would destroy Europe in order to save it... NATO's bluff could be called and Europe could be utterly destroyed"(95).

Many US strategists are concerned that their main land-based intercontinental ballistic missile (ICBM) - 'Minuteman' - has become vulnerable. These advocates of the current US defence build-up argue that the Soviets, by a combination of high yield warheads and highly accurate missiles, have the capability to destroy all of the 'Minuteman' missiles, while retaining sufficient reserve warheads to discourage retaliation by US nuclear bombers and submarine-launchedballistic missiles (SLBMs). This eventuality would leave the US President with limited, and unpalatable, options.

One would be to 'launch on warning' viz. fire a retaliatory ICBM strike, relying on the absolute fidelity of radar early warning systems. There have been numerous false alarms, but no Russian ICBM attacks, in the past(96). Another would be to wait for confirmation of the attack (announced by the destruction of 'Minuteman' silos), and then retaliate with the two surviving legs of the 'strategic triad' - the nuclear bombers and the SLBMs. But the targets for these nuclear weapons could only be the Soviet cities, since 'Minuteman' alone is accurate enough for 'silobusting'. This would ensure a Soviet second strike directed against the American cities.

If a Russian thrust into Western Europe was accompanied by an ICBM strike against US land-based missiles (and nothing else), the US would then be reduced to defending Europe by threatening Soviet cities with its surviving nuclear bombers and SLBMs. "That threat is not credible, for neither the Soviets nor the Western Europeans are likely to believe that the US would sacrifice its civilian population for the sake of Europe"(97).

"When the defence of Europe is seen to entail its nuclear destruction, the European incentive to permit the use of nuclear weapons on its soil diminishes rapidly"(99).

"The triad of forces which both states possess came about because the three Services had vied with each other in the build-up of nuclear armaments, and not because of the fulfilment of some plan worked a priori on behalf of the President of the United States, or the head of the Politburo"(101).

"... decades of military thinking have so far failed to show how nuclear weapons could be used successfully in the actual operations of war"(102).

(98) Ibid.
(99) Helmut Schmidt, 'Defence or Retaliation', (Oliver and Boyd, 1962).
(100) Frank Barnaby, op cit, p29.
(101) Lord Zuckerman (Chief Scientific Advisor to (UK) Ministry of Defence) in New Scientist, 14 January, 1982, p96.
(102) Ibid.
(103) Frank Barnaby, op cit, p32.
(104) Next, Sept/Oct 1980, p29.
(105) L.R. Beres, op cit, p25.
(106) Ibid, p31.
(107) See 'Nuclear War by 1999?', Harvard Magazine, Nov 1975, p22.

President Reagan's response to the 'window of opportunity' has been to proceed with a new land-based mobile missile of high accuracy (MX), along with other new weapons systems including two new bombers (B1, Stealth) and a new SLBM (Trident 2). President Carter had originally envisaged a 'desert shell game' of concealing 200 MX missiles among 4600 missile shelters in Utah and Nevada. In the less-ambitious Reagan plan, 100 MXs will be dispersed among 1000 existing Minuteman silos - the same silos, somewhat 'hardened', whose supposed vulnerability was mooted as the justification for MX in the first case. With this new (MX) option, the US response to an attack on its ICBM force would not necessarily have to be directed against the Soviet cities - thus, in the American view, reducing the risk of a devastating second strike on US cities(98).

Advocates of MX base their case on the perceived vulnerability of present US land-based ICBMs. An alternative response, not adopted, could be to rely instead on improved SLBMs - such as Trident 2 - deployed on essentially invulnerable submarines. The maintenance of an expensive (at least $30,000 million for MX) land-based missile system may originate as much from interservice rivalry as from strategic considerations(100). Without SALT 2, its nett effect is likely to be an open-ended arms race between the number of MX missiles deployed by the Americans, and the number of warheads deployed by the Russians to counter them.

Notwithstanding US concerns, the rationale for new weapons systems to replace vulnerable land-based ICBMs seems, if anything, more compelling from a Soviet perspective. Because land-based missiles represent by far the major component of Soviet strategic forces, the threat posed by a first strike on these is far more serious for the Russians than it is for the Americans(103). This fact is often overlooked by Western strategists.

The possession of nuclear retaliatory forces does not guarantee a nuclear capability unless these forces are 'secure' against a pre-emptive first strike attack. This security is subject to a technological reversal at any time. Indeed, such a reversal is a major goal of both superpowers. In a recent Delphi study of ways of averting nuclear war, the only suggestion strongly supported by all respondents was a treaty designed to prevent either side from gaining a sudden military advantage over the other(104). Should either side succeed in undermining the nuclear deterrent of the other (a major goal of both superpowers), the likelihood of a first strike by <u>either</u> side is increased(105). Each side presently fears that the other is pursuing a first strike capability.

Although it has always been American policy not to initiate a war by a nuclear first strike, the <u>first use</u> of nuclear weapons, in response to a Soviet attack, has never been disavowed. This strategy is essentially destabilizing, because it offers an incentive for a Soviet first strike(106). In similar vein, the Soviet Union has never disavowed the first use option, and furthermore continues to strive for nuclear superiority, augmented by a major nuclear civil defence programme.

The efforts to retain secure nuclear retaliatory forces generate fear and uncertainty on both sides, which could culminate in a pre-emptive strike or the accidental breakdown of ever more complex command and control systems. "There are no cases in history of absolutely insane arms races ending peacefully... arms races usually end up in wars"(107).

"Figures from the London-based International Institute for Strategic Studies show that although the Soviet Union outspends the United States, NATO outspends the Warsaw pact by $180 billion to $160 billion. Furthermore about one quarter of the Soviet defence effort is directed at China. Thus with China factored in, the NATO advantage is roughly three to two. Moreover, some analysts claim that the IISS figures, which are based on Central Intelligence Agency data, exaggerate Soviet spending. One expert recently guessed that the CIA estimates may exaggerate Soviet spending by as much as 40 per cent and that Soviet and US spending may be roughly equal. If so, NATO outspends the pact by about five to three. If Soviet forces facing China are deducted the NATO advantage is more than two to one. This advantage does not mean that the United States and NATO are without defence problems, but it casts doubt on the assumption that more defence spending is the solution"(112).

"The pace of the arms race has probably been faster since the end of the Second World War than it has ever been in all human history"(117).

"The arms race can bankrupt the superpowers without adding anything to their respective military strengths"(118).

"At base, the momentum of the arms race is undoubtedly fuelled by the technicians in governmental laboratories and in the industries which produce the armaments ... it is all but impossible to believe that the process of defence research and development is under rational control"(119).

"The men in the nuclear weapons laboratories of both sides have succeeded in creating a world with an irrational foundation, on which a new set of political realities has in turn had to be built"(120).

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(108) See 'Soviet Military Power', US Defense Department report, 29 Sept, 1981.
(109) Dimitri K. Simes in International Security, Winter 1980-81, p80.
(110) Ibid.
(111) The Defense Monitor, vol 6, No.4, 1977, p1.
(112) Frank Barnaby, op cit, p11. The quotation above is from B.R. Posen and S.W. Van Evera in Foreign Policy No.40, 1980, p99.
(113) The Defense Monitor, vol 9, No. 2, 1980, p2.
(114) Frank Barnaby, op cit, p12.
(115) Ibid, p7.
(116) Ibid, p37.
(117) Lord Zuckerman, Chief Scientific Advisor to (UK) Ministry of Defence in New Scientist, 21 January, 1982, p170.
(118) Ibid.
(119) Ibid.
(120) Ibid.
(121) See 'The Cruise Missile : a Weapon in Search of a Mission' in The Defence Monitor, vol 5, No.7, 1976, p1.
(123) Frank Barnaby, op cit, p52. Cruise missiles offer emerging nuclear powers a cheap alternative to ballistic missile delivery systems.
(124) From B.J. Bernstein, 'The Week We Almost Went to War', Bulletin of the Atomic Scientists, vol 32, 1976, p13. The crisis was caused by the deployment of Soviet missiles in Cuba, and American insistence on their withdrawal, backed up by a naval blockade. The missiles were withdrawn.

US leaders are concerned over the growth of Soviet military forces(108). Many Russians have the same fear of American intentions. Both sides accuse each other of being unwilling to live with nuclear parity, of seeking unilateral advantages, and of trying to develop capabilities to fight and win a nuclear war(109). It is futile to try to determine the legitimate defence requirements for another state. Because of different traditions and images of threats, Soviet decision-makers are bound to have a markedly different view from their US counterparts of how much is enough(110). Viewed through Soviet eyes and in historical context (of enormous suffering during World War 2) much of their military effort is aimed at overcoming vulnerabilities and matching American, NATO, and Chinese capabilities. The Russian obsession with national defence has deep historical roots, and permeates Soviet society(111).

It is reasonable to assume that NATO and Warsaw pact forces are in general about equivalent now, in the sense that in a war it is difficult to predict which side, if either, would gain an advantage. Moreover, there is now so much military power on both sides that quite large differences (even if these did exist) would be meaningless in military terms(112). Military spending by NATO has in fact exceeded that of the Warsaw pact every year throughout the 1970s(113).

There is thus little reason for increases in military spending by either side, at least from a military point of view. The projected increases in military spending by NATO countries will do little to increase their security. Indeed, it has even been suggested that the West would be more secure if it spent less on weapons and more on facing the forthcoming economic crises (of zero growth, rising unemployment, and high inflation flowing on from the energy crisis), which are perceived as a greater threat than even the Warsaw pact forces(114). This is particularly so, because the Eastern European countries, including the USSR, will be as preoccupied with energy problems as will the West. But the arms race today appears out of the control of political leaders. Vast bureaucracies have grown to deal with military matters. Academics and bureaucrats have joined with the military and defence industries of both sides to create an 'academic-bureaucratic-military-industrial-complex' intent on maintaining and increasing military budgets, and agitating for the use of every conceivable technological advance for military purposes. This complex has so much political power as to be almost politically irresistible. This is as true today in the Soviet Union as it is in the United States(115).

Military technology is providing a major thrust towards a nuclear war. The real reason why new weapons systems are being deployed in Europe by both sides is that military technology has made them available. "Once available, weapons are most often deployed. Policies are then modified to rationalize this deployment"(116). There is, for instance, "no persuasive rationale for the long-range cruise missile"(121). This weapon will offer little additional security to an already grossly-militarized Europe. But if they proliferate into Third World countries, as seems likely given the NATO example, they could have even more serious implications for world peace(123).

"During the week of October 22-28, 1962, the two superpowers stood near the abyss of nuclear war. It was a fearsome week.... as Premier Nikita Khrushchev later said, "when the smell of burning hung in the air". President Kennedy placed the likelihood of disaster at somewhere between one out of three and even" (124). The decision to resort to nuclear weapons is not likely to be made under normal circumstances. Rather the decision is likely to be taken during an international crisis, as the culmination of risk-taking. During the Cuban

Soviet 'Backfire' bomber

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(125) Comment attributed to Dean Rusk, US Secretary of State.
(126) The question is posed by Professor L.R. Beres, op cit, p33.
(127) The US Department of Defense has acknowledged thirty-two serious accidents involving US nuclear weapons. These are cited in The Defence Monitor, vol 10, No.5, 1981. None involved a nuclear detonation, although the 1961 Goldsboro (North Carolina) event came close to this.
(128) In the United States there have been at least five major incidents, involving false warnings, that have been publicly reported. See L.R. Beres, op cit, p47; also New Scientist vol 87, 1980, p375.
(129) "It seems that King Arthur's son, Mordred, revolted against his father. After some fighting, the two contenders met, with all their troops, on the field of Carnian to negotiate. Both sides were fully armed and desperately suspicious that the other side was going to try some ruse or stratagem. The negotiations were going along smoothly until one of the knights was stung by an asp and drew his sword to kill the reptile. The others saw the sword being drawn and immediately fell upon each other. A tremendous slaughter ensued." (Cited in Herman Kahn, 'On Thermonuclear War' (Princeton University Press, 1960) p525).
(130) Newsweek, 5 October 1981, p12.
(131) It has been acknowledged (CBS TV Documentary, 'The Defense of the United States' screened on NZ television 14 Dec 1981) that submarine commanders have the capability, and the delegated authority, to launch their missiles if communications are lost, presumed due to a nuclear attack on the United States.
(132) L.R. Beres, op cit, p60.
(133) Ibid, p70.
(134) J.D. Frank, 'Sanity and Survival : Psychological Aspects of War and Peace' (Random House, 1967) p57 (cited in L.R. Beres, op cit).
(135) L.R. Beres, op cit, p73.

missile crisis alluded to above, the avoidance of escalation lay with Khrushchev and Kennedy. The two superpowers were "eyeball to eyeball" when "the other fellow blinked"(125). Can superpower leaders today and in the future be counted on to choosehumiliation rather than war?(126).

While the arms race continues unrestrained, the numbers of weapons and the complexity of their command and control systems must increase. No system, however carefully devised and maintained, and the human beings who have custody of it, can be presumed to be infallible. Ballistic missile submarines can, and have, collided. Nuclear bombers can, and have, crashed or inadvertently or deliberately dropped nuclear bombs(127). ICBMs could be launched because of a mistaken belief that a disabling first strike was on the way(128). Even if American safety systems are presumed infallible, security from accidental nuclear war is contingent upon the reliability of Soviet (British, French, Chinese, Indian...) safety systems. The notion that a false alarm can set off a catastrophic chain reaction is as old as the legend of King Arthur himself(129).

Nuclear war is not so much unthinkable as it is unknowable. Real wars take place in the world of bad weather, technical failures, and unpredictable personalities. Soviet intentions towards the United States are murky, and to the Soviets the reverse is doubtless true as well(130).

Under these conditions, a secondary nuclear power could catalyse a war between the superpowers, deliberately or by accident. It could be almost impossible to identify the country-of-origin of a SLBM attack in the decades ahead.

Unauthorized use of nuclear weapons, like accidental use, cannot be absolutely precluded. For a credible deterrence, there appears to be no alternative to some system of delegated authority for the use of nuclear weapons. (Otherwise, for instance, a single blow against the top command could incapacitate a nuclear retaliation). It may be presumed that field commanders under great duress, for example, can fire the nuclear weapons in their custody, without authority from above(131). Tens of thousands of nuclear weapons imply a very large number of personnel with access to them. Another related concern is the seizure of nuclear weapons. The United States has 7,000 tactical weapons stockpiled in Europe alone. The mere presence of such weapons creates a risk of seizure - not only by criminal and terrorist groups, but also by allies. There was, for instance, some concern over the security of US nuclear weapons stored in both Greece and Turkey when these two countries were at war(132).

A basic dilemma of nuclear deterrence is that procedures implemented to improve the safeguards against accidental or unauthorized use weaken the deterrence function, and vice versa. It cannot be in the interests of deterrence by nuclear retaliation to impede the due process of retaliation, yet 'safeguards' do just this.

The safeguards problem is perhaps most acute at top decision-making level. "We live in a world in which security... rests on the continuing rationality of relatively few national leaders, equipped with nuclear weapons responsibility"(133). "At least 75 chiefs of state in the last four centuries led their countries while suffering from severe mental disturbances"(134). The present system of nuclear deterrence requires rational leadership. Were President Kennedy's decisions during the Cuban missile crisis 'rational' given his own assessment of the odds of nuclear disaster "between one out of three and even"? Even given its satisfactory outcome for the West, the Cuban missile crisis points to the precarious nature of presidential judgement in such instances(135). US Secretary

<u>Table 4.1</u> <u>Top Ten Potential Nuclear Weapon Powers</u>(144)

1. Argentina	6. Libya*
2. Brazil	7. Pakistan
3. Egypt	8. South Africa
4. Iraq*	9. South Korea*
5. Israel	10. Taiwan*

(* parties to Non Proliferation Treaty)

(136) 'Nuclear 'demo' claim by Haig hotly disputed', <u>The Evening Post</u>, 6 Nov 1981.
(137) Paul Rogers in <u>Futures</u>, October 1981, p431.
(138) <u>The New York Times</u>, 14 July, 1981.
(139) <u>Next</u>, Sept/Oct 1980, p29.
(140) L.R. Beres, op cit, p74.
(141) 'North-South : a Program for Survival', the Report of the Independent Commission on International Development Issues under the Chairmanship of Willy Brandt (MIT Press, 1980), p122.
(142) US Senator Daniel Patrick Moynihan reported in <u>The New York Times</u>, 14 July, 1981.
(143) See 'Argentina leads Latin America's A-bomb race' in <u>New Scientist</u> vol 92, 1981, p649.
(144) Frank Barnaby, op cit, p18.
(145) L.R. Beres, op cit, p75.

of State Haig's recent suggestion(136) of a 'demonstration' nuclear warhead into Eastern Europe suggests the lessons of the 1962 crisis have not entirely been absorbed.

Kennedy's decisions were careful, calculated judgements, not those of a deranged President. This is the most sobering point of all. Even if 'rational' leaders make 'sane' decisions, the risk of nuclear disaster remains intolerably high. Is it that the strategy of nuclear deterrence itself is irrational?

4.2 Nuclear War through Proliferation

Since the end of the Second World War, there have been more than 140 regional wars, mainly involving Third World countries. The likelihood of a regional war escalating to a nuclear disaster is greatly increased if one or more of the combatants have their own nuclear weapons.

In 1981, five major powers had nuclear weapons (United States, Soviet Union, United Kingdom, France, China). Another (India) exploded a nuclear 'device' in 1974. Israel is widely assumed to have had a nuclear capability for nearly a decade(137), or, in the words of one United States intelligence specialist, is only "a screwdriver's turn away" from completing 10 to 20 atomic bombs(138). Similarly, it is believed South Africa already has nuclear weapons, or could assemble them with little difficulty.

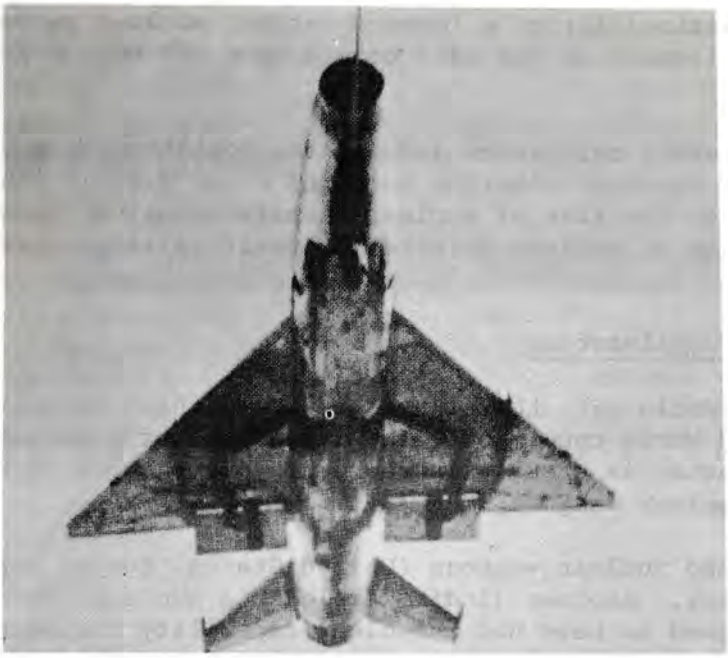
A recent Delphi study rather optimistically concluded that 10 countries will possess nuclear weapons by 1990, and 13 by the year 2000(139). A more pessimistic assessment suggests that 50 countries will have the potential to manufacture nuclear weapons by 1985, although not all will chose to do so(140). The Brandt Commission chose a middle course: 30 to 40 countries will have nuclear weapons by the year 2000(141). "The challenge of the 1970s was whether we could limit the number and spread of nuclear weapons. The answer was that we could not. The challenge of the 1980s is whether we can prevent their use"(142).

Countries may acquire nuclear weapons for a variety of reasons, the important ones being prestige and a desire to solve real or perceived security needs. A regional arms race is likely to be a strong inducement - for example for Pakistan to counter the Indian bomb. Brazil is likely to acquire nuclear weapons for prestige, to reinforce its pre-eminence in South America. Argentina is thus under pressure to follow suit, although recent reports suggest it could in fact pre-empt a Brazilian bomb by acquiring its own first(143).

Thirty years ago there was a widespread fear of nuclear proliferation. This fear was not realized, but there is now evidence that the kind of proliferation then envisaged will take place during the 1980s. Table 4.1 (facing page) is a ranked list of potential nuclear weapon powers, deduced from perceived or real security needs, prestige, and technological capabilities(144).

The situation seems ominous. As 'peaceful' nuclear power technology spreads across the planet, so too does the capacity for dozens of countries to produce nuclear weapons.Nuclear reactors designed for the generation of electricity also produce the element plutonium, the fissile material used in the Nagasaki bomb. After chemical separation from other reactor products, plutonium can be fashioned into nuclear warheads. Countries engaged in 'civilian' nuclear programmes can achieve a nuclear weapon capability, without originally intending to do so(145).

Commercial 'reprocessing' (the extraction of plutonium from other reactor products) will soon be possible in many countries. Regrettably, a few countries,



New-type Chinese fighter

"Imagine for a moment a somewhat different nuclear-armed world from the one at present.

Forty nations have nuclear weapons instead of the handful of today. To stop these 40 countries from using their weapons, an international army of inspectors, under the auspices of the United Nations, pays a weekly visit to each nuclear weapons site to check the devices have not been readied for firing : that the warheads are being kept separately, under lock and seal, away from the missiles.

It is a ludicrous idea of course. It would take only a few hours for an experienced missile crew to break the seal on the warhead, fix it on the missile, and fire it. A single inspection a week, or even a day, would not suffice and the inspectors could not be sure of giving the United Nations timely warning of a country's nuclear intentions.

Yet in the real world of today, nuclear safeguards inspectors at the International Atomic Energy Agency face exactly the same problem. They cannot provide timely warning of the theft or diversion of bomb-grade material - either plutonium or highly enriched uranium - from a nuclear power reactor programme"(150).

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(146) Ibid, p98.
(147) Ibid, p76.
(148) Frank Barnaby, op cit, p20.
(149) L.R. Beres, op cit, p96.
(150) Peter Pringle, writing for the London 'Observer' News Service, reproduced by The Evening Post, 3 December 1981.
(151) Frank Barnaby, op cit, p22.

notably West Germany and France, are actively exporting 'reprocessing' technology. Since the interests of these states seem strongly oriented in the direction of profits and sales, other prospective suppliers are likely to enter the lucrative nuclear market(146). An important technological development is the plutonium-fuelled 'breeder' reactor, which in addition to providing electricity actually produces more plutonium than it consumes. Although President Carter proposed in 1977 that the US Government defer commercial reprocessing and recyling of domestically produced plutonium, this lead may not be followed by President Reagan, and certainly not by other countries, notably France. "Clearly the development of worldwide breeder-energy economies could make large inventories of weapons-grade plutonium available to any country with appropriate reprocessing facilities"(147).

A typical reprocessing plant extracts about 12,000 kg of plutonium a year. At any particular time, perhaps 3,000 kg of plutonium will be in transit through the plant. It would take only a few kilograms (0.1% of the inventory) to make a Nagasaki-type bomb. The present systems of 'safeguards', as administered by the International Atomic Energy Agency, are simply not adequate to provide an unqualified assurance that plutonium has not been removed clandestinely from a reprocessing plant. Complete protection is technically impossible, even with the best technology feasible(148).

Projections for the year 2000 suggest that nuclear reactors generating 600 GW(e) will be operational, and will be producing about 150 tonnes of plutonium each year, a quantity sufficient for 30,000 Nagasaki-type bombs.

The concerns expressed above may appear to ignore the existence of the Treaty on the Non-Proliferation of Nuclear Weapons (NPT), negotiated in 1970. Today, 115 nations have signed the treaty but 46, including Israel, India, Pakistan, and South Africa have not. The NPT binds nuclear weapons states not to transfer nuclear weapons to any other country, and commits non-nuclear states not to acquire nuclear weapons by any means. Six of the ten potential nuclear weapons states listed in Table 4.1 have not ratified the NPT. The other four (Iraq, Libya, South Korea and Taiwan) could well decide to abrogate it if, at any time, they considered the NPT to be "contrary to their own immediate judgements of self-interest"(149). (Israel, in carrying out a pre-emptive strike against an Iraqi reactor in 1981 was not reassured by Iraq's ratification of the NPT).

But the greatest weakness of the NPT, at least for the non-nuclear countries, has been the total failure of the nuclear weapons powers, notably the Soviet Union and the United States, to pursue effective negotiations for nuclear disarmament. The treaty is 11 years old, yet the world still has neither a SALT 2 treaty nor a comprehensive nuclear test ban treaty. "Worse still, the nuclear arms race is about to accelerate again in a most dangerous direction, with the development and deployment of Soviet and American strategic and tactical nuclear war fighting weapons... Vertical proliferation is essentially out of political control"(151).

The superpowers realize, of course, that the spread of nuclear weapons to other countries - horizontal proliferation - is exceedingly dangerous for them, and for the world as a whole. But they can hardly expect other countries not to strive for nuclear capabilities, when through their own obsessions with the 'strengthening' of their own nuclear arsenals, they forcibly demonstrate that nuclear weapons have an immense political and military value. Many Third World countries, impressed by Chinese and Indian accomplishments, can only conclude that nuclear weapons - like the 'sixshooter' in the American west - are effective 'equalizers' in the politics of power.

A Scenario

"It is 1985. Some fifty countries have nuclear energy programmes, each producing several dozen nuclear explosives every year. A crisis exists in the Middle East between Israel and her Arab neighbours, Egypt and Saudi Arabia. In the midst of all the sabre rattling, a deadly series of nuclear-tipped missiles strikes deeply into Egypt and Saudi Arabia. The victim states, believing this to be the first wave of an Israeli assault, unleash a retaliatory strike against Israel... which is startled by the speed and destructiveness of these events. Israel has no choice but to respond in kind. After the Israeli strike, which the Arab states view as a counter-retaliation and the Israelis see as a retaliation, Syria, Jordon, Libya, Lebanon, and Iraq join in a final concerted assault on Israel. When the smoke has cleared, only one major power in the area remains unscathed and in undisputed control - Iran - the country responsible for the original, anonymous strike against Egypt and Saudi Arabia"(153).

(152) L.R. Beres, op cit, p84.
(153) The scenario is given by L.R. Beres, op cit, p86.
(154) Sean MacBridge (1974) Nobel Peace Prize winner) in Bulletin of the Atomic Scientists, vol 33, No.7, 1977, p23.
(155) L.R. Beres, op cit, p99.
(156) Mason Willrich and Theodore Taylor in 'Nuclear Theft : Risks and Safeguards' (Ballinger, 1974), pl.
(157) 'Nuclear Proliferation and Safeguards' (US Office of Technology Assessment, 1977), pl40.

The spread of nuclear weapons into areas of regional conflict can hardly improve matters. Their influence on longstanding disputes - for instance, between Israel and the Arab states, or India and Pakistan, or Brazil and Argentina, or North and South Korea, or China and Taiwan, or South and Black Africa - is unpredictable. The involvement of the superpowers is possible, perhaps likely, with the potential for dangerous escalation especially where strategic interests (for example, access to Middle Eastern oil) are threatened.

Efforts by Third World states to create and maintain secure nuclear retaliatory forces are likely to stimulate regional arms races, which can only divert scarce resources from other areas of human need. The emerging nuclear countries are most likely to adopt 'hair trigger' launch-on-warning systems to reduce the vulnerability of their fledgling nuclear forces to a pre-emptive first strike by an opponent. These systems can only increase the chances for accidental, miscalculated, or unauthorized use of nuclear weapons(152). It may prove increasingly difficult, in a world of many nuclear weapon states, positively to identify the country-of-origin of a nuclear first strike, as the scenario on the facing page illustrates(153).

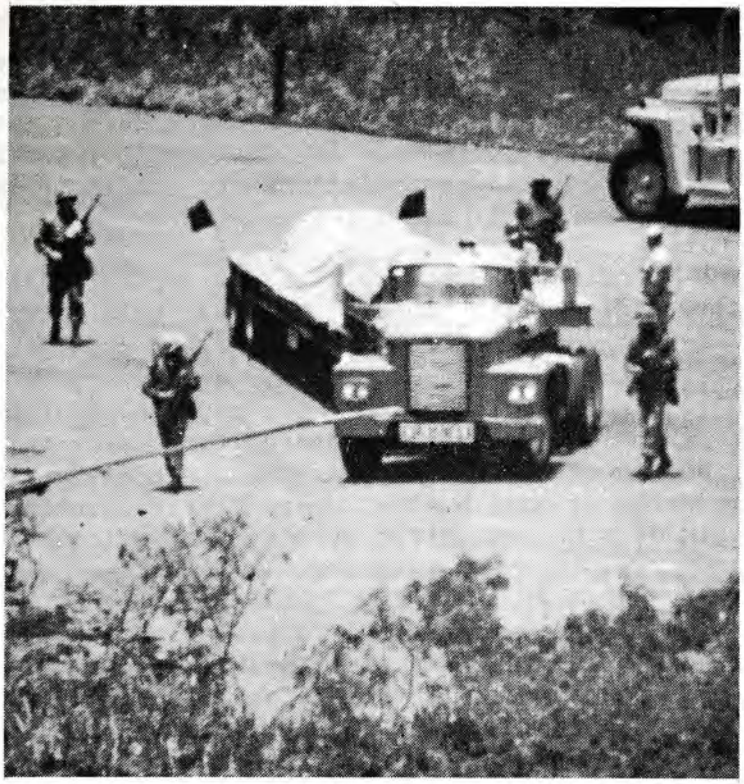
The proliferation of nuclear weapons increases the prospects for irrational use. In 1981, democracies are greatly outnumbered by dictatorships, which often have the most rudimentary safeguards on abuses of authority and which may be led by reckless, and occasionally deranged, strongmen. "Have we reasons to hope that the Governments and men who now wield power are more responsible than those in the past? Can we believe that there will be no more Hitlers in the world? It has been said that there are thirty governments in the world today that are not dictatorships, and that enjoy democratic processes in the true sense of the word. Since, however, there are a hundred or so dictatorships around the world, do we really believe that there is no danger that some dictator will ... use nuclear weapons?" (154).

4.3 Nuclear Terrorism

Today's nuclear technology provides future opportunities for terrorist groups to exploit its destructive potential, either through the use of nuclear explosive or radiological weapons, or through the sabotage of nuclear power reactors or reprocessing plants. Five principal reasons have been suggested for the growing threat of nuclear terrorism(155):

- expanding stockpiles of nuclear weapons present opportunites for theft.
- terrorists are showing a penchant for indiscriminate violence.
- terrorists are often insensitive to the deterrence provided by orthodox security procedures.
- international co-operation is developing between terrorist groups.
- some states support terrorist groups as their surrogate agents.

A determined, organized, and adequately funded terrorist group could make a crude bomb. Declassification and public dissemination of information about the design of fission weapons has been extensive. "The design and construction of a crude nuclear explosive is no longer a difficult task technically"(156). "The terrorist group would require modest machine-shop facilities, persons capable of understanding and implementing the open technical literature, and sufficient quantities of fissile material"(157). A terrorist bomb, with a yield of perhaps



Nuclear weapons in transit

"We, the nuclear hostages - all the peoples of the Earth - must educate ourselves about conventional and nuclear warfare. Then we must educate our governments. We must learn the science and technology that provide the only conceivable tools for our survival. We must be willing to challenge courageously the conventional social, political, economic and religious wisdom. We must make every effort to understand that our fellow humans, all over the world, are human. Of course, such steps are difficult. But as Einstein many times replied when his suggestions were rejected as impractical or as inconsistent with 'human nature': What is the alternative?(165)."

(158) The Defense Monitor, vol 4, No.2, 1975, p8.
(159) Willrich and Taylor, op cit, p24.
(160) L.R. Beres, op cit, p110.
(161) Ibid, p112.

1 kt, would cause only slightly less destruction in an urban area than occurred at Hiroshima and Nagasaki.

Terrorist access to fissile material is linked with the 'civilian' nuclear power programmes which are expanding in many countries. The 'safeguards' problem is similar to that for proliferation, except that the acquisition of weapons material by a terrorist group might be achieved by violent rather than clandestine means.

Alternatively, a group intent on nuclear terrorism might seize a functional nuclear weapon. "US Army Special Forces exercises have shown that nuclear weapons storage areas can be penetrated successfully without detection despite guards, fences, and sensors. Their example could obviously be followed by a daring and well-organized terrorist organization"(158).

Less understood than nuclear explosives, but equally ominous, are radiological weapons. In principle, these could be fashioned from any radioactive material, but, most likely, terrorists would resort to plutonium, which in the form of an aerosol is extraordinarily toxic. Terrorists could, by dispersing a few tens of grams of plutonium, contaminate an area of tens of square kilometers to an extent that evacuation and decontamination would be required(159).

A nuclear power reactor or a reprocessing plant might prove to be an attractive target for terrorist attack. Sabotage of either could cause widespread death and injury through the release of their radioactive inventories. However the worst-conceivable consequences (of a reactor core meltdown resulting from a terrorist attack) would still be less than the consequences of a low-yield nuclear bomb detonated in an urban area. The most serious health effects of nuclear sabotage would be latent cancers.

Terrorism is mainly a propagandist activity. Through indiscriminate violence, the terrorist group seeks to publicize or achieve its demands. Nuclear terrorism offers a significant escalation of the level of violence. Because the terrorist groups are ideologically motivated, often to the point of nihilism, they are unlikely to be responsive to the threats of retaliation which are the traditional mainstay of order between states(160). Their activities are likely to be destabilizing for international relations.

A disturbing trend has been the developing international liaison between terrorist groups as diverse as the Japanese Red Army and the Popular Front for the Liberation of Palestine -jointly responsible for the Lydda Airport Massacre(161). Another is the active support of terrorism by many countries - notably Libya and most Arab states, the Soviet bloc, and Cuba - often under the guise of 'liberation movements'. This support allows the sponsoring state to exercise influence from a safe distance. It is possible that such practices could spark major wars between states, involving terrorist surrogates on one or both sides, with the potential for nuclear escalation especially if the terrorists resort to nuclear 'devices'.

If nuclear terrorism does finally become a reality, any counter-nuclear-terrorist measures are likely to be extremely repressive, since the consequences of their failure are so drastic. However these countermeasures, while necessarily eroding civil liberties, are likely to provoke even greater excesses by those terrorists who survive them.

"If we face reality squarely, even the most hopeful of us must concede that our world today stands in great danger - greater danger, perhaps, than at any time since 1945. The need to save the world from 'the scourge of war' is clearly more urgent now than it was when the charter first promised to meet that need; the human condition which the crisis in development and the global economy poses is more pressing than it was then. For 'East-West' and 'North-South' it is a time of tension, uncertainty and agony, if not despair"(167)

Fig. 5.1

World Arms Trade

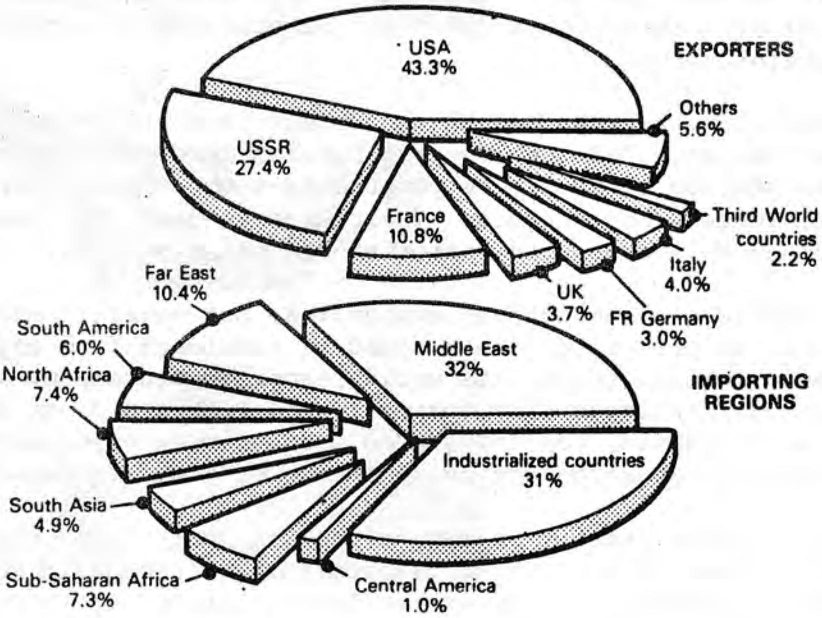
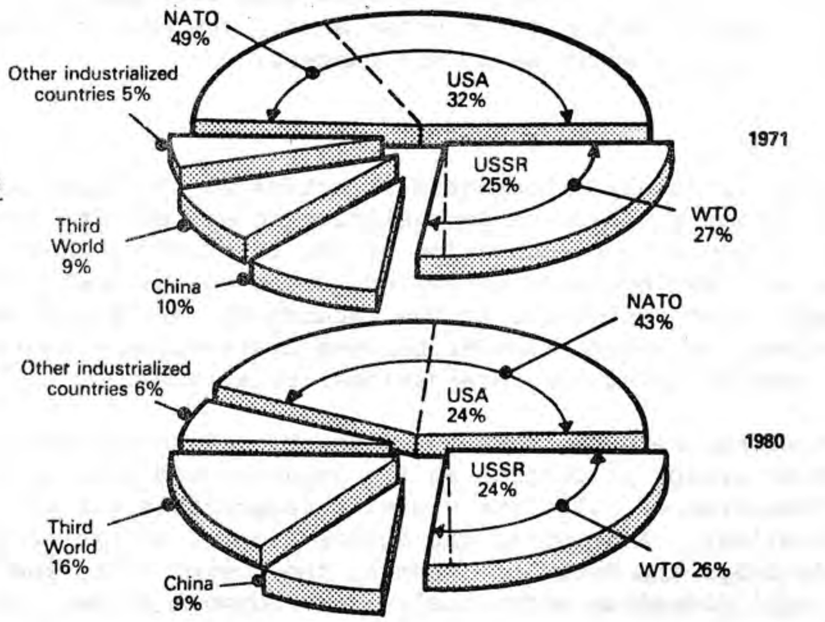


Fig. 5.2

World Military Expenditure



(162) See for example Frank Barnaby, Director of the Stockholm International Peace Research Institute, in 'Prospects for Peace' (Pergamon, 1980) p1.
(163) See for example Louis R. Beres, Professor of Political Science at Purdue University, in 'Apocalypse: Nuclear Catastrophe in World Politics' (University of Chicago Press, 1980), p13.
(164) Probability of nuclear war + probability of nuclear peace = 1 (exactly)
(165) Carl Sagan, 'Cosmos', (McDonald, 1980), p330.
(166) George Ignatieff, Toronto University Chancellor, at the 31st Scientific Arms Control Conference (Banff, Canada, 1981), reported in New Scientist vol 92, 1981, p58.
(167) Shridath Ramphal, Commonwealth Secretary-General, in New Zealand International Review vol 6, No.5, 1981, p2.
(168) New Scientist, vol 92, 1981, p58.

5. PREVENTING NUCLEAR WAR

This CFF report has two major theses:

- The world may be heading towards a nuclear war, presently because of the uncontrolled arms race between the United States and the Soviet Union(162). In the decades ahead, nuclear proliferation and nuclear terrorism are likely to increase the danger of nuclear war(163).
- New Zealand, being remote, relatively self-sufficient, strategically insignificant, and in the Southern Hemisphere may escape many, but not all, of the apalling consequences of a major nuclear war. Further mitigation could derive from anticipatory planning.

Some have argued forcibly (see section 1, ref (14)) that to plan for nuclear war makes it more likely, and that a continuing effort towards a resolution of the present nuclear 'crisis' is the only sane course. The argument may make less sense for New Zealand than it undoubtedly does for the targeted countries of the North.

In previous sections 3 and 4 respectively, perceptions of the likelihood of nuclear war, and the ways nuclear war might eventuate, are analysed. The analysis is inverted for this section 5, which examines the problems which must be solved as necessary and sufficient conditions for a lasting peace. This approach is pertinent because there is a simple relationship between the probabilities of nuclear war and of nuclear peace(164).

It is imperative that the efforts for peace continue, and in no sense does this CFF report denigrate them. However an appraisal of the obstacles to peace is useful - in this report, to explain the inclusion of contingency planning for post-war survival in spite of the arguments outlined above.

5.1 The Arms Race

"Negotiation as an approach to arms control and disarmament, is the real alternative to the illusory hypothesis that security can be achieved by an arms race"(166). This statement from the 31st Pugwash conference exemplifies the frustrations of "men of science (called) to assemble in conference to appraise the threats posed by the development of weapons of mass destruction". The conference called for a nuclear freeze by the superpowers. It also expressed deep concern over the destabilizing systems now being developed, including cruise missiles, strategic anti-submarine warfare, anti-satellite weapons, and "Euro-strategic systems with counterforce capability including Soviet SS20, (and American) Pershing 2 and cruise missiles". The previous (1980) Pugwash Conference had scientists from both East and West agreeing that "four nuclear fallacies persist in the political arena:

- nuclear war can be limited, or even won.
- civil defence can provide a chance of survival for the community.
- a first strike counterforce strategy can destroy the retaliatory capacity of the other side.
- parity in nuclear weapons is essential for effective deterrence"(168).

These four 'fallacies' form part of the current strategic thinking of both superpowers.

"It stands to the everlasting credit of ... biologists that (they), with rare exceptions, never pushed the development of biological weapons ... If any of these weapons were ever used on a large scale, they would probably cause as much death and human misery as a war fought with hydrogen bombs ... Also biologists persuaded the governments of those countries that had started biological weapons programs to abandon (these) and to destroy their stockpiles ... The biologists, unlike the physicists, came through ... with clean hands ... Matthew Meselson, professor of biology at Harvard, came to the (US) Arms Control and Disarmament Agency in 1963 to see what he could do for peace... He talked with army officers who specialized in biological warfare, and read their writings... The most frightening of all the things which Meselson discovered at ACDA was Army Field Manual 3-10... a booklet issued to combat units to instruct them in the details of biological warefare... (Meselson) worked indefatigably, in private and public, to expose the idiocy of... policies concerning biological warfare. His arguments rested on three main points. First, biological weapons... provide opportunities for a small and poor country or .. terrorists to do grave and widespread damage to a large country such as the United States. Second, the chief factor increasing (this) risk is (the US) development of (biological) agents... Third, biological weapons are uniquely unreliable and therefore inappropriate to any military mission ... even including retaliation in kind for a biological attack... Meselson (persuaded) military and political leaders to agree with his first two points... For retaliation in kind, the alternative of nuclear weapons was available and would be preferred. After listening to Meselson's questions and to the generals' answers, the (US) congressmen became convinced ... that even from the narrowest military point of view, (US) biological weapons policy made no sense. In 1968, Kissinger became right-hand man to President Nixon. Meselson urged Kissinger to move fast. In 1969 ... Nixon announced the unilateral abandonment by the United States of all development of biological weapons (and) stockpiles ... Nixon invited the Soviet Union to negotiate a convention to make the action multilateral ... According to orthodox diplomatic doctrine, to negotiate from a position of weakness is a mistake. But ... Brezhnev signed the convention in 1972, just nine years after Meselson arrived at ACDA"(169).

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(169) Recounted by Freeman Dyson in 'Disturbing the Universe' (Harper and Row, 1981), p173.
(170) Frank Barnaby, op cit, p79.
(171) Of the 1271 nuclear explosions reported between 1945 and 1980, 783 (62%) were carried out after the PTB Treaty was ratified, almost all of those by parties to the Treaty.
(172) Pierre Trudeau's address to the United Nations, 26 May 1978 (reported in New Zealand International Review vol 7, No.1, 1982, p18. See also Frank Barnaby, op cit, p74 for updated (but consistent) figures. (Casualties now exceed 30 million).
(173) Stockholm International Peace Research Institute, Brochure, 'Armaments or Disarmament', (SIPRI, 1981) p13.
(174) 'North-South : a Program for Survival', Report of the Independent Commission on International Development Issues, Willy Brandt, Chairman (Pan, 1980), p14.
(175) SIPRI Brochure, op cit, p7.
(176) L.R. Beres, op cit, p213.
(177) Even if the United States lost 90% of its strategic forces, the surviving 10% could destroy all 219 major Soviet cities, four times over (Beres, op cit, p214).

But the 31st Pugwash conference is just one of literally hundreds of international meetings held since 1945 in an effort to control the nuclear arms race. The record to date is dismal. The only disarmament that has taken place in the last 25 years has been the destruction of stockpiles of biological weapons by the United States, and possibly by the Soviet Union. The history of this achievement is outlined on the facing page(169). It was possible because the military were persuaded "of the idiocy of policies concerning biological warfare". Apart from this single achievement, not a single weapon has been destroyed as the result of an international agreement(170). Instead, vast numbers of weapons - conventional, chemical, nuclear - have been developed and deployed at a rate determined only by technological 'advancement'.

Apologists for arms control regard the Partial Test Ban Treaty (1963) as a success. However this has functioned mainly as an antipollution measure (in itself meritworthy), but has not slowed down the arms race between the superpowers(171).

Not only has there been no progress towards disarmament, but the world has become increasingly violent. In the 36 years since 1945, scant progress has been made towards restricting the transfer of major weapons to the Third World. In this time, 133 wars have been fought by 'conventional' weapons, involving 80 countries, and killing 25 million people(172). During the past decade, not surprisingly, the international trade in 'conventional' armaments has grown dramatically. As shown in Figure 5.1, the major suppliers are the United States (43.3%) and the Soviet Union (27.4%), and the major recipients are the Third World (69%)(173). "It is a terrible irony that the most dynamic and rapid transfer of highly sophisticated equipment and technology from rich to poor countries has been in the machinery of death"(174).

But it is the superpower blocs themselves which contribute most to the arms race, with 69% of total world military expenditure in 1980 - 43% by NATO (including 24% by the United States) and 26% by the Warsaw pact (24% by the Soviet Union) - see Figure 5.2(175). This expenditure will increase dramatically in the next few years as the United States, and undoubtedly the Soviet Union, in response 'rearm'.

The Strategic Arms Limitation Treaty (SALT 2), negotiated between 1969 and 1979, would have set ceilings on the aggregate numbers of US and Soviet strategic nuclear missile launchers and bombers, and imposes sub-limits on certain categories of strategic weapons. It would not slow, much less halt or reverse, the qualitative arms race. SALT 2 would have had only a minor impact on the military programmes of both sides. Current weapons can be modernized under its terms. An optimistic view is that SALT 2 validated the present inventories of nuclear weapons of both sides. However, in response to the Soviet intervention in Afghanistan, the United States has refused to ratify it, and indeed has initiated another surge in the arms race.

The present balance of terror cannot last forever. What is to be done? Professor Beres suggests four minimum criteria for meaningful arms control(176):

(1) the United States and the Soviet Union must return to strategies based on minimum deterrence (i.e. the minimum ability to inflict unacceptable damage on an aggressor after absorbing a nuclear first strike). Both sides already have far more than is required for minimum deterrence(177). SALT 2 would stabilize strategic forces at a level grossly in excess of these requirements, if it were ratified.

(2) a comprehensive nuclear test ban treaty (i.e. the renunciation of all nuclear tests by all nuclear powers - China and France are not signatories to the Partial Test Ban Treaty of 1963).

Table 5.1 Nuclear Power Reactors in 1980 (185)

	Operating		Under construction		Share of nuclear in total electricity (per cent)
	Number units	Total MW(e)	Number units	Total MW (e)	
Argentina	1	335	1	600	7.5
Belgium	3	1 665	4	3 807	22
Brazil	–	–	3	3 116	–
Bulgaria	2	816	2	828	19
Canada	11	5 495	14	9 751	11
Cuba	–	–	1	408	–
Czechoslovakia	2	801	6	2 520	~ 3
Finland	3	1 740	1	420	~ 20
France	18	9 983	31	30 950	~ 20
German Democratic Republic	5	1 695	4	1 632	~ 10
Germany, Federal Republic of	14	8 607	10	10 636	~ 10
Hungary	–	–	2	816	–
India	3	602	5	1 087	2.5
Italy	4	1 382	2	1 930	~ 2
Japan	23	14 466	9	7 274	10
Korea, South	1	564	6	4 954	8
Mexico	–	–	2	1 308	–
Netherlands	2	499	–	–	6
Pakistan	1	125	–	–	0.3
Philippines	–	–	1	621	–
South Africa	–	–	2	1 843	–
Spain	3	1 073	7	6 259	6
Sweden	6	3 700	5	4 686	23
Switzerland	4	1 940	1	942	26
Taiwan	3	2 158	1	950	17
UK	33	6 982	6	3 714	13
USA	70	50 900	88	96 254	12
USSR	32	11 616	15	13 680	~ 5
Yugoslavia	–	–	1	632	–
Total	**244**	**127 144**	**230**	**211 618**	

* Construction in Austria and Iran has been interrupted and the plants are not included.

(178) See for example Scientific American vol 245, No.2, p21. Precision-guided anti-tank weapons may nullify the present numerical advantage in tanks held by the Warsaw pact in Central Europe.
(179) L.R. Beres, op cit, p221.
(180) 'World Arsenals in 1980', Annual Report of the Stockholm International Peace Research Institute in The Bulletin of the Atomic Scientists Sept 1980, p9.
(181) See for example 'Bombs away!' in New Scientist, vol 91, 1981, p202; 'Can Nuclear Safeguards Ever Work?' in The New York Times, 13 July, 1981.
(182) SIPRI Annual Report, op cit.
(183) Article 6 of the Non-Proliferation Treaty requires them to do just this. Neither has complied.
(184) L.R. Beres, op cit, p232.
(185) SIPRI Brochure, op cit, p23.
(186) L.R. Beres, op cit, p240.

(3) renunciation of the first use of nuclear weapons (contrary to the most basic elements of US nuclear deterrence strategy viz. stopping a 'conventional' attack with tactical nuclear weapons). A compensating increase in defensive 'conventional' weaponry would be required : this is not implausible given current rapid improvements in defensive precision-guided munitions, which are shifting the balance between offensive and defensive conventional weapons in favour of the latter(178).

(4) expansion of nuclear-weapon-free zones, leading eventually to worldwide 'denuclearization'. Such an expansion offers a promising means of reducing the opportunity for superpower nuclear confrontation and conflict. Superpower support for this notion is problematic. Both the United States and Russia opposed a 1971 General Assembly declaration which designated the Indian Ocean as a 'zone of peace'.

These four proposals amount to a redefinition of superpower interests. Both superpowers would have to recognize that "the will to survive must take precedence over the wish to prevail, and this entails new forms of compromise and interdependence"(179). There is little evidence that either superpower is even remotely so inclined.

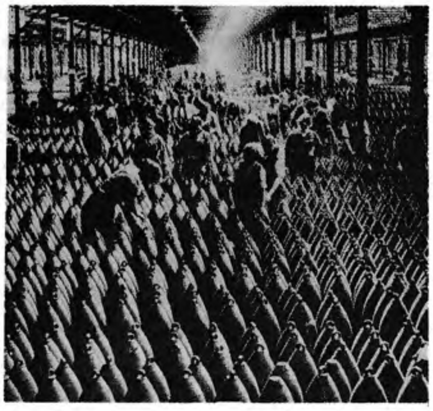
5.2 Nuclear Proliferation

By the year 2000, 'civilian' nuclear power reactors generating about 600 GW (electrical) are projected to be operational, and producing about 150 tonnes of plutonium every year - enough for 30,000 Nagasaki-type bombs. "The spread of reactor-grade plutonium is the most immediate threat to the non-proliferation regime"(180). Governments now recognize that there is no technical way to prevent the spread of nuclear weapons by diversion of fissile material from 'civilian' nuclear power reactors. India (and shortly Pakistan, Argentina, Brazil...) demonstrate this fact. The Israeli attack on an Iraqi reactor in June 1981 underlines it. (Saudi Arábia has said it will pay for rebuilding the Iraqi reactor that Israel bombed. Other Arab states are keen to acquire nuclear technology and reactors - in spite of their energy abundances(181)). "If any solution to the problem of nuclear proliferation is to be found, it must be political"(182).

The obstacles are formidable. Before the world's non-nuclear powers begin to take non-proliferation seriously, the United States and the Soviet Union will have to sustain a meaningful new SALT agreement(183). Similar restraint will be required from other nuclear-weapon states, yet two (China and France) have shown remarkable intransigence over their own weapons programmes.

The strengthening and expansion of the International Atomic Energy Authority safeguards and functions is vital for a non-proliferation regime. Another option could be the location of sensitive fuel-cycle activities, such as reprocessing, in international 'enclaves' under appropriate multinational supervision(184).

The export of nuclear technology is a related issue. The heart of the problem is that nuclear exports - while they contribute to the spread of nuclear weapons - are a lucrative market for supplier states. Table 5.1 (facing page) lists power reactors, either operational or under construction, in 29 countries in 1980(185). "Some supplier states are apt to pay closer attention to their balance of payments problems than to their long-term security interest, a situation which would have enormously corrosive effects on the non-proliferation regime"(186).



Exports

"The United States may buy itself two things with its $1 trillion defence budget of 1981 to 1985. The first is an economic decline of the sort that comes about once or twice in a century. The second is a nuclear war"(189).

(187) Ibid, p245.
(188) Ibid, p248.
(189) Emma Rothschild in 'Protest and Survive', ed. E.P. Thompson and Dan Smith (Penguin, 1980).
(190) UNCTAD 1 - 1964 United Nations Conference on Trade and Development.
(191) Australia and New Zealand are included in the 'North', along with North America, Europe, Russia and Japan.
(192) 'North - South : a Program for Survival' (Brandt Report), op cit, p11.
(193) Philippe le Prestre, 'The North-South Conflict - From Game to Debate' in <u>Journal of Southern African Affairs</u>, vol 3, 1978, p99.
(194) Phillip Hay in <u>New Zealand International Review</u>, vol 7, No.1, 1982, p18.

A non-proliferation regime will be in doubt as long as it depends on voluntary compliance by individual states which expect reciprocal compliance by all other states. It may prove necessary for the United States and the Soviet Union to exert "bipolar political pressure" on issues concerned with the spread of nuclear weapons. "What is required is a nuclear regime which extends the principles of superpower war avoidance to the rest of international society ... individual states, however much they may dislike each other, are tied together in the struggle for survival"(187).

Finally, should non-proliferation fail, the superpowers may then be forced to assist the new nuclear states to develop 'safe' weapons and reliable command, control, and communication procedures. "Only a desperate intervention... would be able to prevent disaster"(188).

5.3 A New International Economic Order

In the longer term, a 'North-South' nuclear war over resources (see below) may present a greater threat than an 'East-West' nuclear war over political ideology.

The 'New International Economic Order' (NIEO) emerged officially at the Sixth Special Session of the United Nations in 1974, but concern for it can be traced back to UNCTAD 1(190) at which the 'Group of 77' was formed (viz. an association of less developed countries, collectively the 'South'). The process of decolonization had given the South a majority in the United Nations, where they had begun to press their claims for reform. The 1973 OPEC embargo, and first oil shock, gave a new impetus to their determination, and provoked a strong reaction from the industrialized countries (collectively the 'North'(191)). Yet many people accepted that "the existing system of international institutions was established at the end of the Second World War, 35 years ago, and that the South - mostly as latecomers on the international scene - faces numerous disadvantages which need fundamental correction"(192).

The North, stung by the first oil shock, overreacted. NIEO was "in many minds, another avatar of the larger ideological struggle between capitalism and socialism, democracy and authoritarianism... What is striking in the North-South conflict is the short-sightedness of the (North). Their neglect, their refusal to acknowledge that a problem existed, and finally their reliance upon the structural violence they had built (the existing system) entailed a more and more aggressive attitude on the part of the (South), who felt frustration and injustice in not sharing the fruits of Western expansion"(193). Progress since towards NIEO has been meagre.

Last-ditch talks aimed at restarting a dialogue on NIEO took place at the North-South summit at Cancun, Mexico in October 1981. Many developing states, burdened with a combined current account deficit of $100,000 million were hoping that Cancun might break the deadlock. "Developing states identify a correlation between the huge annual sum spent by industrialized states on armaments, and the widespread poverty and disability experienced by their own peoples... They stress that even minimal reductions in the nuclear powers' annual defence procurements could have a dramatic effect in helping poor countries weather crises of food, shelter, and energy"(194).

"Not only are the world's poor effectively required to subsidise the living standards of the world's rich, but they must also now bear the brunt of the cost of the arms race in the coinage of human misery. In terms of hunger, wretchedness, deprivation and death, intimations of the 'Third World War' have

Pierre Trudeau (on Cancun) - "There have been flops before, but none at such a high level"(202).

"The decline from detente is dangerous for the world; but for the Third World it is calamitous. When East and West are each enlarging their arsenals of destruction and justifying it in terms of the other's offensive intent, we are indeed in a time of peril"(203).

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(195) Shridath Ramphal, op cit.
(196) Philip Hay, op cit. To be fair, the United States has contributed more in development aid than any other country, including the Soviet Union, (but relatively poorly as a fraction of GNP).
(197) 'North-South : a Program for Survival' (Brandt Report), op cit, p117.
(198) 'Strategic Survey 1978' (London, International Institute for Strategic Studies, 1978).
(199) Paul Rogers in <u>Futures</u>, October 1981, p428.
(200) 'North-South : a Program for Survival' (Brandt Report), op cit, p21.
(201) Ibid, p117.
(202) Quoted by Phillip Hay, op cit.
(203) Shridath Ramphal, op cit.

already claimed thousands of casualties; a toll that increases daily and which those who argue that the nuclear arms race has maintained a balance of peace conveniently ignore... The facts are ugly and shameful and searing. It now seems that the number of people in absolute poverty... at present 780 million... may increase during the 1980s... Many developing countries will find it hard to maintain political stability.

"What is needed is not an act of intervention but an act of will to carry perceptions of social and economic justice, of balanced growth, beyond the frontiers of the industrialised countries. The record of persistent failure to advance development through the North-South dialogue represents one of the most damaging blows struck against human rights in recent times... All the dictators and all the aggressors throughout history, however ruthless, have not succeeded in creating as much misery and suffering as the disparities between (North) and (South)"(195).

The proposed disarmament-development linkage, like NIEO, does not work because the North refuses to make the sacrifices necessary to start the process. "One of the disappointments at Cancun was President Reagan's call for developing countries to get their own economies in order rather than depend on the West for cash handouts. He stressed that 'market-place magic' was the key to their prosperity...' and three days later showed the (South) his kind of 'market-place magic' - the sale of five AWAC aircraft and ... missiles to Saudi Arabia ... (costing) $8.5 billion. That the United States could spurn the plight of developing countries at Cancun, yet turn around and sell them weapons worth billions of dollars less than a week later is an irony in emphasis that one encounters often in the 1980 Brandt Report"(196). For example - "Total military expenditures are approaching $450 billion a year, of which over half is spent by the Soviet Union and the United States, while annual spending on official development aid is $20 billion. If only a fraction of the money, manpower, and research presently devoted to military uses were diverted to development, the future prospects for the Third World would look entirely different"(197).

According to the London-based International Institute for Strategic Studies, the most serious challenge facing the West in the 1980s is not the Soviet Union, but "how to assure the supply, from an unstable Third World, of the raw materials on which its economic well-being, domestic stability and political cohesion has come to depend"(198). The resource-consuming nations of the North could elect to follow a path of co-operation with the South along the lines proposed in the Brandt Report, or "they could seek to ensure the integrity of their resource base by other means, including military intervention. The indications are that they are tending in the second direction, the proposals for a rapid deployment force being part of this response. In the final analysis, this might be self-defeating..."(199).

"A steady and secure supply of raw materials can only be obtained if the (South) still want to supply them, free from compulsion and at their own discretion, because they get fair and stable prices and substantially better opportunities for processing at home... Development means interdependence, and both are preconditions of human survival"(200).

"More arms do not make mankind safer, only poorer"(201).

"As a country with no obvious geographic or security reasons for dependency, New Zealand has remained oddly reliant upon great powers for guidance, protection or even the very perceptions it has about the nature of the outside world and its place in it"(209).

(204) Commission For the Future, 'International Relations: Opportunities - New Zealand in the Future World', (Government Printer, 1979), p9.
(205) 1978 Defence Review (Ministry of Defence, 1978).
(206) Commission For the Future, op cit, p7.
(207) See for example Ann Trotter, 'New Zealand and Japan: building the peace' (NZ Int. Rev. Vol 6, No.6, 1981, p17).
(208) Commission For the Future, op cit, p18.
(209) J.C. Clad, 'Small is Dutiful? Aspects of New Zealand Foreign Policy and the Dependency of Small Powers', thesis, Harvard University, USA (to be published).
(210) The National Party firmly supports a continuing New Zealand association with ANZUS. So too does the New Zealand Labour Party, with some qualifications, although its Annual Conference in 1980 did not. The Social Credit Political League in 1978 adopted a policy of "responsible neutrality" for New Zealand, but in 1981 resolved to support the ANZUS alliance "as the best defence option for the time being" (Bruce Beetham MP, reported in NZ Int. Rev. Vol 6, No.5, 1981, p19).
(211) See S. Levine in NZ Int. Rev. Vol 5, Nol.2, 1980, p19; also S. Levine and P. Spoonley, 'Waging Peace: A Study of Public and Parliamentary Attitudes Towards Peace and Security Issues' (New Zealand Foundation for Peace Studies, 1979). In a survey conducted for this CFF Report, 66% of respondents were in favour of remaining in ANZUS (see Table 3.2).
(212) 1978 Defence Review, op cit, p16.

6. FRIENDS AND ENEMIES

New Zealand is caught up in a web of associations, obligations, and activities that is exceptional for a country of its size(204). Its international ties have been shaped in three regions (Europe, the Pacific, and Asia); in three forums of international association (the Commonwealth, the United Nations, and collective regional arrangements); and in dealings with three close allies (Britain, the United States, and Australia).

"The stark fact of the vast power deployed by the United States and the Soviet Union remains the over-riding and vital strategic factor in the world today ... the key element in the strategic equation remains - each side retains the capacity to destroy the other, even after a nuclear attack ... The other critical factor in the global balance is relations between the Soviet Union and China ... Roughly a quarter of the Soviet Union's forces are deployed in the East: this in itself is a factor in the global balance"(205).

How does New Zealand stand with respect to international tension and the possibility of war? Our possible involvement in wars will continue to be shaped by our foreign policy. It may be prudent to continue alignment with one of the major powers, or alternatively to take advantage of our distance from the likely centre of war, and develop an independent, non-aligned stance(206).

6.1 The ANZUS Alliance

After 1945, the New Zealand Government, reflecting public fear of a military resurgence in Japan, argued for a punitive peace. By 1948, it was clear that the United States was thinking of Japan no longer as a potential enemy, but rather as a potential ally against Russia. The Security Treaty between Australia, New Zealand and the United States (ANZUS), signed in 1951, made a peace treaty with Japan more acceptable to New Zealand(207).

By 1959, Prime Minister Nash was able to describe Japan as a Pacific neighbour of "great and ever increasing importance to the Free World". In 1962, the United Kingdom, which took 53% of New Zealand's exports at the time, announced that it would apply for membership of the European Economic Community, further underlining the importance of Japan for New Zealand, not as an adversary but as a trading partner. By 1970, Japan was New Zealand's third largest export market.

The ANZUS alliance, however, has continued as the basis of New Zealand's defence policy. It has reflected a common strategic interest on the part of the United States, Australia, and New Zealand, and a common sense of political purpose. Militarily, the United States replaced Britain as our major ally in the Pacific(208).

A continuing New Zealand commitment to ANZUS is supported by the three major political parties, with some reservations(210). Public support for ANZUS is unequivocal only among National voters according to a 1979 survey; Labour and Social Credit voters are evenly divided on the issue, although, overall, a majority of New Zealanders (61%) favours continuation with the alliance(211).

The ANZUS alliance has been accepted by successive New Zealand governments as the ultimate guarantee of security in the Pacific(212). The importance of ANZUS to New Zealand reflects the role of the United States as the leader of the West. It underlines the value of New Zealand access to the administration in

"The Labour conference was probably nowhere at greater odds with the conviction of the country than in its advocacy of a go-it-alone defence role for New Zealand. Delegates ruled that we should break with Anzus; that is to say the alliance with Australia and the United States, which has been respected by National and Labour Governments alike as the cornerstone of defence, should be ended.

To accede to that is to abandon all pretence at defence. New Zealand obviously could not defend itself without help. Such a policy represents the height of folly in a world as dangerous as ours. Labour policy-makers should exercise their option to reject the nonsense "(221).

"The Pentagon and the State Department are grateful for New Zealand's participation in ANZUS because it demonstrates such total support and commitment to America's ideals and interests that we are prepared to accept, in the event of nuclear war, a proportion of the nuclear devastation that would otherwise be concentrated on the United States "(225).

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(213) Ibid, p17.
(214) Ibid, pp5-8.
(215) The Prime Minister (Rt. Hon. R.D. Muldoon), interviewed in NZ Int. Rev. Vol 5, No.1, 1980, p2.
(216) Mr Muldoon interviewed in NZ Int. Rev. Vol 6, No.5, 1981, p14.
(217) R. Northey in NZ Int. Rev. Vol 5, No.6, 1980, p2.
(218) J. Henderson in NZ Int. Rev. Vol 5, No.3, 1980, p2.
(219) 1978 Defence Review, op cit, p8.
(220) Ibid, p11.
(221) The Dominion, 11 June 1980.
(222) D. Ball (Strategic and Defence Studies Centre, ANU) in Pacific Defence Reporter, Sept 1981, p25. A similar point is being made by the Europeans.
(223) R. Northey, op cit. New Zealand is presently out of range of Soviet land-based ICBMs.
(224) Ibid.
(225) Gail Eisenstadt, US Disarmament Agency, cited by R. Northey, op cit.
(226) R. Northey, op cit.
(227) "US can count on NZ, says PM, if fighting breaks out in Gulf" (The Evening Post, 22 April, 1980).

Washington, particularly in matters of trade, Pacific affairs, defence, and political consultaton and intelligence(213).

The world is dangerous, unpredictable, and likely to become more so. For the time being, however, there is no obvious threat to New Zealand's security. The problems this country is now facing are economic rather than military. We are caught "in a pincer movement between inflation and agricultural protectionism" (214). Accordingly, New Zealand has adopted a low profile stance in foreign policy. "Our foreign policy is trade. We are not interested in the normal foreign policy matters to any great extent"(215).

There is evidence that ANZUS has assisted New Zealand's trade with the United States - for instance, President Reagan's blocking of congressional moves against casein imports from New Zealand(216). However, critics of ANZUS have suggested that non-aligned countries may, in general, receive better treatment because "their diplomatic support cannot be counted on and must be won"(217). New Zealand trading interests have not always parallelled those of the United States, particularly over Iran (during the hostage crisis) and the Soviet Union (after the Afghanistan intervention)(218).

Differences of perception also exist over the relevance of ANZUS to New Zealand's actual security. Although there is no obvious threat for the time being, "no government can afford to assume that New Zealand's security will never be threatened"(219). Five recent developments are suggested as reasons for becoming more security-conscious: the continuing decline of British interest, the withdrawal of American ground forces from South East Asia, the emergence of China after decades of isolation, political unrest in the South Pacific, and the new responsibility for policing an Exclusive Economic Zone. New Zealand's industrial base provides an inadequate platform for defence production. Consequently, "go-it-alone policies would not only be unsettling to the development of continued relationships across the full range of our interests but would ... be quite unrealistic for New Zealand ... For these reasons the theme of collective security as reflected in ANZUS will continue to be fundamental to New Zealand defence policy"(220).

An Australian commentator has suggested that ANZUS may in fact "be quite peripheral to the essence of the relationship (between Australia and the United States). Whether or not the United States would come to Australia's (or New Zealand's) assistance in any particular situation, the nature of that assistance, and the conditions under which it would be forthcoming would depend essentially on the calculations of interests made by the United States Government at the time"(222). The same point could be made about any treaty with the Soviet Union.

New Zealand critics of ANZUS currently perceive the only realistic threat to this country to be nuclear-tipped missiles, presumably launched by Russian Delta class submarines(223). The only justification for the use of such weapons would be "to attack significant strategic targets ... or to crush us because we remained allied to the United States at a time of conflict ... In other words, our participation in ANZUS makes us a likely nuclear target and greatly decreases our security"(224).

Another concern relates to the extension of the area of operation of the Treaty to cover the Indian Ocean, "very remote geographically from New Zealand and containing no conceivable compensatory benefit"(226). This expansion has been underscored by expressions of New Zealand support for the United States in any conflict with the Soviet Union in the Persian Gulf region(227).

Table 6.1 "Do you agree that New Zealand should seek to establish a nuclear-weapon-free zone in the South Pacific?"(232)

Voting affiliation	National	Labour	Social Credit
Agree	57%	84%	79%
Disagree	37%	9%	18%
Undecided	6%	7%	3%

Soviet 'Kara'-class cruiser

(228) 1978 Defence Review, op cit, p17.
(229) D. Ball, op cit.
(230) (Australian) Defence Department, '1975 Strategic Basis' (Defence Department 1975), cited in D. Ball, op cit. Despite opposition from its ANZUS partners, New Zealand raised the issue at the 1975 South Pacific Forum meeting in Tonga. In December 1975, the United Nations General Assembly endorsed the establishment of a nuclear-free zone in the South Pacific.
(231) In February 1976, Mr Muldoon told the United Nations Secretary General (Kurt Waldheim) "there is little point in making a gesture which can't be translated into reality".
(232) S. Levine in NZ Int. Rev. Vol 5, No.2, 1980, p19.
(233) Newsweek, 5 October, 1981, p. 12.
(234) "USSR won't use N-weapons against countries free from them', Soviet News, 27 Nov, 1981 (published by the USSR Embassy, Wellington).
(235) International Affairs: Soviet Views, 5 April 1981 (published by the USSR Embassy, Wellington).
(236) Vladimir Sazanov, Novosti Press Agency observer, reported in The Evening Post, 28 August, 1980.
(237) V.F. Misyuchenko, First Secretary USSR Embassy (pers. com.).

Proponents of ANZUS cite important political consultations and intelligence information which accrue from membership. The Treaty provides a framework for ... intensified co-operation in ... joint planning and doctrine, standardization and rationalization of equipment, logistic planning, operations, research, and defence production(228). Critics, while conceding Australasia is dependent on the United States for much of its intelligence, question how much of this is needed (229).

A more substantive objection may relate to recent New Zealand proposals for a nuclear-free zone in the South Pacific. "The United States has recently made clear its objections to New Zealand's nuclear-free zone proposal and its dissatisfaction that an ANZUS ally should persist on a course which the United States has declared harmful to its interests"(230). With the change of government in New Zealand in 1975, support for the proposal has waned(231), although New Zealand public opinion remains strongly in favour of it - see Table 6.1 (facing page).

6.2 Bombs on Australasia?

Whether New Zealand would be attacked in a nuclear war between the superpowers has been a matter for speculaton, and can be little else. "Real wars take place in the world of bad weather, technical failures, and unpredictable personalities(233).

Stated Soviet policy is reasonably clear. President Brezhnev, in his speech to the 26th Congress of the Communist Party of the Soviet Union, paid particular attention to efforts to achieve a relaxation of international tension(234). He later declared, "The Soviet Union has said more than once that it will never use nuclear weapons against countries which refuse to manufacture and acquire nuclear weapons and do not have them on their territories. Even this is a sufficiently firm guarantee. But we are prepared to go further and to conclude at any time a special agreement with any of the non-nuclear states (which) pledges not to have nuclear weapons on (its) territory"(235). As suggested earlier, whether such an agreement was honoured may depend on the calculations of interests made by the Soviet Government at the time.

The 1978 Defence Review does not consider at any point the possibility of a nuclear attack on New Zealand. Orthodox defence analysis draws a distinction between 'strategic' nuclear weapons (which threaten the Soviet Union) and 'tactical' nuclear weapons (which do not). Thus, since there are no 'strategic' targets in New Zealand (visiting warships carry 'tactical', or no, nuclear weapons), this country would not attract a nuclear strike from the Soviet Union.

This analysis may, or may not, be shared by the Soviets. Concerning ANZUS, "it goes without saying that neither New Zealand nor Australia is to play the main role in this alliance. Even now, it is clear the two countries are to become just basing areas. It should be borne in mind that a basing area becomes an obvious target for a response attack in case of conflict, and the possibility of conflict increases with the formation of this military conglomerate"(236). The subject of 'targeting' in this quote arises "not in connection with New Zealand's membership in ANZUS, but rather with a (however hypothetical) possibility for this country to become a sort of permanent site to host foreign nuclear weapons either in the form of nuclear-missiled battleships or some other"(237).

The analysis above is not accepted by critics of ANZUS, who believe that, because Russia has "a vast surplus of strategic nuclear weapons at (its)

Table 6.2 Some United States defence and scientific installations in Australia (242).

(1) Naval Communications Station 'Harold E. Holt', North West Cape.

(2) Joint Defence Space Research Facility, Alice Springs, commonly known as Pine Gap.

(3) Joint Defence Space Communications Station, Woomera, commonly known as Nurrungar.

(4) Joint Geological and Geophysical Research Station, Alice Springs, commonly known as USAF Detachment 421.

(5) TRANET Station 112, Smithfield, SA.

(6) Portable geodetic satellite observation posts, currently at Perth and Townsville.

Table 6.3 An Australian Attack Scenario (13 Mt)

Priority	Nuclear Detonation	Target
1st	1 Mt airburstx 2 1 Mt groundburst	Pine Gap, Nurrungar) US bases North West Cape)
2nd	1 Mt groundburst x 5	Australian military installations (e.g. B52 airfields, Darwin)
3rd	1 Mt airburst x 5	Cities i.e. Sydney, Melbourne, Adelaide, Perth, Brisbane

(238) R. Northey, op cit.
(239) "US military installation, group claims", The Evening Post, 20 Dec, 1981.
(240) Information supplied by Carter Observatory, Wellington. In any case, current trends in warhead guidance are towards 'pattern recognition' in the target area. It makes no sense to use faint stars of accurately-known position, when bright stars of accurately-known position are available.
(241) D. Ball, op cit.
(242) Ibid.
(243) Newsweek, op cit. The same logic applies to the New Zealand attack scenarios (p.23).
(244) Carl Sagan, 'Cosmos', (McDonald, 1980), p318.

disposal, we would be taught a totally unforgettable lesson by those in conflict with the United States"(238). This view is held even although New Zealand does not harbour any 'strategic' targets. (Visiting warships and submarines carry only 'tactical' weapons - 'strategic' submarines, by the nature of their missions, do not make harbour visits).

Some fears are undoubtedly overstated. For example the group calling itself "Campaign against Foreign Control in New Zealand" claims that the United States wil spend $1.25 million on a 'military observatory' on Black Birch Mountain, near Blenheim ... to improve the accuracy of ... submarine-based Trident missiles ... to give "the United States a first-strike capability in New Zealand"(239). The 'military observatory' will in fact refine the celestial positions of fairly faint (ninth magnitude) stars, a programme in 'pure' positional astronomy conducted by the US Naval Observatory under the auspicies of the International Astronomical Union, with the approval of the Soviet Union(240).

The issues identified above are perhaps more clear-cut for Australia. "There is now a widespread acceptance within the defence community of the argument that Australia's hosting of US defence and intelligence installations is likely to involve Australia in a nuclear war in which not just the installations but perhaps also Australia's military bases and facilities, and even cities, might be targets"(241). The installations in question are listed in Table 6.2. The first three appear important enough to be targets in their own right:

- North West Cape is one of three global communication links with United States 'strategic' submarines.

- Nurrungar provides a real-time data link between North American Air Defence Command (NORAD), Strategic Air Command (SAC), National Military Command System and the satellite early warning system.

- Pine Gap is the centre for a wide range of intelligence activities carried out by the Central Intelligence Agency (CIA)(242).

Undoubtedly, communications systems, especially those providing links with 'strategic' submarines and aircraft, are likely to be 'high-priority time-urgent' targets, and their destruction can be assumed in a nuclear war. Lower priority targets are more conjectural, but the attack scenario in Table 6.3 (assuming the source is a Soviet Delta class submarine carrying 13 x 1 Mt missiles) seems plausible. Targets are ranked in descending order of probability(242).

Third priority strikes on Australian cities do not make military sense. But at the time these might be launched, the Soviet Union most likely would be in a state of utter devastation. Blast and EMP (see p.21) would have reduced command, control, and communication systems to chaos. The leadership may have been 'decapitated'. In a losing situation, the motivation for the strikes may be simple, irrational vengeance. "Nuclear war is not so much unthinkable as it is unknowable"(243).

"There are not yet any obvious signs of extraterrestrial intelligence and this makes us wonder whether civilizations like ours always rush implacably, headlong, toward self-destruction. National boundaries are not evident when we view the Earth from space. Fanatical ethnic or religious or national chauvinisms are a little difficult to maintain when we see our planet as a fragile blue crescent fading to become an inconspicuous point of light against the bastion and citadel of the stars. Travel is broadening"(244).

Part Two : Nuclear Disaster

Table 7.1 Countries destroyed or severely incapacitated (acccording to Scenario B1)

(a)	Directly attacked:	
	OECD	Australia, Austria, Belgium, Canada, Denmark, France, Iceland, Ireland, Italy, Japan, Netherlands, Norway, Spain, Turkey, United Kingdom, United States, West Germany
	Asia	China, Philippines, Taiwan, Vietnam
	Middle East	Arab Rep Yemen, Bahrain, Egypt, Iran, Iraq, Israel, Jordan, Kuwait, Lebanon, Libya, Oman, Quatar, Saudi Arabia, Syria, United Arab Emirates, Yemen
	Eastern Bloc	Bulgaria, Czechoslovakia, East Germany, Hungary, Poland, Romania, Soviet Union
	Others	Cuba, Dijbouti, Ethiopia, Diego Garcia, Guam
(b)	Indirectly incapacitated by fallout, trade disruption, etc.:	
		Albania, Cyprus, Finland, Greece, Greenland, Hong Kong, Korea N, Korea S, Liechtenstein, Luxembourg, Macau, Malta, Mongolia, Portugal, Singapore, Sweden, Switzerland

(245) A quarter of present Soviet forces are deployed on the Chinese frontier. China would present a major strategic threat during Soviet post-war 'reconstruction'.

(246) The United States will repel "by any means necessary, including military force, any attempt by an outside force to gain control of the Persian Gulf region" (President Carter reported in The Evening Post, 22 April, 1980).

(247) American aircraft shot down two Libyan aircraft over the Mediterranean in 1981.

(248) Targeting strategy has been considered in section 6.2. Russia may have reason to fear an unscathed Japan during a post-war 'reconstruction' period.

(249) The distribution of remaining known oil reserves is Europe 4%, Africa 9%, Americas 13%, Asia + USSR + Oceania 17%, Persian Gulf 57% (Opec Review, Vol.5, No.3, 1981).

7. DEVASTATION OF THE NORTH

In this section, the consequences of a nuclear attack on a targeted country are described. Reference is made in it, and in subsequent sections, to four nuclear war scenarios which may be summarized as follows:

Scenario A (global war)

New Zealand is subjected to a nuclear attack, and is left in a similar condition to the targeted countries of the Northern Hemisphere. (The likelihood of this course of events has been assessed in section 6.2). As a consequence, the New Zealand state ceases to exist as a functioning entity, although there are scattered pockets of survivors.

Scenario B1 (global war, NZ survives)

A major nuclear war breaks out for one or more of the reasons outlined in section 4. As a direct consequence, all NATO and Warsaw pact countries, many Middle Eastern countries, plus China, Japan, and Australia are essentially destroyed. Other countries suffer varying degrees of collateral damage. Different courses of events lead to this same outcome. A fully-fledged nuclear China (aligned with the United States) may exploit a NATO-Warsaw pact war by striking hard-pressed Russia, which would respond in kind. Russia may have good reasons to pre-emptively strike China with SS-20 missiles deployed along the eastern frontier(245). Escalation of a Sino-Soviet war into central Europe is conceivable, especially if the subjugated East European states attempt to exploit the destruction of Russia. Alternatively, a clash of superpower interests in the Middle East could escalate (e.g. by miscalculation of a response) into a major conflict(246). A covert nuclear strike or act of nuclear terrorism by a fanatical Third World country against one, or both, superpowers would be exceedingly dangerous(247). Involvement of Middle Eastern countries might result from exploitation of superpower preoccupation elsewhere by one of them (e.g. by a first strike against Israel), or through Soviet strikes designed to maximize economic dislocation for the West through the destruction of Persian Gulf oil installations. Table 7.1 lists countries destroyed or severely incapacitated by blast, radiation, EMP, fallout, subsequent social unrest and/or reliance on trading partners. New Zealand escapes the initial, but not the ultimate consequences.

Scenario B2 (NATO-Sino-Soviet war)

This scenario is identical to B1, except that Australia and Japan emerge intact (except for strategic targets, which are destroyed(248)). Major industrial and urban areas in these two countries survive, and imports/exports remain sufficient for viable, but truncated, economies. New Zealand avoids direct attack.

Scenario C (Middle East war)

A nuclear war, likely to (but not necessarily) involve Israel, results in the destruction of most production wells, pipelines, tank farms, refineries, tankers and wharf facilities in the Persian Gulf(249). World oil supplies are dislocated.

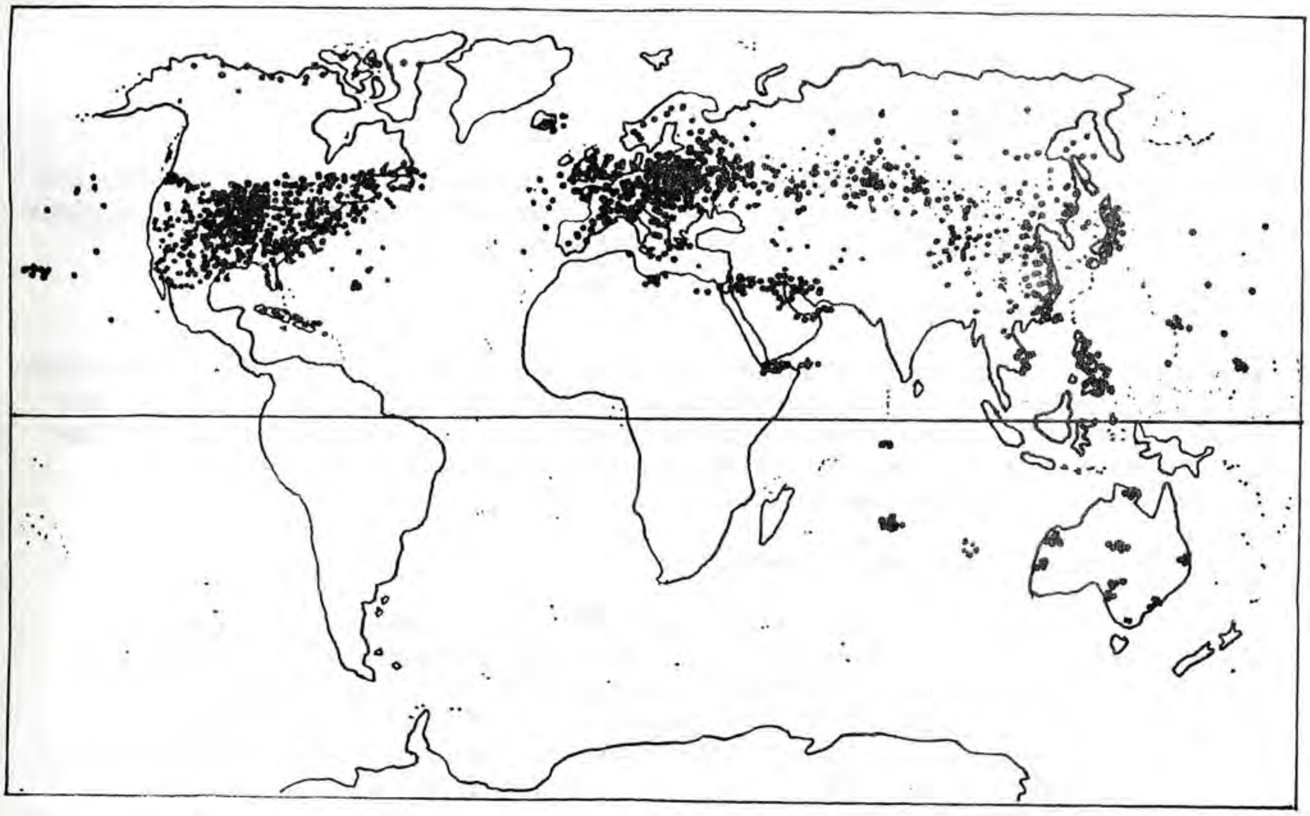

Fig. 7.1 Lethal Local Fallout (250)

(250) This map shows potentially lethal fallout zones according to scenario B1.

(251) These facilities are particularly numerous in the United States (158 reactors operating or under construction), Europe (178), Soviet Union (47), and Japan (31). A major breach of a German reactor, for example, would require the evacuation of 750,000 people from an area of 10,000 sq km (see B. Ramberg, 'Destruction of Nuclear Energy Facilities in War' (Lexington Books, 1980, p.82).

(252) Chemical weapons are no less devastating than tactical nuclear weapons, and are stockpiled by both superpowers. They are more likely to be used by a non-nuclear power as a cheap, effect weapon of mass destruction. A continuing ban on biological weapons appears to be in some doubt, in the light of (inconclusive) evidence that the Soviet Union has been using such weapons (New Scientist, Vol 92, 1981, p737).

(253) A shelter would be of no use if the air entering it was unfiltered, or if it was located in a 'firestorm' area, (see M. Caidin, 'The Night Hamburg Died' (Ballantine, 1960)). Malnutrition, infectious disease, radiation sickness, and psychological trauma could be devastating even before people attempted to emerge (J. Smith and T. Smith, 'Attitudes towards Civil Defence and the Psychological Effects of Nuclear War', Brit. Med. J., Vol 283, 1981, p963; H.L. Abrams and W.E. Von Kaenel, 'Medical Problems of Survivors of Nuclear War' New Eng. J. Med. Vol 302, No.20, 1981, p1226.

(254) Huge firestorms could occur in forested or urban areas where sufficient combustibles were present. The United States, for example, might experience "a holocaust of firestorms from which recovery would be delayed for decades or centuries" (W.S. Osborne in 'Ecological Aspects of the Nuclear Age' (ed. V. Schultz and F.W. Whicker), (UCL Press, 1972), p489). Dresden and Tokyo experienced firestorms following 'conventional' attacks.

(255) Examples of dangerous materials include dioxin (c.f. Seveso incident), LNG and LPG. See SIPRI, 'Warfare in a Fragile World' (Taylor and Francis, 1980) for amplification.

The extent of human survival, and the quality of life, in a country subject to nuclear attack will depend on many factors (some acting in synergism):

- extent of blast damage (refer section 2.3)
- extent of local fallout (refer Figure 7.1, facing page)
- extent of contamination from damaged nuclear power, reprocessing, and storage facilities(251)
- use of chemical or biological weapons(252)
- availability, and quality, of fallout shelters(253)
- extent of fires(254)
- release of toxic chemicals from industrial plants(255)
- extent of flooding from burst reservoirs and hydroelectric dams
- damage to water supply and sewerage systems
- damage to electrical grid and communication systems
- spread of infectious diseases(256)*
- extent of psychological trauma(257)*
- extent of climate change (possible cooling)*
- effect of increased ultraviolet light (UVB) on crops, and on human activities(258)*
- decline in food production resulting from climate change, increased UVB, fuel and fertilizer shortages, and plagues of insects and rats (from destruction of birds and other predators(259))*.
- movement, and behaviour, of refugees*

(* Life in non-targeted countries may also be altered by one or more of these last six factors).

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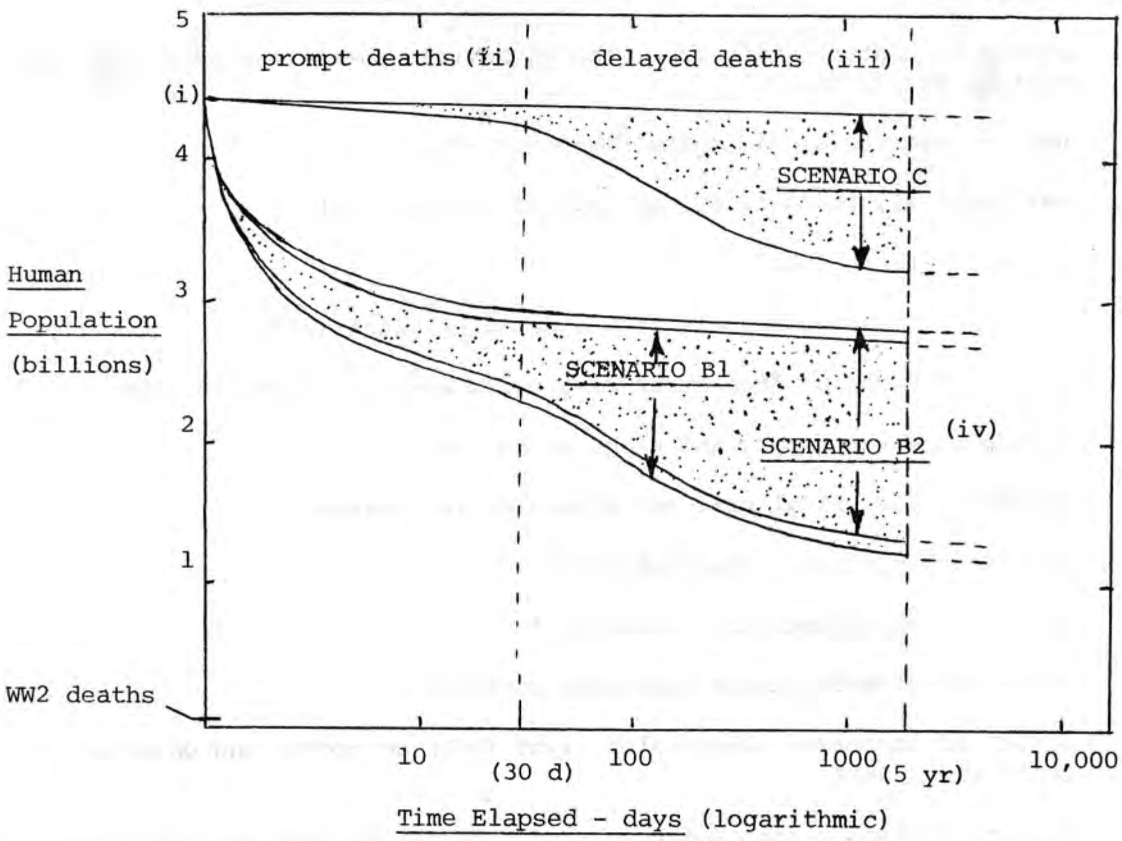
(256) Malaria (presently 300 million cases and 3 million deaths per year) could return to previous endemic areas such as Southern United States, Brazil, Africa, Middle East, Southern Soviet Union, China and Indonesia. Many other diseases, such as influenza, plague, tuberculosis or yellow fever could resurge: the latter is particularly virulent in new areas (e.g. 15 million deaths in the Ethiopian epidemic of 1960-62). See SIPRI, op cit; also H.L. Abrams et al, op cit.

(257) Japanese bomb survivors still feel a sense of impairment, and carry psychological burdens of 'death imagery', and 'death guilt' over having survived. They were also victimized by the rest of Japanese society (R.J. Lifton, 'The prevention of nuclear war', The Bulletin of the Atomic Scientists October 1980, p38).

(258) Climatic and ultra violet radiation effects are considered in section 8.

(259) Insects and rodents are less susceptible than birds to radiation, and could respond to the decline of their predators by a phenomenal population increase - causing famine and disease (e.g. plague) among human survivors (see W.S. Osborn, op cit (ref (254)).

Fig 7.2 Global Population After Nuclear War



(i) Present population - 4,415 billion
(ii) Estimates from OTA Report.
(iii) Shaded area represents uncertainties introduced by synergisms between the effects of radiation, epidemics, malnutrition, and continuing conflict.
(iv) The population could increase again if food production was restored, disease was controlled, and birth control was not widely used (e.g. the World in 1982). Continuing conflict, and pandemics, could result in a further decline.

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(260) Portugal is, most of the time, upwind of Europe and makes a minimal contribution (one maritime reconnaissance air squadron) to NATO so is unlikely to be heavily targeted. Oregon (alone with Arizona and West Virginia among the United States) has no nuclear weapons facilities, but is also upwind of likely targets (see The Defense Monitor, Vol 4, No.2, 1975 for US weapons deployment).

(261) Office of Technology Assessment, 'The Effects of Nuclear War' (OTA, 1979).

(262) Ibid.

(263) A.M. Kat, 'Life after Nuclear War' (Ballinger, 1981).

(264) An earthquake in Tang Shan province in 1976 killed 650,000 people, but passed almost unnoticed outside China ('Future Contingencies 1: Natural Disaster', (CFF, 1980). Russian casualties during World War 2 were 20 million.

A full-scale nuclear attack on the United States, Europe, and (to a lesser extent) the Soviet Union could culminate in the almost total absence of (human) survivors over regions the size of, say, West Germany. Scattered rural communities could have the potential for long term survival, especially in areas in which the direct effect of weapons was reduced (e.g. Oregon state, Portugal(260)). Even a less extensive attack restricted to military targets could reduce the United States economy to "the equivalent of the Middle Ages"(261). Both superpowers could equally face the prospect of being unable to rebuild an industrial society at all(262). Recovery may not be feasible. The qualitative and quantitative effects of both 'limited' and 'full-scale' nuclear attack on the entire fabric of a society include "a virtual dismemberment of life as we know it, with grave and lasting damage to our social, psychological, and political institutions"(263).

In these worst-case scenarios (A, B1, B2), the Chinese could fare better than Americans, Russians, and Europeans. China has fewer military and industrial targets, no nuclear power stations, and a predominantly dispersed rural population. The Chinese economy is basically self-sufficient, and food production has little dependence on fossil fuels or an electrical grid system. The health system is also self-sufficient, technologically unsophisticated and organized at a primary care and rural level. Living standards and lifestyle might change relatively little for Chinese survivors. Both the Chinese and the Russians are likely to be less traumatized than Americans and Europeans, being more accustomed to food shortages, austerity, and disasters(264).

Table 7.3 Continuing Violence(268)

(a) Some states at war in the 1970s (excluding countries bombed in scenarios A, B1, B2):

El Salvado-Honduras Morocco-Algeria Libya-Egypt Libya-Chad	Zambia-South Africa Pakistan-India N Yemen-S Yemen Greece-Turkey	Ethiopa-Somalia Vietnam-Campuchea Cyprus-Turkey Indonesia-Timor
Major disputes:		
Argentina-Chile	Argentina-Brazil	India-China

(b) Some governments in conflict with separatist movements:

Indonesia Philippines Pakistan	India Iran, Iraq Canada	Northern Ireland Spain China

Table 7.2 Food Requirements

(a) Nations in the present world with a significant food trade deficit(266)

(Greater than $1 billion)
United Kingdom, West Germany, Italy, Poland, Czechoslovakia, Soviet Union, Iran, Saudi Arabia, Algeria, China, South Korea, Japan, Hong Kong

(Others)
Egypt, Libya, Iraq, Pakistan, Bangladesh, Vietnam, North Korea, Singapore, Venezuela

(b) Nations in the present world in which significant starvation occurs(267)

(20%+ additional calories per head required):
Bolivia, Mali, Niger, Upper Volta

(10-20% required):
El Salvadore, Algeria, Mauritania, Guinea, Benin, Nigeria, Zaire, Angola, Zambia, Sudan, Botswana, Mozambique, Tanzania, Ethiopia, Somalia, Yemen, Afghanistan, India, Bangladesh, Philippines

(0-10% required):
Indonesia, Papua New Guinea, Burma, Laos, Nepal, Pakistan, Iran, Iraq, Jordan, Tunisia, Namibia, Kenya, Uganda, Congo, Gabon, Cameroons, Chad, Togo, Sierra Leone, Senegal, Peru, Equador, Colombia, Venezuela, Dominican Rep, Honduras, Guatemala, China

(265) P. Ehrlich, A. Ehrlich, J. Holdren, 'Ecoscience', (Freeman, 1975) p690.
(266) Food and Agricultural Organization Trade Yearbook (United Nations, 1977).
(267) Food and Agricultural Organization Fourth Food Survey (United Nations, 1980).
(268) M. Kidron and R. Segal, 'The State of the World Atlas' (Pan, 1981), pp 12, 61.
(269) Ibid, p62.
(270) In an OTA scenario (ref (261)), lawless bands of teenage refugees rampage in a post-war United States.

The death of tens or hundreds of millions of people, destruction of whole economies, and a dislocation of international trade would terminate aid to the developing countries. The abrupt end of shipments of grain, fertilizers, seeds, tractors, irrigation equipment, trucks, oil drilling and refinery technology, mining and excavating equipment, pharmaceuticals, vaccines, and other manufactured products or machines could be traumatic for the Third World(265). Setbacks to agriculture could place countries listed in Table 7.2 at risk of famine.

Surviving governments may direct resources into a continuation of the war, albeit at a reduced scale, resulting in more human misery. In an unstable, post-war situation, some of the simmering conflicts listed in Table 7.3 might erupt, as wars between non-targeted countries with longstanding disputes, or as civil wars within countries in which strong separatist movements exist. Surviving populations in the Soviet Union may decide upon 'derussification', probably with a continuation of violence(269). Bandits and pirates are likely to resurge throughout the world(270).

The outcome for global population of Scenarios B1, B2, and C is shown schematically in Figure 7.2 (Scenario A is essentially identical with B1, in a global context.)

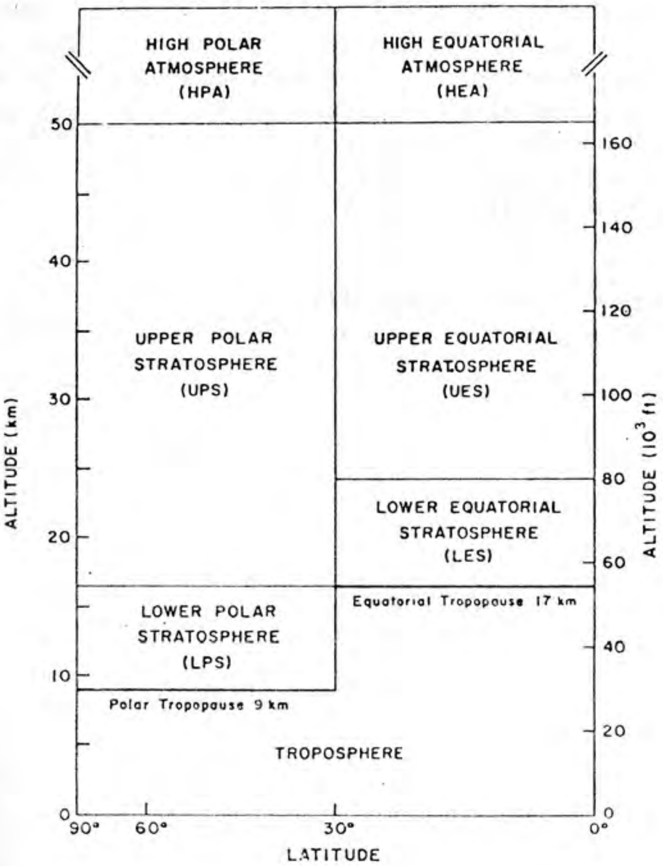


Fig. 8.1 Atmospheric Partitioning (272)

(271) NAS (National Academy of Sciences), 'Long-term Worldwide Effects of Multiple Nuclear-Weapons Detonations', (NAS, 1975) p7.

(272) K.R. Peterson, 'An empirical model for estimating world-wide deposition from atmospheric nuclear detonations', Health Physics, vol 18, p360.

(273) 'Half-residence' time refers to the time for half of the original material to be removed (transferred). 'Residence time' refers to the time taken for a decrease to 1/e (about 0.368) of the original quantity.

(274) Glasstone and Dolan (eds), 'The Effects of Nuclear Weapons', 3rd ed, (US Department of Defence and US Department of Energy, 1977), p442.

(275) NAS, op cit, p27.

8. GLOBAL ENVIRONMENTAL CONSEQUENCES OF NUCLEAR WAR

The detonation of a large number of nuclear weapons is likely to have long-term global consequences. These could include long-term somatic and genetic damage from radiation, possible changes in the physical environment (including the possibility of damage to the ozone layer of the upper atmosphere), and changes in the ecological systems of which humans are a part.

8.1 Atmospheric Transport

To understand the global impact of nuclear weapons, it is useful to know some of the characteristic features of the atmosphere. The vertical structure of the atmosphere can be subdivided according to the variation of temperature with altitude. Ascending from the earth's surface, the region of falling temperature is the 'troposphere', and its top is the 'tropopause'. Above the tropopause is the 'stratosphere', in which temperature is constant or increases with height. Most visible phenomena associated with weather occur in the troposphere, whereas the stratosphere is exceptionally stable(271). Figure 8.1 shows the atmosphere partitioned into compartments, useful for understanding the transport of nuclear debris(272).

Nuclear debris which enter the troposphere will 'fall out' on a time scale of days to a month or two. Tropospheric debris tends to fall out in a band along the latitude of injection, after encircling the globe several times. If injection occurs in the lower stratosphere, the major influx of debris into the troposphere begins during the following winter or spring. Winds in the lower stratosphere are predominantly in the same direction, and so transfer between the hemispheres takes place slowly. For injection in the upper stratosphere, rapid transfer between the hemispheres takes place. The debris begins to arrive in the lower stratosphere during winter or spring in both hemispheres after a delay of a year or so.

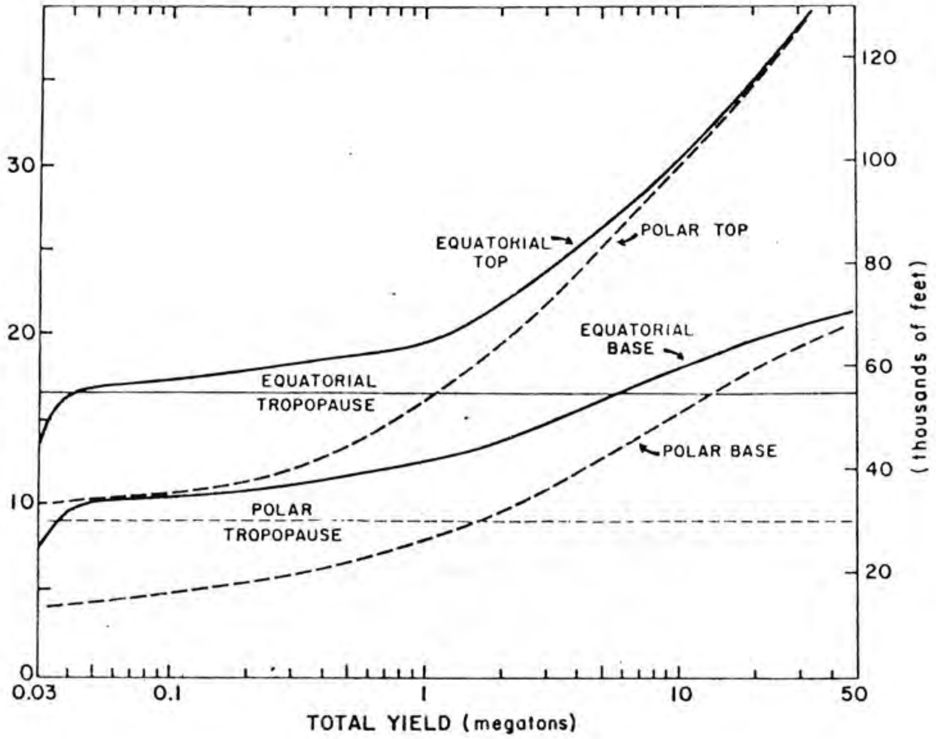
In the lower stratosphere, the 'half-residence time'(273) for transfer between hemispheres is roughly 60 months (5 years), whereas the half-residence time for transfer to the tropopause is about 10 months. In the troposphere, interaction between hemispheres takes a year or so. Since the half-residence time in the tropopause is only a month, it is apparent that nuclear debris entering the troposphere or lower stratosphere will tend to fall out in the hemisphere in which it is produced(274).

8.2 Nuclear Explosions in the Atmosphere

The fireball resulting from the detonation of a nuclear weapon rises rapidly into the upper atmosphere, and with high yield weapons is capable of penetrating the stratosphere. Unlike the lower part of the atmosphere, the stratosphere lacks the moisture needed to quickly remove injected materials. Since such materials remain in the stratosphere for a long time, their effects become diluted and widely dispersed, and they last longer.

Three possible mechanisms have been recognised which could have adverse worldwide impacts(275):

- The oxides of nitrogen produced in nuclear explosions, if raised to stratospheric altitudes in sufficient quantity, could cause significant depletion of the earth's natural ozone layer through chemical



<u>Fig. 8.2 Penetration of Nuclear Debris v. Weapon Yield</u> (278)

(276) R.J. Sullivan et al, 'Survival during the first week after a nuclear attack', (System Planning Corp Arlington, VA, Dec 1979), p162.
(277) Glasstone and Dolan, op cit, p447.
(278) K.R. Peterson, op cit, p359.
(279) NAS, op cit, p5.
(280) A curie (Ci) is defined as the activity (or quantity) of any radioactive substance undergoing 3.7×10^{10} disintegrations per second.
(281) NAS, op cit, p165.
(282) A.W. Klement, Jr, 'Radioactive fallout phenomena and mechanisms,' <u>Health Physics</u> 11(12). V. Schultz and F. Wicker (eds), 'Ecological Aspects of the Nuclear Age: Selected Readings in Radiation Ecology', (1972), p480.

interactions. This could increase the amount of biologically harmful ultraviolet radiation (UVB) that reaches the earth's surface, and could also have adverse climatic impacts.

- Hazardous radioactive isotopes (e.g. strontium 90) which do not decay rapidly could be dispersed through the stratosphere, falling out slowly on a global scale.
- The injection of large amounts of dust in the upper atomosphere, resulting from surface bursts, could alter the amount of solar radiation arriving at the earth's surface.

While a surface or near surface detonation is neccessary for the production of dust, it would reduce the production of nitrogen oxides by half(276). Surface bursts also result in local fallout, thereby reducing the global component by approximately half(277). For a given latitude, the degree of penetration of the nuclear debris cloud into the stratosphere (above the tropopause) depends on weapon yield (see Figure 8.2(278)).

8.3 Effects on the Environment

Radioactive Fallout

In estimating delayed fallout, it is useful for several reasons to determine the amount of strontium 90. It has a half life of 27.7 years, much longer than the residence time in the stratosphere, and so does not decay appreciably before deposition on the earth. It is produced in large quantities by fission, and its deposition after nuclear testing has been monitored.

A National Academy of Sciences (NAS) study(279) estimated that a 10,000 Mt nuclear war, confined to the Northern Hemisphere, would produce average cumulative fallout of strontium 90 of about 1 Ci/sq.km(280) in the middle latitudes of the Northern Hemisphere.

This estimate was obtained by scaling from the total strontium 90 content of the soil of the United States in 1964 viz. about 50 mCi/sq.km from 200 Mt of fission yield. A fission/fusion ratio of 0.4 was assumed for a total yield of 500 Mt. Strontium 90 fallout for the Southern Hemisphere was estimated to be roughly one third of that for the Northern Hemisphere.

As a result of 530 Mt of mixed fission and fusion yields prior to 1970, the dose likely to result over the three decades following a 10,000 Mt war was estimated to be 4 rem in the Northern Hemisphere, and 1.25 rem in the Southern Hemisphere (see section 2.2, ref (18)). Roughly half of this dose would be delivered in the first year following injection(281).

Simple extrapolation may not provide a realistic estimate of global fallout from a war, because the mix of weapons used is likely to differ from that of bomb tests. Furthermore, scaling from a total fission yield injected into the atmosphere by 1962 of 166 Mt (viz. 139 Mt airburst and half of 54 Mt groundburst), increases the predicted fallout by 20%, on the assumption that all weapons are airburst(282).

Atmospheric nuclear test sites during the years of peak testing (1961-62) were located either in equatorial latitudes (United States tests) or in polar latitudes (Soviet Union tests). In a nuclear war, the bulk of the megatonnage would be detonated in the middle latitudes of the Northern Hemisphere. Fallout reaching the Southern Hemisphere from Northern middle latitudes would be substantially less than that from equatorial latitudes. As a result of this

(283) K.R. Peterson, op cit.
(284) B.R. Williamson, unpublished, 1982.
(285) R.O. Chester, 'Biological Dose and Radiological Activity from Nuclear Reactor or Nuclear Weapon Fission Products', (Oak Ridge National Laboratory ORNL-4996, Dec 1974), p4.
(286) H. Johnston et al, 'Effect of Nuclear Explosions on Stratospheric Nitric Oxide and Ozone', Journal of Geophysical Research, Vol 78, No.27, 1973.
(287) P. Goldsmith et al, 'Nitrogen Oxides, Nuclear Weapon Testing, Concorde and Stratospheric Ozone', Nature, Vol 224, 1973, p545.
(288) E. Bauer and F.R. Gilmore, 'Effect of Atmospheric Nuclear Explosions on Total Ozone', Reviews of Geophysics and Space Physics, vol 13, No.4, Aug 1975.
(289) NAS, op cit, p5.
(290) J. Hampson, 'Photochemical war on the atmosphere', Nature, Vol 250, 1974, p189.
(291) A.L. Hammond and T.H. Maugh, 'Stratospheric Pollution: Multiple Threats to Earth's Ozone', Science, Vol 186, 1974, p335.
(292) W.H. Duewer et al, 'The Effects of a Massive Pulse Injection of NOx into the Stratosphere', (Lawrence Livermore Laboratory, Preprint UCRL-80397, April 1978), cited in R.J. Sullivan et al, op cit, p161.

factor, the NAS study has overestimated fallout in the Southern Hemisphere, and underestimated fallout in the Northern Hemisphere.

As a result of these deficiencies in the NAS methodology, global fallout has therefore been recalculated for this CFF report using a model(283) which takes into account type, yield, latitude, and season for each burst. Detailed calculations are given in an Appendix(284) on p97. Predicted fallout in this case is 4.4 Ci/sq.km for the middle latitudes of the Northern Hemisphere (or 5.6 Ci/sq.km if delayed tropospheric fallout is included), and 0.24 Ci/sq.km for the middle latitudes of the Southern Hemisphere.

Additional radioactive contamination would result if nuclear reactors are targeted. From Table 5.1 (p.60), a plausible estimate of the capacity of reactors that might be targeted is 100-200 GW(electrical). Scaling from weapon and reactor activities given in reference (285) for 100 GW(electrical), overall activity is increasd by a negligible amount during the first few months, by 40% after one year, 110% after 3 years, and 130% after ten years (assuming a 10,000 Mt nuclear war with 50% fission). Since groundbursts would be required to inject this activity into the stratosphere, approximately half would fall out locally.

A two-fold increase in the long term dose from global fallout would be expected if nuclear reactors equivalent to 200 GW(e) were destroyed by high yield weapons in a 10,000 Mt nuclear war. However, fallout would not be expected to damage ecosystems appreciably. Increased cancer deaths and genetic effects would nonetheless be expected among surviving human and animal populations.

Ozone Depletion and Increased Ultraviolet Radiation

The injection of a large quantity of nitric oxide (NO) into the stratosphere by many high-yield nuclear weapons may cause a depletion of the ozone layer. This would allow more harmful ultraviolet radiation (UVB) from the sun to reach the surface of the Earth, where it could produce skin burns and potentially dangerous ecological effects.

Nuclear explosions in the lower atmosphere produced about 5000 tonnes of nitric oxide per Mt of yield(286-288). Detonations equivalent to 10,000 Mt would produce 5 to 50 times more nitric oxide than naturally occurs in the stratosphere(289). Since nitric oxide has a controlling influence on the breakdown of ozone, an injection of this magnitude could result in a large depletion of the ozone layer. Detonation of nuclear weapons at high altitudes (to destroy incoming missiles or to produce EMP) would increase damage to the ozone layer(290-291).

The NAS estimated that 30-70% depletion of the ozone layer in the Northern Hemisphere, and 20-40% depletion in the Southern Hemisphere (with a recovery time of two to four years) could result from a 10,000 Mt nuclear war confined to the Northern Hemisphere.

More recent calculations(292)indicate that the degree and duration of ozone depletion are, in most cases, less than is suggested in the NAS report, and depend on weapon yield. For a 10,000 Mt attack with 4 Mt weapons, the expected ozone depletion is 60%, corresponding to an increase in ultra violet light by a factor of 4. Ozone concentrations would recover to within 15% of normal in about 3 years (instead of 5 years according to NAS). For a 10,000 Mt attack with 1 Mt weapons, the expected ozone depletion is 35%, recovering to within 15% of normal in 18 months. For weapons of 0.35 Mt, a small (3%) increase in ozone is predicted, persisting about 1 year. The faster recovery of the ozone layer

(293) NAS, op cit, p45.

(294) P. Cutchis, 'Stratospheric Ozone Depletion and Solar Ultraviolet Radiation on Earth', Science, Vol 184, No.4132, 1974.

(295) Erythemal dose takes into account the relative response of a biological specimen to UV radiation as a function of wavelength, and causes skin damage.

(296) P. Cutchis, op cit, p18.

(297) NAS, op cit, p15.

(298) J. Calkins and T. Thordardattir, 'The Ecological Significance of Solar UV Radiation on Aquatic Organisms', Science, Vol 283, 1980, p563.

(299) E. Koslow, 'An Aposematic Statement on Nuclear War: Ultraviolet Radiation in the Postattack Environment', Bioscience, Vol 27, No.6, 1977, p411.

(300) R.P. Turco et al, 'Tunguska Meteor Fall of 1908: Effects on Stratospheric Ozone', Science, Vol 214, 1981, p19.

predicted by Duewer et al(292) would result in less depletion in the Southern Hemisphere(293).

Increased ultra violet light may have harmful effects and can be related to stratospheric ozone depletion(294). The ultra violet light intensity depends on latitude. A 50% ozone depletion increased the erythemal dose(295) at a latitude of 60 degrees by a factor of 4.5, but this would not bring it up to the dose corresponding to a latitude of 30 degrees(296).

A 70% depletion of ozone would mean that, at temperate latitudes, a person would acquire a severe sunburn from exposure to the summer noontime sun in about 10 minutes(297). A 50% depletion increases the exposure time required to about 1 hour. These exposures preclude significant outdoor activities without some form of protection. Severe sunburn and eye injury from increased ultra violet light are a major problem to Arctic explorers, and mountain climbers on snow fields. Snow reflects about 80-90% of ultra violet light, thus increasing exposure about five fold. This is equivalent to a depletion of 60-70% in the ozone layer. The protective measures resorted to by mountaineers (protective eye glasses, creams and clothing) are indicative of what would be required if a similar depletion occurred in a post-attack environment.

Animals may suffer damage to the eyes and exposed skin. These problems would be exacerbated by the limited opportunity for domestic animals to find shelter. Some domesticated plants might not survive higher ultra violet light levels. Vegetables such as peas, onions, beans and tomatoes are already close to their thresholds for response to present ultra violet light levels. There may be significant interactions between ultra violet light and some agricultural chemicals. Recent research results indicate significant effects on aquatic organisms and therefore, potentially, fisheries(298).

The impact of increased ultra violet light on natural and agricultural ecosystems remains essentially unknown, especially in a post attack situation in which climatic changes and higher levels of ionising radiation are possible(299). There is a strong synergism between ultra violet light and ionising radiation, but information is insufficient to estimate its effects.

A significant reduction in stratospheric ozone may have occurred already as a result of the Tunguska meteor fall of 1908 over Siberia(300). The meteor disintegrated in the earth's atmosphere, and may have deposited 30 million tonnes of nitric oxide (NO) in the stratosphere and mesosphere (a layer overlying the stratosphere). This would correspond to the nitric acid produced by nuclear detonations equivalent to 6000 Mt. (The total energy of the meteor was equivalent to 1000 Mt and the explosion to a 10 Mt nuclear detonation). Calculations indicate that up to 45% of ozone in the Northern Hemisphere may have been depleted early in 1909, and that large reductions may have persisted until 1912. For the 10 degree latitude zone centred on 60 degrees north, calculations indicate a depletion of 85% for several months (the stratospheric ozone layer was essentially removed locally). Measurements of the atmospheric transparency for the years 1909 to 1911 show evidence of a steady ozone recovery from unusually low levels in early 1909, suggesting a total ozone deficit of 15-45%, in agreement with the theoretical predictions.

Although the direct effects of increased ultra violet light on humans appear amenable to solution and control, its impact on natural and agricultural ecosystems, which appear vital to the survival of society, is essentially beyond man's capacity to control.

(301) NAS, op cit, p38.

(302) 'Albedo' represents the fraction of light falling on a surface which is reflected by it.

(303) NAS, op cit, p54.

(304) H. Stommel and E. Stommel, 'The year without a summer', Scientific American, June 1979, p176-186.

(305) R.P. Turco et al, op cit, p22.

(306) J. Gribben, 'Sun and Weather: the stratospheric link', New Scientist, 10 Sept 1981, p669.

(307) K.Ya. Kondratyev and G.A. Nikolsky, 'The Stratospheric Mechanism of Solar and Anthropogenic Influences on Weather and Climate', edited by B.M. McCormac and T.A. Seliga, (Reidal, 1979), p317.

(308) J. Gribben, op cit, p671.

Climatic Change

The detonation of a large number of nuclear weapons could result in a global long-term disruption of climate. The following atmospheric effects could result in a redistribution of atmospheric heating(301):

- Dust injected into the stratosphere absorbs radiation (a heating effect), but scatters incoming solar radiation back into space (a cooling effect at the earth's surface).
- The destruction of ozone in the stratosphere removes a source of heat from that region, (ozone absorbs in the ultra violet, visible, and infrared spectrum). The loss of infrared absorption by ozone would cause cooling at the earth's surface because absorption and reradiation back to the surface of outgoing terrestrial radiation would be less.
- Nitrous oxide derived from nitric oxide absorbs visible and infrared radiation. Its presence in the stratosphere represents additional heating aloft, and may cause cooling at the earth's surface.

It is possible that changes in surface albedo(302), resulting from a dislocation of agriculture, could also cause a climatic change.

The climatic effects of dust injected into the stratosphere can be estimated from the effects of past volcanic eruptions. The eruption of Krakatoa (in Indonesia) in 1883 injected 6 cubic kilometers of dust into the atmosphere, with 10-100 million tonnes deposited as stratospheric aerosol(303).

Following the eruption, a minor global cooling of a few tenths of a degree occurred. Since a 10,000 Mt nuclear exchange would inject a comparable quantity of stratospheric dust, it may have a similar climatic impact (as a result of dust alone).

In 1815, Mt Tambora (also in Indonesia) erupted and injected 100 cubic kilometers of dust into the atomosphere. Worldwide temperatures were abnormally low for the next year, ("the year without a summer"). The mean temperature in June, 1816, was 3 deg C below normal(304). Even this perturbation, equivalent to a 100,000 Mt nuclear war did not result in any adverse, long-term climatic change.

Regarding ozone depletion, the NAS study concluded that the potential decrease in global surface temperature over a few years might range from a negligible amount to a few degrees. Calculations of the response of tropospheric and stratospheric air temperatures to changes in ozone, oxides of nitrogen and dust resulting from the Tunguska event suggest surface coolings of a few tenths of a degree celsius(305).

Recent research (not yet published in English) suggests that the testing of nuclear weapons in the late 1950s and early 1960s had a pronounced effect on global weather(306). It is claimed that oxides of nitrogen generated by nuclear detonations increased the absorption of solar radiation(307) and reduced surface temperature consistent with the negative temperature anomalies of the early 1960s. This work, which is tentative and at present the subject of controversy, suggests a reduction in global temperatures of 5-10 deg C after a nuclear conflict(308).

Dust and nitric oxide injection into the stratosphere could lead to significant climatic effects. Present understanding is inadequate to predict these. They probably lie within normal global climatic variability, but the possibility of climatic changes of a more dramatic nature cannot be discounted. A protracted

"The foreseeable consequences to society from mega extinction of species would be, in the opinion of some, worse than economic collapse, limited nuclear war or conquest by a totalitarian government"(313).

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(309) P.R. Ehrlich et al, 'Ecoscience', (Freeman, 1980), p59.
(310) 'Future Contingencies 1: Natural Disaster', (Commission for the Future, 1981).
(311) J. Gribben ed, 'Climatic Change', (Cambridge, 1978).
(312) J.E. Hobbs, 'Applied Climatology', (Butterworths, 1980).
(313) E.O. Wilson cited in P. Ehrlich and A. Ehrlich, 'Extinction' (Random House, 1980) p1.
(314) J.E. Anderson, 'First Strike: myth or reality', <u>The Bulletin of the Atomic Scientists</u>, Vol 37, No.9, 1981, p9.

period of less favourable climate could have a substantial impact on society, especially in a country such as New Zealand which presently depends on agriculture and on climate-dependent energy (i.e. hydro electricity).

The long-term drop in average midlatitude temperature associated with a major ice age is as little as 4 or 5 deg C(309). It is possible that an even smaller drop could trigger such an event. Its onset would have disastrous consequences for mankind and, if it occurred, could be more destructive than the direct effects of a nuclear war. Further implications of climatic change are discussed in a companion report in the 'Future Contingencies' series(310), and in books on the subject(311-312).

Terrestrial and Marine Ecosystems

Although most animals, and certainly all plants, are less radiation-sensitive than humans, disruption of ecosystems will occur near target areas. Fires may be as destructive as radiation, especially in forested areas. Erosion and sterilisation of soil may lead to desertification in some areas. Ecosystems are likely to become less stable, due to loss of diversity and to predator-prey imbalances. Ultimately, extinction of species localised to certain parts of the United States and Europe could result.

Ironically, a nuclear war might preserve more species than it destroys. At present, the world's tropical rain forests contain a great abundance of species but are being destroyed by the developed world's demand for hardwoods and beef.

Top soil and radioactive debris will be washed into the sea, adding to environmental damage resulting from attacks on oil installations and super tankers. Effluent from damaged reactors, reprocessing plants, waste storage facilities, underwater nuclear explosions, chemical storage tanks and ruptured pipelines will add to marine pollution. Many species of aquatic life, especially sea birds, could be in danger.

Conclusions

The Southern Hemisphere would receive negligible fallout from a Northern Hemisphere nuclear war. The average dose over three decades would be approximately 1 rem. The expected long-term fallout in the Northern Hemisphere is 20 times this amount. For comparison, the natural background radiation is approximately 0.1-0.2 rem/yr, or 3-6 rem over three decades.

Significant ozone depletion resulting in increased ultra violet light is possible, but is less likely to be severe as a result of the trend to smaller yield weapons.

Dust and nitric oxide injection into the stratosphere could cause significant climatic effects. Recent work, which must be regarded as tentative, suggests that the reduction in global tempeatures may reach 5-10 deg C. A more likely decrease in temperature is at most 0.5 deg C.

Synergism between these effects could amplify the global impacts of nuclear war, although they are to some extent mutually exclusive. Maximum production of dust results from surface bursts, but these minimize long-term fallout and photo-chemical effects. (Groundbursts are likely for hardened targets, as the accurate fusing required for low airbursts is difficult to achieve reliably(314)).

Other widespread ecological effects could result from mass fires, loss of forests, mutations, and soil erosion. Uncertainty dominates these possibilities

Table 8.1 Weapon yields and stratospheric partitioning of strontium 90 for the strategic forces expected during the mid 1980s.

Yield Mt	Number of weapons	Proportion of Mt %	Stratospheric Partition MCi LPS	UPS
0.04	3,360	1	0.5	0
0.1	3,200	2	3.2	0
0.2	5,810	8	17.4	0
0.35	1,650	4	15.1	0
0.6	800	3	19.2	0
0.8	3,000	17	111.0	0
1.0	1,890	14	93.6	0
1.5	2,794	30	181.7	28.0
5	40	1	1.9	8.1
9	54	4	0.6	23.7
20	100	14	0	100.0
	------	---	-----	-----
	22,698	100%	444.2	159.8
	======	===	=====	=====

(315) For example, the Minoan civilization after the eruption of Santorini.

(316) K.R. Peterson, op cit.

(317) NAS, op cit, p44.

and it is not known how to calculate quantitatively their likelihood. Major changes in human behaviour could also occur as a result of the unprecedented trauma. There is archaeological evidence of civilisations that disappeared after some shattering experience(315).

8.4 Appendix - Fallout Calculations

An empirical model(316) for estimating worldwide fallout has been applied to the nuclear exchange used in the NAS study. It was then used to examine worldwide fallout from the mix of weapons expected during the mid 1980s.

The weapon mix used in the NAS study consisted of five thousand 1 Mt weapons and one thousand 5 Mt ones(317), giving a total of 10,000 Mt. This mix of yields results in 60% of strontium 90 entering the Lower Polar Stratosphere (LPS) and 40% entering the Upper Polar Stratosphere (UPS). The hemispheric partitioning is 20:1 for the LPS and 4:1 for the UPS. This results in an overall partitioning of approximately 8:1, contrasted with that used by NAS of 3:1. This difference increases the long-term fallout in the Northern Hemisphere by 20%, and reduces the fallout in the Southern Hemisphere by more than 50%, compared with the values calculated by NAS.

The strategic force estimates given in Table 2.2 are now used to estimate worldwide fallout for an all-out nuclear war between the Soviet Union and the United States. If all weapons are detonated, the total megatonnage is 13,836 Mt. A fission yield of 50% is assumed for all weapons (The yield achieved using the minimum amount of fissile material efficiently is 5-10 kt. It is thus likely that even the smallest strategic weapons are thermonuclear devices).

Table 8.1 shows the weapon yields and stratospheric partitioning of strontium 90 taking the number of warheads for each yield into account The difference between the total LPS and UPS burdens and the predicted production of strontium 90 is the tropospheric fallout fraction. This amounts to 88 MCi, which would fall out over the latitudes 30-60 N. The approximate seasonally-averaged cumulative fallout is calculated from the deposition tables given in the fallout model.

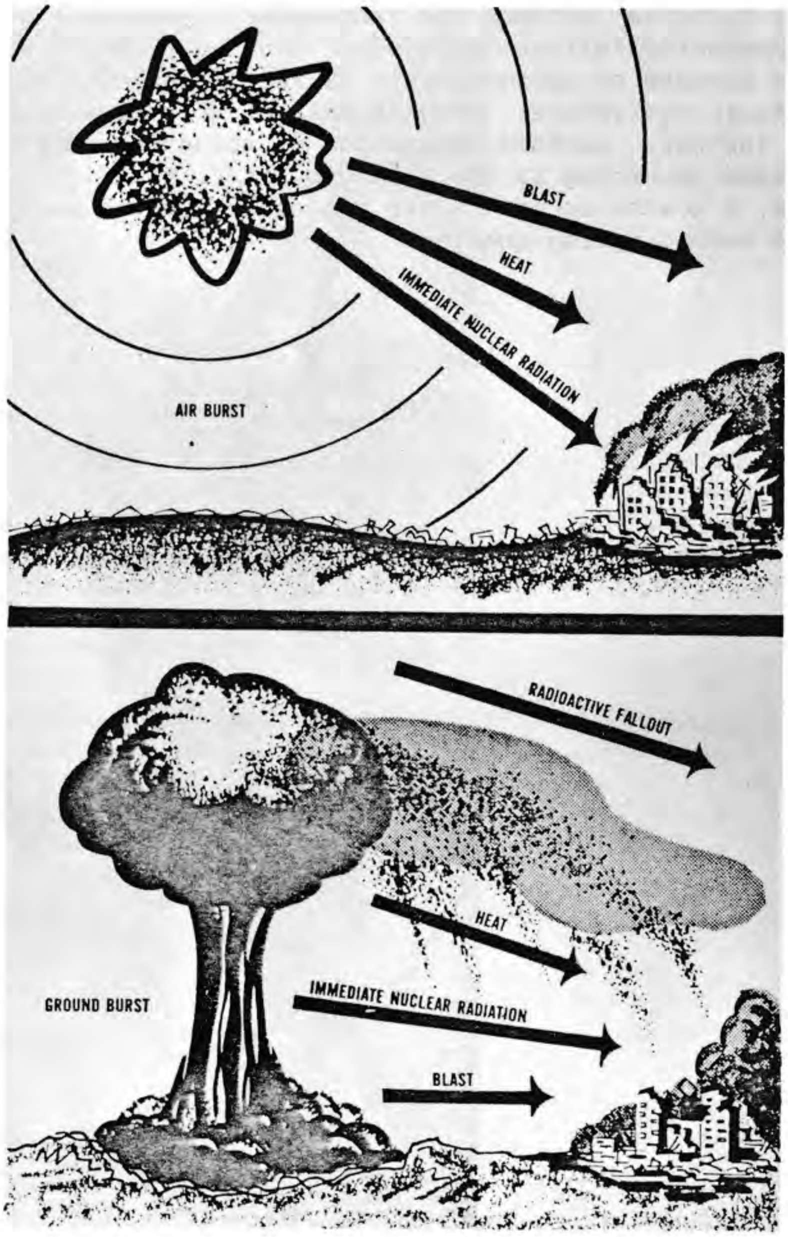
	Stratospheric Inventory MCi			Surface Deposition kCi/MCi		Conversion Factor		Activity mCi/sq.km.
For 30-50S (NZ)	LPS	444	x	14	x	0.0113	=	70
	UPS	160	x	95	x	0.0113	=	170

								240
								===
For 30-50N (USA)	LPS	444	x	500	x	0.0147	=	3,300
	UPS	160	x	450	x	0.0147	=	1,100

								4,400
								=====
	Additional tropospheric			88	x	0.014	=	1,200

Nagasaki survivors (35 km from epicentre)

Therefore the predicted fallout for the middle latitudes of the Southern Hemisphere is 0.24 Ci/sq.km, and for the middle latitudes of the Northern Hemisphere is 4.4 Ci/sq.km without the tropospheric component(viz. 5.6 Ci/sq.km with delayed tropospheric fallout included). Scaling from the NAS figures gives a dose over three decades of approximately 20 rem in the Northern Hemisphere and 1 rem in the Southern Hemisphere. Roughly half of this dose is delivered in the first year after the war. Surface deposition of strontium 90 follows an annual cycle with the peaks occurring in the spring quarter. The first peak will occur in the springtime, 6 months or more after a nuclear war and maximum deposition will occur in the second spring quarter.



(318) The figure above is taken from 'Eleven Steps to Survival', by Emergency Planning Canada (Ministry of Supply and Services Canada, 1980), p5. The information on p101 has been extracted from pamphlets supplied by British, Canadian, Swedish and Swiss Civil Defence departments.

(319) For a brief discussion of effectiveness, and cost, of domestic nuclear shelters see <u>New Scientist</u>, 29 January, 1981, p284.

9. HAZARD REDUCTION IN A DIRECT ATTACK

Even though a direct nuclear attack on New Zealand seems unlikely, information on reducing the hazard of a nuclear explosion may be of value, especially for those visiting the Northern Hemisphere. The immediate dangers of concern are heat, light and initial nuclear radiation from the fireball (Fig. 9.1), blast, and radioactive fall-out(318).

Emergency Protection Measures

If you believe a nuclear attack is imminent:

1. Evacuate yourself and your family if you are in or near a likely target area - viz. major city, industrial area, airport, port facility, defence installation, etc.

2. Plan for water and food supplies and for waste disposal for a period of at least 14 days (assuming normal supplies and services are disrupted). Keep a battery radio with spare batteries, in order to listen to Civil Defence announcements.

If you see a nuclear explosion:

1. Take cover immediately. If you are outside, throw yourself down on the ground, preferably behind a solid object so that you are shaded from the flash. If you are inside, throw yourself on the floor. If you are in a car, stop the car on the roadside and lie down on the seat or on the floor. These actions provide some protection from the light and heat rays, as well as against some of the initial radiation.

2. Stay under cover until the blast has passed. The blast winds move outwards from the epicentre, and later in the opposite direction, for about a minute.

3. Attend to any injuries you or people close to you have suffered.

4. Prepare yourself for protection against fallout.

Protection from fallout requires the avoidance of:

- inhalation of dust.
- consumption of contaminated food or water.
- external radiation from surfaces contaminated by fallout.

The most effective way to decrease exposure to fallout is to evacuate from a fallout area. In New Zealand the predominant wind direction is westerly, and so fallout from a target area is likely to pass over a narrow corridor of land and out to sea.

Shelters

Fallout shelters are unnecessary in areas free of direct fallout, and are of very dubious value in areas directly attacked(319).

Part Three : Aftermath For New Zealand

Table 10.1 — Additional cancer fatalities in the New Zealand population resulting from a 10,000 Mt Northern Hemisphere nuclear war. (A dose of 1.25 rem is used on a constant population of 3.2 million, and no change is assumed in present agricultural methods or diet.)

risk estimate	expected total fatalities	expected annual fatalities. (i)
UNSCEAR (1977)	300-700	10-23
IRCP-26 (1977)	400	13
BEIR-3 (1980)	300-920	10-31

(i) An average value over 30 years. It is important to compare these incidences with the present death rate from cancer in New Zealand of around 5,300/year.

Table 10.2 — Radiation-induced Cancer Risk Estimates (fatal cancers/million people/rem exposure) for an acute dose.

Study	Reference	Risk
UNSCEAR (1977)	(386)	75-175
IRCP-26 (1977)	(386a)	100
BEIR-3 (1980) (i)	(321)	75-230

(i) Some contributors to BEIR-3 have disagreed with its conclusions: Rossi considered that the risks are overestimated by an order of magnitude, whereas Radford considered that the risks are underestimated, and that the true incidence is 412-1,295 (cited in (322)). Speakers at a recent conference have also suggested that the whole BEIR-3 report be revised because of new evidence suggesting that the risk figures could be underestimated, possibly by a factor larger than 2(323).

(320) National Research Council - National Academy of Sciences, 'Long-Term Worldwide Effects of Multiple Nuclear Weapons Detonations' (National Academy of Sciences, 1975).

(321) Advisory Committee on the Biological Effects of Ionising Radiation (BEIR-3) (NAS, NRC, 1981).

(322) J. Rotblat, 'Hazards of Low Level Radiation - Less Agreement, More Confusion', Bull. Atomic Scientists June/July 1981, p31. Uncertainty concerning hazard of plutonium 239 is especially great compared to that from other radionuclides, J.T. Edsall, op cit (ref (425)).

(323) E. Marshall 'Japanese A-Bomb Data will be Revised' News and Comment in Science, Vol 214, p31, 1981.

10. MEDICAL CRISIS

10.1 Health Effects of Fallout Reaching New Zealand

New Zealand would experience fallout from a major nuclear war in the Northern Hemisphere. Further information on its arrival, descent, and geographical distribution is contained in Appendix 10.1 (p. 119).

The dose of radiation received in the first 25 years after a Northern Hemisphere 10,000 Mt war for people living in the temperature zone of the Southern Hemisphere has been estimated in the NAS study at about 1.25 rem, most of which would be received in the first two or three years(320). About a fifth is attributed to carbon 14 (half-life 6,000 years) and this might contribute a further 1.2 rem of dose commitments spread over some 30,000 years in the future. This long-term commitment applies mainly to future generations and is relatively insignificant in comparison with background radiation which would amount to about 3,000 rem in the same period.

The major fallout dose of 1.25 rem (which may be an over-estimate, see Section 8.3) is roughly equivalent to doubling the average natural background dose rate of 0.1 rem per year for 12 years. This will cause an increased incidence of cancer over the following 5 to 40 years which is unlikely to be detectable in comparison with the natural incidence of cancer in New Zealand. In some areas of the world, the background dose rate is 3 or even 10 times higher than average, but this has not caused an observable increase of cancer incidence(321). Nevertheless, some estimate can be made of the numbers of additional cancers which might result from this dose, and this is done in Table 10.1. The risk estimates on which these results are based are given in Table 10.2, and have been assessed by national and international committees.

Further information on radiation-induced cancers is given in Appendix 10.2 (p.119).

In some circumstances, radioiodine could pose a short-term risk if nuclear weapons were detonated over Australia or the Tasman sea. The risk is almost impossible to assess quantitatively, because fallout would depend critically on wind direction and weather at the time, but is unlikely to be serious. The dose and effects of radioiodine in New Zealand as a result of a Northern Hemisphere nuclear war would be less than those attributable to other longer-lived radionuclides, and could amount to one or two additional thyroid nodules or cancers in the New Zealand population over a 40 year period. A crude quantitative assessment of the risk presented by radioiodine is given in Appendix 10.3 (p.121).

Genetic diseases can also be expected in present and future generations as a result of fallout, but the incidence of a seriously-handicapping disease is likely to be small, and similar to the incidence of radiation-induced cancers(321).

Estimates of the incidence of disabling genetic diseases in the New Zealand population resulting from a 10,000 Mt Northern Hemisphere nuclear war are given in Table 10.3. More detailed discussions of these estimates is given in Appendix 10.4 (p.125).

Although the results above strongly indicate that fallout resulting from a 10,000 Mt Northern Hemisphere nuclear war would not present a serious risk to health in New Zealand, some simple precautions, if taken, would reduce the risk further. These precautions are outlined in Appendix 10.5 (p.127).

"Pure white skin and wide brim hats could become the new fashion"(326).

Table 10.3 Radiation-induced genetic defects

	Seriously handicapping genetic defects estimated per 1 rem of parental exposure per million live births		Seriously handicapping genetic defects in the New Zealand population	
	First Generation	Equilibrium(i)	First Generation(ii)	Sum Total(iii)
BEIR (1980)	5-75	60-1,110	10-146	117-2,165
UNSCEAR (1977)	63	185	129	361
IRCP (1977)	50	200	98	390

(i) The equilibrium value is the number of additional effects that will eventually occur in each generation, if the increased parental exposure is experienced in every generation (which, of course, won't happen). However it has the same numerical value as the total number of effects summed over all succeeding generations after an exposure to a single generation of parents (the nuclear war situation).

(ii) The first generation (30 years) is assumed to received a dose of 1.25 rem. The birth rate is assumed to be 52,000 live births per year viz. 1.56 million per generation.

(iii) This is the sum of all defects in all succeeding generations. It would, in fact, be slightly greater, as this estimate does not include the very small dose derived from radionuclides with long half lives. Of these, carbon 14 would contribute the largest dose, viz. 1.2 rem during the next 30,000 years(320). It is important to compare these incidences with the natural incidence of seriously-handicapping genetic diseases viz. 164,000 cases per generation(321).

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(324) See 'Skin Cancer Deaths' in New Zealand Official Yearbook (Government Printer, 1981).

(325) Skin cancer is a disease easily diagnosed and treated in its early stages, with a cure rate of over 90%. Almost half of all people who live to be 65 will have had at least one skin cancer during their lifetime. (American Cancer Society, 'Clincial Oncology' (University of Rochester, 1978)).

(326) Climatologist, 1990.

(327) R.R. Dynes 'Organised Behaviour in Disaster', Monograph Series No.3 (1974), Disaster Research Center, Ohio State University, cited in D.K. Kentsmith, 'Minimising the Psychological Effects of a Wartime Disaster on an Individual', Aviation, Space and Environment Medicine, April 1980, p409.

(328) For the continuance of psychological effects in a post-war environment see A.M. Katz, 'Life after Nuclear War' (Ballinger, 1981); also R.J. Lifton, 'The Prevention of Nuclear War', Bullentin of Atomic Scientists, Oct 1980, p38.

10.2 Health Effects of Increased Ultra Violet Light Intensity

The 1975 NAS study (ref (320)) concluded that up to 70% of the ozone layer in the atmosphere of the Northern Hemisphere would be depleted by a 10,000 Mt Northern Hemisphere nuclear war. The same war would reduce Southern Hemisphere ozone by a smaller amount, perhaps 20-40%. The ozone layer is expected to achieve a 60% recovery from its initial depletion over a period of 2 to 4 years. For a 50% depletion of the ozone layer, the NAS report has estimated that a 3-30% increase in skin cancers would result, due to increased ultra violet (UVB) light intensities at ground level(324). For the New Zealand population, 4-40 additional skin cancer deaths per year might be anticipated for a 50% depletion, using this NAS risk estimate. However, since a 50% depletion of the ozone layer above New Zealand appears an unlikely consequence of a Northern Hemisphere war, considerably fewer deaths could be anticipated.

Other non-fatal effects of increased ultra violet light intensities would include skin changes (such as wrinkling, hyperpigmentation, hypopigmentation, and atrophy) especially in younger age groups. The most common sites for cancers and other skin diseases would include nose, ear, top of the head, lower lip, cheek, and front of the neck(325). Skin damage in a post-war society might be exacerbated by a shift in employment pattern to more outdoor work, and by a shortage of pharmaceutical sunscreens. Compensating trends might include a decline in outdoor leisure activities such as sailing and skiing, and an increased awareness of the value of protective clothing (and sunscreens if these were readily available).

10.3 Psychological Effects

Previous major disasters, including the atomic bombing of Hiroshima, have given insight into the likely effects of a nuclear war on psychological health. Dynes(327), for example, taking a major war as his illustration, identifies the following phases in the psychological impact:

Predisaster phase - international tensions are mounting and conventional weapons are being used in limited confrontations. Individuals may deny any danger exists or may develop anxiety symptoms, or may adapt by leaving perceived target zones.
Warning and threat phase - large scale conventional or limited nuclear war begins. In an unprepared population, panic could be widespread, for instance among the 13% of Aucklanders who believed that their city would be attacked, and among the 28% who previously had considered that nuclear war was unlikely (refer survey results on p36).
Impact phase - a major nuclear exchange occurs, resulting in a communications break with targeted areas, and the arrival of alarming reports from surviving areas. Dynes(327) suggests that, in this situation, most individuals (75%) will be dazed or stunned but two minority groups will respectively either remain effective, or degenerate to a state of absolute panic and acute confusion. The duration of the impact phase could be quite brief if New Zealand were not attacked, and the consequences of a nuclear war were known and had been internalised by a significant proportion of the population beforehand. If New Zealand were attacked, the impact phase could persist almost indefinitely for some individuals(328).
Inventory phase - a time of reassessment for those individuals who had coped with the impact phase, but for those who had not, this phase could be characterised by apathy and aimless wandering(327). A major contributing factor to these symptoms could be concern expressed for relatives and close friends in the Northern Hemisphere (refer survey, p36). Socioeconomic upheavals (e.g. loss of

(329) R.R. Dynes, op cit.

(330) Symptoms include psychosomatic loss of motor or sensory function (e.g. paralysis, loss of taste) and obsessive concern over personal hygiene.

(331) New Zealand Official Yearbook (Department of Statistics, 1980).

(332) The 1929 New York stockmarket collapse preceded an increase in suicide rates.

(333) See for example Marijke Robinson in 'Future Contingencies: 2 Societal Disaster' (Commission For the Future, 1982).

(334) A. Forrest et al, 'Companion to Psychiatric Studies', (Churchill Livingstone, 1978).

(335) Z.J. Lipowski in <u>Amer. J. Psychiatry</u>, March 1977, p134.

(336) L. Rees 'Stress, Distress and Disease', <u>British Journal Psychiatry</u>, Vol 128, 1976, p3; Z.J. Lipowski, op cit.

(337) Z.J. Lipowski, op cit.

urban jobs) could, for some, cause 'situational psychosis', characterised by irritability and disturbed sleep. Even if the individual was able to cope with the turn of events, but was nevertheless subjected to prolonged stress, neurosis would be likely. Dynes(329) believes that at least a third of all individuals involved in a nuclear holocaust will show symptoms of severe anxiety, and "will appear dazed and withdrawn and (will) wander about aimlessly".
Rescue, remedy and recovery phase - initial psychological reaction could be expected to continue for many months. Some could feel fortunate, or feel a sense of achievement derived from a mastery of the crisis. Less successful reactions could include anxiety states, phobias, anger and aggression, and prolonged mourning. Long-lasting effects of specific neurotic illnesses might include hysterical conversion symptoms, obsessive-compulsive neuroses and anxiety reactions(330).

After a nuclear war, a long list of problems would begin to have severe psychological effects:

Drug withdrawal - New Zealand's 53,000 chronic alcoholics and 50-200,000 excessive drinkers(331) would begin to suffer withdrawal if alcohol supplies were disrupted. Irritability and other reactions might accompany withdrawal from nicotine (in imported tobacco), caffeine (imported tea, coffee and chocolate) and pharmaceutical drugs such as tranquillisers (valium).
Other medical concerns - shortages of imported drugs could create fear, or even a threat to life, in individuals suffering from, for example, depression, diabetes, asthma, and certain heart diseases. Public anxiety over fallout could be intense. Even today, cancer is a dreaded disease, and it is likely that these fears, whether realistic or not, would be greatly intensified.
Economic collapse - those with substantial investments in banks, shares, and insurance schemes would be hardest hit if a calamitous loss of confidence occured in the commercial sector of the economy(332).
Unemployment - the association between unemployment and health (physical and psychological) is well-documented(333). However, the unprecedented level of unemployment resulting from the economic dislocation of a nuclear war (considered in the next section, p133) may alter social attitudes to work (and the unemployed) in both the formal and informal economies.

A striking decline in suicide rates occurred in both World Wars in countries as diverse as the United Kingdom and Switzerland (a non-combatant)(334), suggesting that when a state of national cohesion develops during a crisis, individuals may acquire a sense of purpose within their own society.

These widespread stresses could cause an increase in psychosomatic diseases. Psychological stress may be, indirectly, as injurious as extremes of temperature, pathogenic micro organisms, and physical trauma(335). Diseases that are exacerbated by, and partially induced by psychological stress include asthma, diabetes mellitus, essential hypertension, ischaemic heart disaease, rheumatoid arthritis, thyrotoxicosis, ulcerative colitis, Chrohn's disease, urticaria, and eczema(336). But stress is not necessarily pathogenic, and may indeed be beneficial. "Its effect on health depends on a person's coping capacity, social support, and other factors. The key intervening variables in psychosocial stress are information, its cognitive appraisal, subjective meaning and emotions"(337).

The longer term consequence of a nuclear war on psychological health are more difficult to assess. Enforced lifestyle changes would be stressful, and undoubtedly, fears over cancer, genetic damage, and epidemics would be

"Nuclear advances have shown me how stupid some adults can be. If they knew it could easily kill them, I have no idea why they support it. Once in a while it makes me start to think that the end of my time in life may not be so far off as I would like it."

US adolescent on the arms race, 1981(338)

"If a sense of local identity emerges, and reliance on the community for the satisfaction of needs such as health, education, and social interaction is felt, the individual will see more clearly his own stake in that community, and crime will decrease"(343).

"Infectious diseases are never static. The conditions under which they increase, or decrease, change. The diseases, and their methods of prevention, require continuing study. We must not take success for granted"(348).

(338) J.E. Mack, 'The Psychological Effects of the Nuclear Arms Race', Bull. Atomic Scientists, April, 1981.
(339) J.W. Prescott, 'Body Pleasure and the Origins of Violence', Bull. Atomic Scientists, Nov, 1975.
(340) See for example W. Innes, 'How to Survive in Suburbia', (Pupuke Press, 1981).
(341) The term 'nuclear' itself might cease to be used in this context.
(342) E.M. Schumacher, 'Small is Beautiful' (Cox Wyman, 1973). See also T.H. Holmes and R.H. Rahe, 'The Social Readjustment Rating Scale' Journal of Psychosomatic Research, Vol 11, 1967; also ref (358).
(343) M. Smith, 'Crime and Punishment', in 'New Zealand 2001', ed. G. Bryant (Cassell, 1981).
(344) The services offered by several hospitals to assist relatives of victims of the Mt Erebus air disaster are useful examples. About one-third of the adult population could be affected (see Table 3.2 (p. 36)).
(345) Up to 40% of children in some parts of New Zealand have not received immunisation against measles (S.R. West et al, 'Health Survey, Health Needs and Primary care', NZ Med. J., vol 91, No.657, 1980). The few cases of diphtheria that still occur do so mainly among non-immunised people in areas where the level of immunisation is low, and serve as a reminder that, unless immunisation levels are maintained, diphtheria could once again become common in New Zealand
(346) In 1978 in Holland, where 90-95% of the population is immunised against poliomyelitis, there was an outbreak of 110 cases (Health, Journal of Commonwealth, Dept of Health, Vol 29, No.1, 1979). Immunisations against influenza generally fail to induce the desired immunity due to frequent changes in the virus. See M.S. Pereira, 'Flu: The Mutant Virus', World Health July, 1978.
(347) These are diptheria, tetanus, whooping cough, measles, polio, and tuberculosis (see 'Six Killers', World Health, Feb. 1977, p4).
(348) Health, Vol 29, 1977.
(349) E. Lund 'Human Pathogens as Potential Health Hazards in the Reuse of Water' Ambio vol 7, p56, 1978. See also H.L. Abrams W.E. Von Kaenel 'Medical Problems of Survivors of Nuclear War' New England J. Medicine Vol 302, p1226, 1981.

prevalent. Other fears might include the threats posed by further conflict or invasion (by combatants or refugees). Many thousands of nuclear weapons would be likely to be unaccounted for, creating a situation where children and adolescents would grow up in a threatened environment. Surveys have shown that adolescents (in the United States) are "deeply disturbed by the threat of nuclear war, have doubt about the future and about their own survival ... have doubts about planning families, or are unable to think ahead in any long-term sense"(338). These reactions could continue indefinitely for some individuals.

New Zealand society might have less access to alcohol, tobacco, barbiturates and tranquilisers. Violence on the television screen and in the cinema might be curtailed. Essentially spectator sports (such as boxing and rugby) could decline (along with personal mobility), resulting in a reduction in aggression and other social pathologies(339). The strengthening of local community, in response to a decline in personal mobility, would be psychologically benefical(340). Reduced availability of state institutional care might reverse the present trend towards the nuclear family(341). A greater degree of shared responsibility for child rearing and for the household would change the status of women. A significant shift to small-scale worker-owned cottage industries could offer job satisfaction and reduced stress for those who accept the Schumacher philosophy(342).

Reducing the Psychological Effects of Nuclear War

Public misinformation is a major problem today. Many people believe that nuclear war will kill everyone on earth. Public awareness of the real threat posed by this 'neglected expectation' (p33) is essential if the impacts are to be minimized. Medical practitioners, or lay counsellors, with appropriate training could assist the large number of people mourning relatives in the Northern Hemisphere (344). The churches could also have a significant role in this process. The loss of cultural treasures, particularly in Europe, could be mitigated (albeit slightly) if copies or replicas of music, art, literature, and scientific knowledge were held in New Zealand.

10.4 Health in a Post-War Era

Communicable Diseases

Since imported vaccines and antibiotics would not be available, new patterns of communciable disease might emerge in a postwar New Zealand. Vaccination programmes could be upset by migration and other social disruptions. Even today, a large minority of New Zealanders lack adequate protection against common communicable diseases(345). Yet even when the level of immunisation is high, the risk is not insignificant for some of these diseases(346). It is still the case that the six most dangerous childhood infections identified by the World Health Organisation could again become prevalent in New Zealand, without requiring re-introduction from overseas(347).

Demographic shifts in New Zealand (e.g. urban to rural, south to north) could create local overcrowding, with consequent overloading of water and sewage disposal systems. With overcrowding, there would be an increased risk of diseases such as rubella, streptococci infections and rheumatic fever, influenza, whooping cough, measles, diphtheria and tuberculosis. Contaminated water would increase the risk of typhoid fever, salmonella infection, leptospirosis and hepatitis(349). Urban migrants would be at risk from tetanus, brucellosis and hydatids, diseases presently restricted to rural areas of New Zealand. Communicable diseases could be introduced into New Zealand by refugees. Malaria, cholera, tuberculosis and leprosy could be introduced from

"The 1918 influenza epidemic overran New Zealand in a matter of weeks after a ship carrying sick people arrived. The deaths were in excess of 6,700, and 46% of these were in either Auckland or Wellington"(353).

Post War Tobacco and Alcohol Consumption

During the crisis phases, tobacco and alcohol consumption are likely to increase sharply, but what happens during the later recovery phases would depend largely on psychological reactions and the production of these products.

About half of the tobacco consumed in New Zealand is imported leaf from the United States, likely to become unavailable in the event of a nuclear war. This is a result of a trading agreement (GATT), and, in time, New Zealand could become self-sufficient. According to the United States Surgeon General, most smokers (up to 90%) wish to break their addiction(356). They may choose to exploit a temporary shortage by deciding to give up smoking, or they may switch to alternatives, especially since remaining tobacco would be more expensive. (Marijuana cultivation is likely to increase sharply, especially since law enforcement officers may be facing more pressing problems during the impact phases).

Most of the alcohol consumed in New Zealand is locally produced. Commercial producers may find market vegetables more profitable, especially during a period of economic uncertainty. Two factors could compensate for any decline in production: a resurgence in home brewing, and the production of ethanol as an alternative transport fuel in the longer term. Consumption may shift away from the public bar to the home (as public mobility declines), but whether more or less would be consumed can only be guessed at. Government measures could also discourage the recovery of the cigarette and tobacco production and distribution industries if this was thought to be in the nation's interests. Similarly, fuel ethanol could be officially denatured to avoid consumption, bootlegging and accidental poisonings.

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(350) Although these diseases are generally considered tropical, malaria could possibly exist in northern New Zealand (see 'Malaria fear by health officer', NZ Herald, 5 Dec 1981). Cholera has appeared regularly in European countries, and leprosy was once fairly common in Norway (see 'Leprosy' Encyclopaedia Brittanica). J. Brisou 'The Health Situation Around The Mediterranean', Ambio, Vol 6, No.6, p342. Tuberculosis was once quite common in New Zealand, and reached epidemic proportions in Australia as recently in 1947 (Health, Journal of Commonwealth Department of Health, Vol 28, No.1, 1978).

(351) Migratory birds (as well as pigs) can act as reservoirs and carriers for influenza, A. Zahr 'WHO's Communicable Disease Programme' World Health Nov 1980. Migratory birds could conceivably bring bacteriological agents to New Zealand - see R.L. Prosterman 'Surviving to 3000', p318 (Duxbury, 1972). "Wellfounded reasoning suggests that the world is now awaiting the return of an influenza pandemic that would be as widespread as that of 1918. The world wide monitoring of both human and animal diseases ought to be strictly co-ordinated. It remains to be seen from which animal species will come the influenza virus of the sixth great pandemic of the 20th century, and what its scale will be," A. Zahra, op cit.

Australia or from the Pacific Islands, especially if Asian migrants transmitted these diseases through Australia(350). Also, new strains of influenza could be transmitted by migrating birds from the Northern Hemisphere nations(351). These places may be having epidemics associated with socioeconomic collapse, and perhaps the effects of bacteriological weapons(352).

The following steps could reduce the threat of communicable diseases after a nuclear war:

- establishment of stock-piles, or local production, of presently imported vaccines and antibiotics.
- achievement of a higher degree of immunization against the common communicable diseases (and, in the case of brucellosis and diphtheria, perhaps eradication).
- improvement of sewage disposal systems in some areas(354).
- improvement in public education on matters of personal hygiene and preventative medicine, contamination of water supplies, and characteristics of common communicable diseases.
- establishment of quarantine facilities for refugees (capable of rapid expansion if required).
- establishment of laboratory facilities that in times of need could investigate new strains of influenza and other diseases including those associated with biological weapons(355). These facilities could also be used to investigate the storage of vaccines for diseases that could potentially exist in this country.

Heart Disease

Non-congenital heart disease accounts for about one third of all deaths in New Zealand (357). If tobacco consumption was cut by two-thirds, deaths from coronary heart disease would drop by 20%, a saving of some 1,700 lives each year. The impact of nuclear war on tobacco and alcohol consumption is considered on the facing page. Also a reduction in obesity, resulting from a reduced calorie input and from more exercise (cycling, walking, physical labour, home gardening) would undoubtedly have beneficial effects on the heart and other organs. Although psychological stress could increase the risks of heart attacks in vulnerable individuals during the early crisis phase, in the longer term it is plausible that a slower-paced lifestyle could contribute to a decline in the incidence of heart diseases(358).

Cancer

Fallout would probably cause a small, but undetectable, increase in the incidence of cancer in New Zealand. It is possible, however, that the result of a war confined to the Northern Hemisphere would be that cancer rates in New Zealand would actually decrease, if consumption of tobacco, alcohol, and processed food declined(359). A reduced exposure to industrial chemicals in a post war society might also contribute to a decline in cancer rates(360).

Accidents

A rapid decline in the use of the private motor car (as vehicle and fuel imports were cut) would substantially reduce the road toll(361). Public transport is, in general, much safer - especially for young, adult males. Fewer accidents related to motorcycling, power boating, skiing, motor mowers, and rugby might also be expected. A decline in industrial production would be directly associated with fewer industrial accidents. This reduction could be arrested by the use of more primitive safety equipment (the situation in many Third World countries today(362)).

(352) Epidemics would be likely in any country attacked with nuclear weapons. Medical personnel and medicines would be scarce. Water and sewage systems would be damaged and insects would breed in the corpses of the dead. Perhaps a quarter of the immediate survivors of a nuclear attack would succumb later to communicable diseases, especially tuberculosis and plague: see H.L. Abrams, op cit (ref (349). Bubonic plague has already killed over 12 million poeple this century and is endemic in all continents, (World Health Chronicle, Nov 1979; also H.L. Abrams, op cit (ref (349)). Also, hot spots of radioactivity around bombed areas in the Northern Hemisphere (especialy devastated reactors) might induce a higher rate of mutation in some pathogens, increasing their virulence (NAS 1975 report, ref (320)). A fairly simple mutation of the influenza virus soon after the First World War ended enabled it to spread and kill even more peole than the war did: see 'Genetic Engineering', New Zealand Environment, Aug 1977. Some examples of biological agents that could be used in war include influenza, yellow fever, smallpox, anthrax, cholera, plague and typhoid fever: see R.L. Prosterman, op cit (ref (351)) p314. Blast damage from nuclear weapons could also release stores of smallpox in the United States back into the environment (H.L. Abrams op cit (ref (349) p 1228) and this could also apply to biological weapons laboratories in the United States and Soviet Union).

(353) R.E. Owen, 'An Enclycopedia of New Zealand' (Government Printer, 1966).

(354) In New Zealand, 21% of community sewage is disposed on land via septic tanks, and 13% is discharged into the ocean as raw sewage; both practices can constitute a hazard to health (see New Zealand Engineering, June 1, 1980, p2). Good examples of the hazard of human sewage to health are provided by J. Brisou, 'The Health Situation Around the Mediterranean', Ambio, Vol 6, No.6, p342.

(355) R.L. Prosterman, op cit (ref (351)), p314.

(356) The Surgeon General's Report on Health Promotion and Disease, 'Healthy People', US Dept of Health, Education and Welfare.

(357) New Zealand Official Yearbook (Government Printer, 1980).

(358) A decline in such occupations as administrator, machine operator, and office worker and an increase in farm labouring and craftsmanship would significantly decrease stress related diseases such as heart disease: 'Occupational Stress', U.S. Dept. of Health, Education and Welfare; National Institute for Occupational Safety and Health, 1978.

(359) Smoking is thought to cause 90% of lung cancer deaths - about 1,600 per year in New Zealand. Alcohol, too, has a proven relationship with cancer, and it is estimated to cause 4-5% of total cancer deaths (see J.F. Fraumeni, 'Persons at High Risk of Cancer' (Academic Press, 1975)). The cancer risk associated with processed food is also discussed in D.P. Burkitt, op cit, (ref (419)).

(360) Some (e.g. S. Epstein, Technology Review, December 1980) consider two-fifths of cancer deaths in the United States in the next 30 years will be associated with environmental asbestos, arsenic, benzene, chromium, nickel oxides and petroleum fractions. Others (see Journal of National Cancer Institute, December 1979) point out that, in spite of longstanding industrialization and a rapidly expanding petrochemical industry, overall cancer rates are declining for both sexes if tumours related to tobacco and alochol are excluded.

(361) Over 600 deaths and 14,000 injuries per year, resulting in an economic loss estimated at $500 million. See 'Motor Accidents in New Zealand', Statistical Statement Calendar Year 1979, Ministry of Transport.

(362) N.L. Ramanathan K. Shrikant 'Occupational Environment and Health in India' Ambio Vol 4, No.1, p60.

(363) J.A. Ewing, B.A. Rouse, 'Drinking, Alcohol in American Society-Issues and Current Research,', (Nelson hall, 1978).

(364) A New Zealand hospital survey showed that alcohol was the direct cause of 25% of hospital admissions; the inclusion of indirect causes increases this figure to 44%, (Health, Vol 32, 1980).

(365) D.P. Burkitt, op cit, (ref (419)).

Other effects on health

It is possible, perhaps likely, that tobacco and alcohol consumption would decline once the impact phase of a nuclear war had passed. A decline in tobacco consumption could reduced incidences of cancer and heart disease, and also bronchitis, emphysema, gastro-duodenal ulcers and perinatal mortality(356).

A large change in alcohol consumption(363) could, assuming no other factors, lead to:

- a large change in alcoholism, liver cirrhosis, violent assaults, rapes, transport accidents, mental illness, suicides, death by drowning, burns and falls, hospital admissions(364).

- a moderate change in obesity, psychosocial problems (e.g. child abuse), sexual dysfunctions, pancreatitis, and gastritis.

- a small change in cancer, vitamin deficiency diseases, and cardiomyopathy.

A long term decline in calorific intake would reduce obesity and heart disease, and also diabetes, hypertension, hernias, and various accidents. A shortage of imported sugar could improve dental health, while an increase in dietary fibre (reflecting better balance of cereals and vegetables and meat in the longer term) could reduce the incidence of diabetes and hypertension, and also hernias, varicose veins, diverticulosis, and colonic cancer(365).

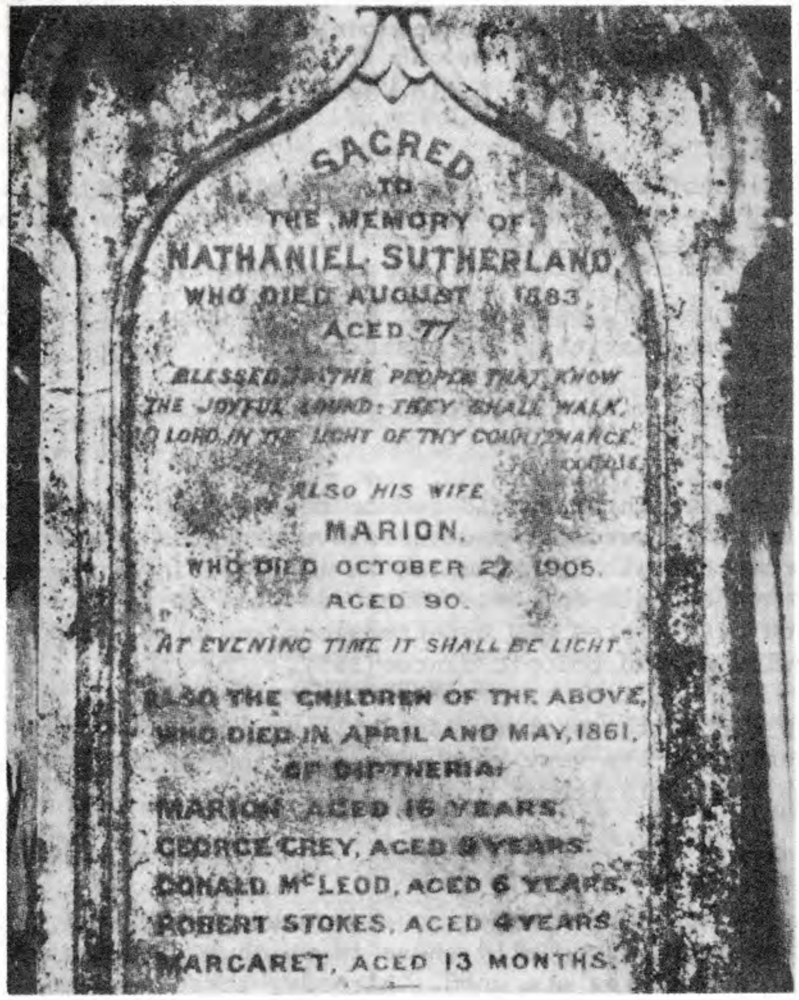
A short term reduction in global temperature (see p93) would produce some casualties among the elderly and the very young, in addition to the natural attrition associated with the vicissitudes of weather (366).

Effects on the Health System

A devastating nuclear war in the Northern Hemisphere could precipitate a decline in New Zealand hospital services, especially those in which sophisticated diagnostic and therapeutic procedures are used. Already, these services are proving excessively expensive (and cutbacks are being imposed), but in addition most medical equipment and pharmaceutical products are imported from the targeted countries of the Northern Hemisphere.

Much of present effort and expense is devoted to prolonging the elderly patient's last few years of life(367). In a post-war society, more resources may have to go to low-technology preventive medicine, if only because high-technology medicine is unavailable from traditional suppliers. Measures to enable an adequate delivery of health care to all sectors of the population could include:

- stockpiling (or achievement of self-sufficiency in) essential pharmaceuticals and medical supplies, including common drugs and contraceptives.
- public education programmes in preventive medicine, and encouragement for individuals to accept greater responsibility for their own health.
- allocation of resources to the training of public health nurses and paramedics (rather than doctors), who could assume a greater responsibility for primary health care(368).
- electronic or other alternative storage of present medical knowledge.



Diptheria victims

(366) See 'Freeze kills 600 a day' (in the Northern Hemisphere) in The New Zealand Times 3 Jan, 1982.

(367) Hospitals function mainly as refuges for the elderly and asylums for the mentally distressed. With 71% of patients either over 64 or in psychiatric care, the predominant function of the hospital is custodial. See P. Davis, 'Health and Health Care', in P. Spoonley et al, 'New Zealand Sociological Perspectives' (Dunmore, 1982).

(368) These last two measures are argued for forcibly by Ivan Illich in 'Limits to Medicine' (Penguin Books, 1977).

10.5 Summary

The impacts on health in New Zealand of a Northern Hemisphere nuclear war (including an attack on Australia) are likely to be predominantly psychological and socioeconomic.

For large numbers of individuals, the psychological effects could be very severe and for some even result in suicide. In general, these adverse effects would resolve in the long term, with even an improvement in the psychological health of some groups being possible. Communicable diseases could, however, pose a serious long-lasting health problem in post-war society, depending on the extent of socioeconomic collapse, refugee influxes and the spread of global pandemics. The extent of this problem could range fron an insignificant increase, up to severe epidemics. Uncertainties also exist over the effects of fall-out. From present knowledge, a slight increase in the cancer rate might occur, though a decrease is not unlikely. In the longer term, genetic disease could show an increase, but current (limited) knowledge suggests that this would be small in relation to the present effects of gene mutations on health.

Socioeconomic and lifestyle changes could decrease the morbidity and mortality from accidents and heart disease among younger age groups. Drug use and its effect on health could also change, with a decline in tobacco consumption, and changes in alcohol consumption being possibilities.

The adverse effects of a nuclear war, in which New Zealand was not attacked, could be mitigated by individual and government action. The dissemination of factual and useful information could reduce many of the psychological problems, and the spread of communicable diseases. A prevention-orientated approach would require a marked change in public attitude. If this change occurred after a nuclear war, it would be much less effective. A prevention-oriented approach would have benefits whether or not a nuclear war occurred.

Table A10.1 Relative contamination of milk by caesium 137 and strontium 90 at New Zealand locations. (Values are normalized to unit activity at Christchurch associated with strontium 90).

Location	caesium 137	strontium 90
Canterbury, Dunedin, Christchurch	1.5	1.0
Westland	17.0	8.8
Palmerston North, Wellington	5.0	2.5
Taranaki	49.5	4.9
Northland, Auckland	4.5(i)	1.2
Waikato	23.0	1.2
Average	16.8	3.2

(i) For the greater Northland area, this figure could be nearer 15-30, because the Northland testing site was considered atypical(373).

(369) R. Melick and L. Van Middlesword, 'Radioiodine in Animal Thyroid Glands From 1966 to 1972', Med. J. Aust, Vol 1, 1974, p298.
(370) National Academy of Sciences, op cit. (ref (320)).
(371) R.J. Garner, 'Transfer of Radioactive Materials From The Terrestrial Environment to Animals and Man', CRC Critical Review in Environmental Control, Sept 1971.
(372) T. Baltakmens, L.P. Gregory, 'Profiles of strontium 90 and caesium 137 concentrations in selected New Zealand soils and their bearing on milk contamination levels', N.Z.J. Science, Vol 20, 1977, p425.
(373) Ibid.
(374) J.W. Bawn, 'Population Heterogeneity Hypothesis in Radiation-Induced Cancer', Health Physics Vol 25, 1973, p97.
(375) Advisory Committee on the Biological Effects of Ionising Radiations (BEIR-1) 'Effects on Populations of Exposure to Low Levels of Ionising Radiations' (National Academy of Sciences - National Research Council, 1977).
(376) BEIR-2, 'Consideration of Health Benefit - Cost Analysis for Activities Involving Radiation Exposure and Alternatives', (NAS - NRC, 1977).
(377) A.P. Jacobson, F.A. Plato, N.A. Frigeric, 'The Role of Natural Radiations in Human Leukemogenesis', Amer. J. Public Health Vol 66, 1976, p31.
(378) K.Z. Morgan, 'Radiation-Induced Health Effects' Science Vol 195, 1977, p344.
(379) K.Z. Morgan, 'Cancer and Low Level Ionising Radiation', Bull. Atomic Scientists Vol 34, 1978, p30.
(380) National Academy of Sciences, 'Risks Associated with Nuclear Power, a Critical Review of the Literature', (NAS 1979).
(381) W.J. Clark et al, 'Strontium 90: Effects of Chronic Ingestion on Farrowing Performance of Miniature Swine', Science Vol 169, 1970, p598.
(382) T.D. Lucky et al, 'Ionising Radiation is Required for Optimum Reproduction in Paramecium Bursaria', Abstracts of American Meeting of Am. Soc. Microbiol, Las Vegas 1978, Abstract I-83, p94.
(383) R.J. Hickey et al, 'Low Level Ionising Radiation and Human Mortality, Multiregional Epidemiological Studies', Health Physics Vol 40, 1981, p625.
(384) J. Rotblat, op cit (ref (322)).
(385) The 'latent period' is the interval between the exposure to radiation and and the appearance of a radiation-induced disease. See J. Rotblat, 'The Risks for Radiation Workers', Bull. Atomic Scientists, Sept 1978, p41.
(386) Report of the United Nations Scientific Committee on the Effects of Atomic Radiation, 'Sources and Effects of Ionising Radiation', (UNSCEAR, 1977).
(386a) Recommendations of the International Commission on Radiological Protection, IRCP-26, Annals of the IRCP, Vol 1, 1977.

Appendix 10.1: Arrival, Descent, and Geographical Distribution of Fallout

In New Zealand, there would be no trace of fallout in the first week following a major nuclear exchange in the Northern Hemisphere. During the second week, fallout, predominantly iodine 131, would begin to be detected. (Thyroid glands of New Zealand sheep have contained radioiodine two weeks after atmospheric tests conducted in China(369)). The maximum rate of deposition of longer-lived radionuclides such as strontium 90, caesium 137, and plutonium 239 would occur about two years after a war with most of these arriving within five years(370). This pattern assumes the most plausible circumstance of a nuclear war lasting for a few days only.

Radionuclides can descend into the biosphere either as dry particulates or in rain. For a climate like New Zealand's, most fallout (80%) would descend as rain, and the rest (20%) as particulates(371).

Soviet, American, and French atmospheric nuclear detonations in both hemispheres have been related to fallout patterns observed over New Zealand(372). Strontium 90 distribution in New Zealand milk was found to depend largely on mean local rainfall, although for caesium 137 the correlation was less marked. Neither radionuclide showed any variation with latitude. Differences in fixing capabilities of local soils were also significant. For example, in Westland and Taranaki, strontium 90 was more readily available for root uptake. Even more pronounced was the high uptake of caesium 137 by plants growing in the yellow-brown loam soils of Taranki and Waikato(373). These soils fix caesium 137 very poorly, because they are lacking in illite clay (which has a strong affinity for this radionuclide). Caesium 137 uptake was also increased, but to a lesser extent, in plants growing in the volcanic soils of Auckland and Northland. Results are summarised in Table A10.1. The variability of fallout uptake into milk is strikingly demonstrated where there are large local variations of soil compositon or rainfall within a district (e.g. Taranaki).

Appendix 10.2: Radiation-Induced Cancer

The hazard presented by the low level radiation arising from radionuclides is a matter of some disagreement among the scientific community. Three views have support:

A. continuous increase - no threshold hypothesis: the biological effects of ionising radiation are hazardous at all levels, with risk increasing with dose (374-380).

B. threshold hypothesis: risks increase with increasing dose above a 'threshold' dose which has no observable effect(383).

C. beneficial effects hypothesis: low levels of ionising radiation, such as environmental background radiation, are beneficial to human populations, and result in extended life span, reduced risk of chronic disease, and reproductive advantages (381-383).

The concensus of scientific opinion supports hypothesis A as the more likely process, though the risk at small doses may be less than in proportion to the dose(384). Hypothesis A has been used in deriving the risk estimates in the BEIR-3 report which are used in Table 10.2.

The radiation-induced cancers listed in Table 10.1 would be expected to begin appearing 5-7 years after a nuclear war, with leukemia being the first. The average latent period for leukemia is about 10 years and up to 25 years for other cancers(385). Leukemia would comprise about one-fifth of all cancer cases, with other cancers being of the thyroid, breast, bone and lung(386).

(387) R. Melick and L. Van Middlesworth, op cit (ref (369)). 'Half-life' is the time in which half of an initial quantity of radionuclide decays by emitting 'ionising' radiation.

(388) R. Melick and L. Van Middlesworth, op cit (ref (369)). New Zealand levels were adjusted due to the larger size of New Zealand sheep thyroids. L. Van Middlesworth, 'Radioiodine in the Biosphere during 1968', Nature, Vol. 221, 1969.

(389) Ibid. However, at this time, New Zealand iodine 131 levels could have been artifically high due to recent French test in the Pacific.

(390) Proceedings of a Symposium, 'Radiological Protection of the Public in a Nuclear Mass Disaster', Interlaken, Switzerland, 26 May - 1 June, 1968.

(391) S. Glasstone, P.J. Dolan, 'The Effects of Nuclear Weapons', (Department of Defense), 1977.

(392) L. Van Middlesworth, op cit (ref 388)).

(393) Proceedings of a Symposium, op cit (ref (390)).

(394) C.H. Kearny, 'Trans-Pacific Fall-out and Protective Countermeasures', (Oak Ridge National Lab., Nov. 1973, p22.

(395) Times Atlas of the World, (Times Newspapers, 1973).

(396) Calculated from data in R. Melick and L. Van Middlesworth, op cit (ref (369)).

(397) The time difference in the arrival of fall out (e.g. 2 days versus 4 days would only mean a difference in total iodine 131 of less than 15%.

Appendix 10.3: Crude Quantitative Assessment of Radioiodine Risk

Radioiodine from the Northern Hemisphere

Chinese nuclear tests show that the nuclear fallout clouds move eastwards with an undulating motion in bands of gradually increasing width. Very little material crosses between the hemispheres during the first cycle of the earth. A 6 week delay in mixing of the hemisphere atmospheres plus the short half-life (8 days) of iodine 131, results in much less contamination with iodine 131 of one hemisphere after an explosion in the other(387). For example, after French nuclear tests in the Pacific, New Zealand levels of iodine 131 were 133 and 34 times greater than those in Tennessee and England respectively(388). When iodine 131 levels in sheep thyroids peaked after Chinese nuclear tests, the New Zealand levels were 50 and 100 times less than those in Tennessee and England respectively(389). Therefore for the following analysis it is assumed that an 80:1 ratio applies for transfer of Northern Hemisphere contamination to New Zealand.

Using this factor, the dose of iodine 131 delivered to New Zealand after a Northern Hemisphere war can be scaled from previous nuclear weapon testing. This has been found to result in infant thyroid doses from iodine 131 of around 2 rem per 1000 Mt of fission detonated at a similar latitude(390) A 10,000 Mt war in the Northern Hemisphere (involving 5000 Mt of fission) would therefore deliver a thyroid dose to the New Zealand infant of around 0.13 rem.

Radioiodine from the Southern Hemisphere

A possible attack scenario for Australia (p.72) involves 7 Mt in airbursts and 6 Mt in groundbursts. Iodine 131 produced by airbursts would be largely ejected into the stratosphere(391). Only after several passes around the world would it begin to enter the troposphere and from there reach the ground(392). Around 40% of iodine 131 from groundbursts would also be ejected into the stratosphere(14c). In total, this would result in a dose of around 0.009 rem delivered internally to human thyroids in New Zealand (scaling from 2 rem per 1000 Mt of fission detonated at an equivalent latitude)(393). Weapons are presumed to have a fission to fusion ratio of 1:1.

An estimate of tropospheric transfer of iodine 131 can be obtained from studies of trans-Pacific fallout from Chinese nuclear tests in the troposphere. From these, it has been estimated that the detonation of 65 Mt in China would result in an average thryoid dose per person in the United States of 10 rem, (presuming no dietary changes)(394). It is difficult to apply these data to trans-Tasman fallout as the surface wind direction in central and Western Australia is seldom westerly, and never uniformly westerly(395). (Central and Western Australia contain most of the military installations upon which groundbursts are likely). Also, the fallout cloud from the Chinese tests reached the United States in 4 days but would take a shorter time to reach New Zealand from central Australia.

On the assumption that half of the 6 Mt of groundbursts on Australia are subject to westerly winds, scaling the United States data indicates a thyroid dose from iodine 131 of 0.5 rem for New Zealanders, multiplied by a scaling factor for different time and distance. Limited data suggest that, (with wide fluctuations), levels of iodine 131 halve every 2,000 km across the Tasman sea(396) and so the United States thyroid dose from Chinese weapon testing (received after a distance of 6,000 km) is reduced by an additional three factors of two(397). The New Zealand dose using these assumptions is then 4 rem (0.5 x 8).

Table A10.2 Effects of Radioiodine

Table 10.2A	child	adult
nodules	12.3	8.2
cancer	4.2	4.2

Cases per million per rem per year from a dose of external radiation on the thyroid.

Table 10.2B	child	adult
nodules	0.62	0.41
cancer	0.21	0.21

Cases per million person per rem per year from a dose of radiation from iodine 131 on the thyroid.

Table 10.2C	child	adult
nodules	0.09	0.11
cancer	0.03	0.05

Number of cases per year in the New Zealand population for a 0.13 rem exposure to the thyroid from iodine 131. The population less than and older than 15 years has been used.

Table 10.2D	child	adult
nodules (in 15 yrs)	1.4	1.7
cancer (in 50 yrs)	1.5	2.5

Total number of cases in New Zealand resulting from the iodine 131 produced by a 10,000 Mt Northern Hemisphere nuclear war.

Table 10.2E	child	adult
nodules (in 15 yrs)	43	52
cancer (in 50 yrs)	46	77

Total number of cases in New Zealand from the iodine 131 produced by a 13 Mt nuclear attack on Australia.

(398) F.W. Lengemann and J.F. Thompson, 'Prophylactic and Therapeutic Measures for Radioactive Contamination - a Review', in Health Physics, Vol 9, p1391 (Pergamon Press, 1980).

(399) Proceedings of a Symposium, op cit (ref (390)).

(400) H.R. Maxon et al, 'Ionising Irradiation and the Induction of Clinically Significant Disease in the Human Thyroid Gland', Amer. J. Med. Vol 63, 1977, p96.

Health Effects of Radioiodine

The first radionuclide to reach New Zealanders in significant amounts after distant nuclear detonations is likely to be iodine 131 in contaminated milk(398). However, if direct exposure to local fallout occurs, this radionuclide could also be inhaled.

Both iodine 129 and iodine 131 concentrate in the human thyroid, and it is only in this organ that radioiodine poses a hazard to health(399). Thyroid lesions can develop after exposure, and include thyroiditis, hypothyroidism, and benign and malignant thyroid nodules(400). A threshold dose for the induction of thyroid nodules by radiation may exist but a linear dependence of risk is supported by several studies(401). These are independent risk estimates of external radiation on the thyroid and are generally very similar(402). The estimates of a recent summary(403) are given in Table 10.2A.

A comparison of the risk from ingested iodine 131 to that of external radiation is difficult. Limited human data suggest that iodine 131 is approximately 1/70 as effective as external radiation in the induction of thyroid cancer, and 1/50 as effective in the induction of nodules. Animal data suggests factors of 1/10 to 1/20, so until further data is available it would seem reasonable to assume that iodine 131 is 1/20 as effective as external radiation in the induction of nodules(404) (see Table 10.2B). Therefore if the New Zealand population is exposed to 0.13 rem from iodine 131 the increased number of cases per year are as shown in Table 10.2C.

All thyroid nodules would appear within 15 years(405) and all cancers would appear within 50 years(406). Therefore, providing the individuals did not die from other causes, the total number of cases resulting from a Northern Hemisphere nuclear war can be calculated (Table 10.2D).

The effect of a thyroid dose of 4 rem to the New Zealand population are significant (Table 10.2E). Iodine 129 would similarly accumulate in the thyroid in very much smaller amounts. It is far less hazardous, due to its extremely slow rate of radioactive decay, and is thought unlikely to pose a long-term problem(407).

The risk of death from a thyroid cancer is relatively low, but shows an increase with patient age(408). Nodules are often of little medical significance; in the general populaton, one in six people is thought to have a thyroid nodule(409).

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(401) Ibid. 'Linear dependence of risk 'here implies that risk is directly proportional to dose for all values. (Strictly the term should be 'protortional risk').
(402) See risk estimates in H.R. Maxon et al, op cit: and also in L.R. Solon, K. Rosenburg, 'The Release of Radioiodine in a Nuclear Emergency', The Bulletin of the Atomic Scientists, Oct 1981, p55.
(403) H.R. Maxon et al, op cit.
(404) Ibid.
(405) R.A. Conard et al, 'Thyroid Neoplasm' Journal American Medical Assoc, Vol 214, 1970, p322.
(406) F.S. Greenspan, 'Radioactive Exposure and Thyroid Cancer', Journal American Medical Assoc., Vol 237, No.19, 1977, p2089.
(407) Proceedings of a Symposium, op cit (ref (390)).
(408) The risk increases from 5% at age 14 to 85% at age 80, with an average risk of 10%. One out of 10 of cancers may be fatal. See J.R. Beattie 'Risks to the Population and the Individual From Iodine Releases', Nuclear Safety, Vol 8, No.6, 1967, p575.
(409) J.M. Hershamn and G.A. Bay (editors), 'The Thyroid Physiology and Treatment of Disease', (Pergamon Press, 1979), p634.

(410) J. Rotblat, op cit, ref (385).
(411) K.Z. Morgan (1978) op cit (ref (379)).

Appendix 10.4: Radiation-Induced Genetic Disease

It is quite possible that the estimates given in Table 10.3 overestimate or, more seriously, underestimate the expected increase in genetic disease in a post-war New Zealand. Uncertainties over the genetic effects of radiation are as great as, if not greater than, those for the cancer-inducing effects, particularly since no definite genetic effects have been observed in any human population at any dose level(410). Estimates are based on results obtained from exposed mice, which might not show induced effects that would cause appreciable human distress. (One cannot ask a mouse if it has a headache). The BEIR reports have been criticised for treating the long-term recessive mutation problem superficially(411). Specifically, a number of non-visible or 'small' mutations might accompany every observed mutation. These 'small' mutations could present as a lack of vigour, a susceptibility to disease, or a slight reduction in intelligence and physique -all of which could pose a greater burden to society, in the longer term, than the easily-identified dominant mutations.

The effect of genetic disease would need to be considered in the context of a post-war society. The relative fitness of people depends on the environment in which they live, and it is likely that the war would cause significant socio-economic upheavals. For instance, neonatal mortality (spontaneous abortion) and parental mortality could rise, due to a decreased fitness of some infants. Prevalence of childhood infectious diseases, malnutrition and other environmental stresses could increase mortality among individuals weakened by genetic disease. A few children today with genetic diseases such as Down's syndrome, haemophilia, juvenile diabetes mellitus, cystic fibrosis, and achondroplasia have an extended life expectancy because they receive sophisticated medical care. Continuing substantial allocation of medical resources to this minority may prove more difficult in a post-war environment.

(412) R.J. Garner, 'Transfer of Radioactive Materials from the Terrestial Environment to Animals and Man', <u>CRC Critical Reviews in Environmental Control</u>, Sept 1971.

(413) Proceedings of a Symposium op cit (ref (390)).

(414) Topdressing of 5 t/ha of hydrated lime on to contaminated pastures would on occasions reduce the level of strontium 90 by factors of 2 or more (R. Scott Russell, 'Radioactivity and Human Diet' (Pergamon, p514).

(415) R.J. Garner, op cit.

(416) In countries where milk is an important food, dairy produce accounts for up to 60% of the total dietary intake of strontium 90 from fallout: see R. Scott Russell, op cit (ref (414)). For caesium levels in food, see C.L. Corner and J.C. Thompson in 'Modern Nutrition in Health and Diseas, (Lea Febiger 1980) p527.

Appendix 10.5: Reducing Exposure to Radionuclides

Fallout from a Northern Hemisphere nuclear war is unlikely to present a serious risk to health in New Zealand. The simple precautions listed below would reduce any slight risk further. However, greater benefit could accrue if these precautions were followed in the event of an attack on New Zealand.

Reducing Foliage Contamination

Approximately four fifths of radionuclides descend in rainfall. Strontium 90, iodine 131 and especially caesium 137 are well absorbed into plants by direct transfer from the surface of foliage(412). This form of uptake could be reduced by the use of glasshouses or cloches. For exposed plants, the use of sprayed water can dislodge 20-60% of the contamination(412), but only if the water used was relatively uncontaminated. Water which has run over or through soil is filtered to some extent, since iodine 131, caesium 137, plutonium 239 and, to a lesser extent strontium 90, bind to soil particles. Lake, and especially bore water, would be useful for spraying crops.

Reducing Plant Uptake

Natural processes of radionuclide decay, leaching, and dislodgement by rain and wind can reduce herbage contamination by a factor of two every two weeks or so(413). Decontamination is assisted by the application of lime, particularly in laterite and other calcium-deficient soil(414). Uptake of caesium 137 would be reduced by the application of other alkali elements such as sodium or magnesium(414).

Deep-ploughing can remove contamination from the reach of shallow-rooted crops and grasses. For instance, concentrations of strontium 90 in soya beans planted in deep-ploughed soil can be 25-50% of concentrations in plants grown in rotary-tilled soil(415). Further reduction can be attained by the addition of organic fertilisers.

Reducing Animal Intake

Plant vigour affects the extent to which contamination is retained by edible parts. Milk from cows grazed on well-fertilised pasture, in which dilution by new growth has occurred, may contain 50% or less iodine 131 and strontium 90 compared with the milk from cows grazed on marginal land(415). Intake of radionuclides is reduced if animals are fed hay or silage, because contaminated soil tends to be ingested along with grass. The most effectve way to reduce contamination of milk and meat would be to use feed that was harvested prior to the deposition of fallout. Storage of contaminated hay for several months would effectively eliminate iodine 131, because of the short halflife of this radionuclide (8 days).

Reducing Human Intake

Dairy Products - Assuming a continuation of present dietary patterns, dairy products would represent the major source of iodine 131 (90%), caesium 137 (40%), and strontium 90 (60%) from fallout(416). Intake could be reduced by restricting milk, cheese, and butter consumption, or by substituting prewar dried milk, or soya bean milk. The temporary storage of milk for a few months would effectively reduce contamination by iodine 131 to insignificant levels.

Water - Domestic drinking water has previously contributed only a small proportion of the body burden of radionuclides derived from atmospheric nuclear

(417) R.J. Garner, op cit.
(418) R.J. Sullivan et al 'Survival During The First Year After A Nuclear Attack', System Planning Corporation, Final Report, SPC 488, Dec 1979.
(419) Although brown bread might contain more Sr 90 than white does, the addition of fibre may effectively compensate. Fibre absorbs a fraction of ingested caesium 137, so reducing its uptake by the intestinal tract (which would otherwise be fairly complete) R.J. Garner op cit. Fibre also reduces the transition time of the intestinal contents, (from 40h to 14h) in some people according to D.P. Burkitt and H.C. Trowell, 'Refined Carbohydrate Foods and Disease' (Academic Press, 1975), p72. About one quarter of ingested strontium 90 is normally absorbed and this fraction could be reduced by the addition of fibre to the diet. A reduction in transition time would also decrease the radiation exposure of the gut wall derived from poorly-absorbed radionuclides such as plutonium 239.
(420) C.L. Lomar, J.C. Thompson op cit (ref (416)).
(421) P.F. Gustafson, J.E. Miller, 'The Significance of caesium 137 In Man and His Diet' Health Physics Vol 16, 1969, p167.
(422) Eskimos have 50 or 100 times the caesium 137 burden of other populations, because they eat caribou which graze on lichens. (Health Physics Vol 16, 1969, p167). Concentrations of caesium 137 in Colorado deer are 5 to 13 times higer than concentrations in domestic beef and pork (R.J. Garner, op cit).
(423) NAS 1975 Report (ref (320)).
(424) R.J. Garner, op cit.
(425) Probably about 0.03% for adults; see J.T. Edsall 'Toxicity of Plutonium and some other Actinides', The Bulletin of the Atomic Scientists, Sept 1976, p27.
(426) Ibid.
(427) R. Scott Russell, op cit (ref (414)).

tests (e.g. 5% of strontium 90(417)). Bore water would contain less contamination than rainwater collected off a roof(418).

Vegetables and Grains - For present New Zealand dietary patterns, 35-45% of strontium 90 and caesium 137 intake from fallout would derive from vegetables, potatoes and bread. Although wholemeal bread has twice the Sr 90 content of white bread, due to the concentration of Sr 90 in the endosperm of wheat, its use, nevertheless, might be preferable(419). Bran stored before fallout arrived would be an ideal source of dietary fibre, although increased consumption of potatoes and other high-fibre vegetables would be beneficial. Foods low in calcium contain significantly less strontium 90 e.g. potatoes. Some foods might be best avoided. Significantly increased caesium 137 body burdens have been found in those who habitually eat mushrooms grown outdoors, and seaweed is known to concentrate iodine 129 and plutonium 239 very effectively.

Meat and Fish - Meat would follow milk as the largest souce of caesium 137 from fallout, although meat would contain rather less strontium 90(420). Caesium is concentrated in food chains - its concentration in body tissues can be three times its concentration in food. Two threefold concentrations might be expected if meat was consumed as an intermediate product between plant and man; however there are wide variations(421). Meat from wild ruminants contains more caesium 137 than meat from domestic animals(422). Populations subsisting to a substantial degree on freshwater fish have twice the caesium 137 body burden of those on more diversified diets(420). Saltwater fish contain less caesium 137 (due to the greater diluting capacity of the oceans), but may contribute significant amounts to a diet, especially if caught in surface waters. Molluscs and crustacea show twice the concentration of caesium 137 that fish do(423).

A comparison of present daily calorific intake (13.5 kJ) with the minimum for healthy functioning (9.6 kJ), shows New Zealanders could readily reduce their consumption of dairy products, meat and fish with no harmful effects, and probably some nutritional benefits.

Reducing Radionuclide Intake by Food Preparation

Washing can remove significant amounts of contamination from fruit and vegetables. Brief washing removes about half the strontium 90 contamination, and more assiduous washing (for about an hour) removes 68-98% of strontium 90 and caesium 137 contamination. Further decontamination can be achieved by peeling or skinning(424). Cooking tends to eliminate iodine 131. Radionuclide contamination of meat can be reduced by cooking if all liquids are discarded.

Reducing the Plutonium Hazard

Inhalation is the only significant route for plutonium 239 intake. Only a tiny fraction is taken up by plant roots and the proportion absorbed by the human gut is also extremely small(425). Cigarette smoking, or air pollution, may act synergistically with plutonium 239 to cause lung cancer. Some researchers believe that smokers are 100 times more susceptible to radiation-induced lung cancer than non-smokers, although others believe that a 5 to 10-fold increase is more realistic(426). A voluntary reduction in smoking could reduce the incidence of lung cancers induced by plutonium 239 and other radionuclides for which a synergistic effect is also suspected, although the risk appears to be fairly small(386).

Other Measures

Procedures have been developed which would allow a technologically advanced society to reduce the fallout hazard. Ion exchange columns can remove iodine

Table A10.3 Crude Cost-Effectiveness Relationships of Measures to Reduce Hazard(437).

COST (in terms of money and human effort)	very large			*Drilling a bore to provide water for drinking and irrigation	*Moving out of an area with high rainfall and yellow brown loam soils	*Constructing glass-houses
	large			*Liming soil low in calcium *Ion exchange columns to remove I 131 from milk	*Post-rainfall spraying of plants with clean water *Replanting pasture after liming *Prewar storage of hay	
	moderate		*Using lake or river water instead of rainwater for drinking and irrigation	*Feeding stock on cut hay *Giving up smoking	*Deep ploughing of pasture *Adding manure frequently to crops	*Prewar storage of dried milk *Constructing cloches *Taking additional iodine after a nuclear explosion in NZ
	low		*Prewar Storage of bran to later add fibre to diet	*Postwar storage of dairy products for 3 months *Avoiding meat and fish	*Consuming only plant foods, especially potatoes	
	very low	*Discard cooking water	*Avoiding mushrooms liver kidney	*Eating less of all foods	*Avoiding dairy products	*Careful washing and peeling of plant foods
		slight	low	moderate	large	very large

EFFECTIVENESS

(in preventing human exposure to radionuclides, especially strontium 90, caesium 137, plutonium 239)

131 contamination in milk most effectively, and strontium 90 concentrations in milk can now be halved on a commercial scale(427).

Limited amounts of potassium iodide are presently stockpiled in New Zealand for distribution in the event of an accident to a visitng nuclear-power warship(428). Non-radioactive iodine can effectively block the uptake of iodine 131 by the thyroid gland. A low dose (15 mg/day) over several weeks can reduce iodine 131 uptake by 98%(429). It is, however, not recommended for those with iodine allergies, and should not be taken without medical advice(430). Iodine prophylaxis would seem justified only if New Zealand was directly attacked. If New Zealand were perceived as a possible target for nuclear weapons, additional iodine(431) might usefully be stored near potential targets such as airports, oil installations, and military bases. Although personal supplies of iodine offer protection against iodine 131, a risk of overdose favours its administration by appropriate local health authorities(432). However, concerned and informed individuals should not be denied access to additional iodine. Other measures against iodine 131, such as the stockpiling of dried milk, the dumping of contaminated milk, and a reduction in milk consumption could be potentially more cost-effective(433).

It has been suggested that stable strontium could be administered to reduce the strontium 90 uptake by bone, but there is no scientific evidence to support this procedure(434). The stockpiling of milk powder before a war would be an effective way of reducing the strontium risk.

Decontamination procedures would need to accommodate considerable variations in the radionuclide content of milk, meat, and plants throughout the country, caused by differences in rainfall and in soil characteristics. Taranaki would benefit more than Canterbury from the substitution of uncontaminated dried milk powder for fresh milk. Glasshouses or cloches would be more cost-effective on the West Coast than elsewhere in New Zealand(435).

The most significant cancer risk is posed by caesium 137, and less so, strontium 90(436). Caesium 137 poses the greatest genetic risk(75). A crude assessment of cost-effectiveness of the measures available is given in Table A10.3(437).

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(428) New Zealand Code for Nuclear Powered Shipping (Government Printer, 1971).
(429) E. Sternthal et al, 'Suppression of Thyroid Radioiodine Uptake By Various Doses Of Stable Iodide' New England J. of Medicine Vol 303, No.19, p1083, 1980.
(430) L.R. Solon, K. Rosenburg, op cit (ref 402). For the risks of taking potassium iodide, see W.K. Waterfall, 'Iodide', British Medical Journal Vol 281, 1980, p989.
(431) As potassium iodide tablets or Lugols solution.
(432) L.R. Solan, K. Rosenberg, op cit (ref (430)).
(433) These actions (undertaken for several weeks following an attack on Australia) might be preferable to the administration of iodine to the New Zealand population.
(434) It is extremely difficult to change the retention of strontium 90 when it becomes fixed in the skeleton. Practical application of a high stable strontium diet, if any, may be limited to predictable high exposure to strontium 90 over a short period. Chronic application seems precluded by evidence of deleterious effects of high doses of strontium on skeletal tissue, especially in young mammals (see D. Depczyk et al in 'Strontium Metabolism' (Academic Press, 1967); also ref (414), p515).
(435) The volcanic soils of Taranaki fix caesium 137 ineffectively (resulting in relatively high uptake by crops grown on them); the West Coast rainfall is prodigious (3000 mm/yr).
(436) NAS 1975 Report (ref (320)). There is still much debate over the hazard of plutonium (see J.T. Edsall, op cit, ref (425).
(437) N.A. Wilson, unpublished, 1981.

Labour Exchange 1931

(438) World War 2 is remembered by many as a terrible experience, and yet its toll barely registers in Fig. 7.2 (p80).

11. SOCIOECONOMIC CRISIS

11. The Impact of Nuclear War on New Zealand

For very understandable reasons, people are concerned, and even frightened, about the prospect of a nuclear war. The preceding section showed that the impacts on health in New Zealand of a Northern Hemisphere nuclear war (including an attack on Australia) are likely to be predominantly psychological and socioeconomic. It went on to suggest that many of the psychological problems could be reduced by the dissemination of factual and useful information.

If, then, New Zealanders understood that a major nuclear war (in which this country was not directly attacked) would not cause them harm through fallout and other weapon effects, how would New Zealand emerge from this unprecedented catastrophe?(438).

The major impact of a nuclear war in which New Zealand was not directly attacked would be on the economy, and accordingly on the lifestyles of New Zealanders. Depending on the extent of the conflict, external trade would be reduced to a greater or lesser degree, either immediately or over a short period of time. Loss of export markets would result in large surpluses of agricultural products, in particular. Loss of imports would affect production in all sectors of the economy. Some industries would not be able to continue once stocks of imported raw materials had run down. Other industries would experience the loss of imports indirectly as inputs from other import-dependent sectors of the economy declined.

Many associate New Zealand's current high living standard with an internationally-linked economy, which, until recently, has experienced significant growth rates. Without a large degree of external trade, living standards in New Zealand (as indicated by overall consumption) could be reduced.
Yet it is this international linkage which makes New Zealand vulnerable to the effects of a major nuclear war. If New Zealand was more self-sufficient (viz. less reliant on external trade) then the impact would be reduced, but so too may be the overall standard of living.

In this section:
(i) Methodologies for exploring the socioeconomic impact of nuclear war on New Zealand will be briefly outlined.
(ii) The degree of New Zealand's dependence on external trade will be established.
(iii) Some indications of the immediate and long run effects on the New Zealand economy of various nuclear war scenarios will be given.
(iv) Some scenarios of possible external determinants of New Zealand's future in the aftermath of a nuclear war will be presented.
(v) Some possible responses by decison-makers in New Zealand to the threat of a nuclear war will be discussed in terms of different planning modes.
(vi) More detailed developments of the outcomes for different planning modes will be presented.

11.2 Scenarios and System Responses

Four different nuclear war scenarios have already been introduced in section 7 (p77). To recapitulate briefly, these are:

Scenario A : global war (NZ attacked)
Scenario B1 : global war (NZ survives)

(439) Professor N.F. Barber, 'The attitude of a physicist' (inaugural lecture at Victoria University, 1963).

(440) New Zealand has the least-diverse economy of all OECD countries, and in this respect is akin to a Third World country (see M. Kidron and R. Segal, 'The State of the World Atlas', (Pan, 1981), p21.

(441) For instance, stagnation, stagflation, unemployment.

(442) New Zealand's 'real' dependence on imports is largely concealed by the interrelationships between different sectors in the economy (see section 11.3).

(443) Figures are derived from 'New Zealand Official Yearbook 1981', (Government Printer, 1981), pp557-580 and relate to the 1979/80 year.

Scenario B2 : global war (NZ, Australia, Japan survive)
Scenario C : Middle Eastern war (oil cut-off)

Note that each, except for the first, is a subset of the one above it. Scenario A has been chosen as a special case because the outcome for New Zealand is extreme. A distinction has been drawn between Scenarios B1 and B2 because, although it is difficult to contemplate global war without involving the United States and the United Kingdom, the involvement of Australia and Japan is less certain. While the involvement of Australia and Japan may have little effect on the global outcome, it would have considerable effect on the outcome for New Zealand. These four countries (United States, United Kingdom, Australia, Japan) are by far this country's most important trading partners, as shown in the table below. Scenario C, while not involving the superpowers, has been introduced because an oil cut-off would not only have extremely adverse consequences for the internal economy, but would also have adverse consequences for New Zealand's trading partners.

A professor once described how a scientist can gain insight into the functioning of a 'system' by subjecting it to a 'stimulus' and noting the 'response'(439). A similar methodology is used for parts of this section:

- The 'system' is a model of the New Zealand economy (in some instances, a sophisticated computer simulation; in others, a set of simple statistical data).
- The 'stimulus' is one of the 4 nuclear war scenarios outlined above, translated into effects on external trade.
- The 'response' is the effect on the model of the New Zealand economy, (which can then be interpreted in terms of likely socioeconomic impacts for the 'real' New Zealand).

Different methodologies are used in other parts of this section:

- Published material on the effects of nuclear war on other countries (notably the United States) is adapted for the New Zealand situation.
- The response of 'real' people is not amenable to 'abstract' computer analyses, and, for this reason, imaginative scenarios representing various facets of the impact are developed. Some scenarios are presented using a taxonomy based on four different ways that people may think about the future, which in turn give rise to four different ways of planning (i.e. planning modes).

The analyses are fraught with uncertainties, and for this reason are necessarily tentative and speculative:

- New Zealand's fate, as an internationally-linked trading country is inextricably linked with the fates of its trading partners (particularly the OECD countries and these are not analysed(440)).
- Questions arising from the complexity and interrelatedness of a modern economy are perplexing enough in 'peacetime'(441). A nuclear war introduces new uncertainties.
- Some essential information on basic parameters, such as the effects of internal linkages, are not available (or at least inaccessible within the timeframe of this CFF study(442).

11.3 Dependency of the New Zealand Economy on External Trade

New Zealand is vulnerable to a dislocation of world trade. As the following percentages show, the economy depends on linkages with four major trading partners(443).

Table 11.1 14 Selected Industries Analysed for Dependence on Imports (see Appendix 11.1, p , for methodology)

Inter Industry Category	'Simple Dependence' (%)	'Linked Dependence' (%)
1 Agriculture and Livestock Production	3.6	12.0
3 Other Farming	5.2	21.9
10 Meat Freezing and Preserving	0.9	1.3
38 Wearing Apparel Except Footwear	16.7	34.6
50 Pulp, Paper and Paperboard	9.6	23.9
57 Chemical Products	22.7	49.4
58 Chemical Fertilizers	50.6	85.1
63 Petroleum and Coal Products	61.8	71.6
65 Motor Vehicle Tyres and Tubes	34.1	76.0
68 Plastics	21.4	48.9
77 Basic Metal Industries	25.1	45.8
82 Agricultural and Pastoral Machinery	24.9	47.0
109 Freight Transport by Road	2.4	21.0
112 Air Transport	19.5	45.2

(444) Op cit, pp594-602, pp607-611.
(445) S.H. Franklin, 'Trade, Growth and Anxiety', (Methuen, 1978), p101.
(446) R. Procter, 'GDP Growth and Energy Forecasting in New Zealand', paper presented at Energy Modelling Symposium, Victoria University of Wellington, Nov 1979, p5.
(447) Inter-Industry Study of the New Zealand Economy 1971-72 (Department of Statistics, 1980).

	Trading Partner	% Exports	% Imports
	Australia	12.1	19.0
	United Kingdom	14.2	14.4
	United States	14.2	13.5
	Japan	12.6	12.6
	(sub total)	(53.1)	(59.5)
(next 4)	Singapore	1.4	5.7
	Fed. Rep. Germany	2.3	4.6
	Soviet Union	5.0	0.4
	Saudi Arabia	0.7	4.5
	All others	37.5	25.3
		-----	-----
		100.0	100.0

Exports are represented by three major commodities - viz. meat (21.5%), wool (18.1%), and dairy products (15.5%) - earning 55.1% of foreign exchange.

Major imports include machinery and transport equipment (29.8%), manufactured goods (27.4%), crude oil and derivatives (19.6%), and chemicals (12.5%), representing 89.3% of all imports(444).

Franklin describes New Zealand's dependence on foreign trade as follows:

"New Zealand's dependence upon foreign trade - amounting to something between 20 and 25% of her GNP - introduces a volatile quality into her economic life which is difficult to accommodate. The programme of import substitution and manufacturing in depth, together with the overall management of the economy, does not eliminate the influence exerted by external trading circumstances, and economic conditions, upon internal economic life. The rhythm of internal economic development often reflects the pulsations of the economic activity among the great industrial nations of the Northern Hemisphere ..."(445).

The programmes of import substitution which have been undertaken have tended to result in the setting up of processing and finishing plants which use imported raw and partly-processed materials as their inputs. Production by these plants certainly means that fewer finished imports are needed and there is local employment generated. But in reality one type of dependency has been traded for another. The need for imported raw materials for industry is as much a constraint on economic activity as terms of trade(446).

This all-encompassing nature of New Zealand's dependency can be gleaned from a study of the Inter Industry Tables produced by the Dept of Statistics(447). Table 11.1 is derived from these tables. The method used is set out in Appendix 11.1 to this section.

The table shows the extent to which a selected group of industries is directly dependent on imports ('Simple Dependence') and also gives an indication of their indirect dependence on imports through their need for inputs from other sectors of the New Zealand economy ('Linked Dependence'). Thus, present levels of agriculture and livestock production depend on the maintenance of inputs from six sectors - chemical products, chemical fertilizers, petroleum and coal, plastics, base metal industries, and agricultural and pastoral machinery. All six are themselves heavily import dependent, as Appendix 11.1 shows.

Table 11.2 Loss of Imports and Exports (%) for Nuclear War Scenarios B1, B2, C

Commodity Import	% of all Imports	% losses B1	B2	C	Commodity Export	% of all Exports	% losses B1	B2	C
crude petroleum	7.1	79	79	79	wool	18.1	96	83	6
motor cars	4.2	97	34	-	beef and veal	10.2	95	92	2
partly refined petroleum	3.4	75	61	24	lamb	9.4	95	92	22
motor spirit	3.1	93	75	22	butter	7.0	79	79	2
steel plate	3.1	98	6	-	milk	4.2	39	32	3
pharmaceuticals	2.2	86	60	-	wood pulp	2.3	90	19	-
organic chemicals	2.2	79	72	-	casein	2.2	92	69	1
distillate fuels	2.0	92	61	18	cheese	2.1	91	56	5
ships and boats	2.0	81	81	-	mutton	1.9	94	83	2
synthetic fabric	1.8	49	18	-					
non-electric generators	1.8	84	79	-					
scientific instruments	1.8	79	54	-					
weighted means (loss of imports)		84%	58%	22%	(loss of exports)		88%	78%	7%

(448) S.H. Franklin, op cit, p50.

(449) Manufacturing now generates nearly a quarter of New Zealand's GNP, employs a quarter of the labour force, and has averaged 30% per annum growth over the 1970's ('Growth Opportunities in New Zealand' (Government Printer, 1980), p39).

(450) W.B. Sutch, 'Gaps in the New Zealand Economy', (1963).

(451) "The type of model to be used in economic forecasting depends on the type of forecasts required ... In practice, at the macro-economic level, simple-minded naive models ... have performed fairly well, even when compared with much more sophisticated models" (P.A. Samuelson, 'Economic Forecasting and Science', Michigan Quart. Rev. Oct., 1965, p274.

(452) A major Taupo eruption, for comparison, would leave Northland, Auckland, Taranaki, Wellington, the East Coast, and the entire South Island intact (see 'Future Contingencies 1: Natural Disaster' (Commission For the Future, 1981).

Franklin notes that, "The farm is central to a set of inter-industry relations that link back to the inputs of basic services like transport and finance or basic commodities like fertilizers and which link forward to processing plants, cool stores and services. In sharp contrast are the manufacturing industries which, once the pastoral processing plants and fertilizer industry are excluded, are without very elaborate inter-industry relationships with the farming sector - at least that was so in 1960. These manufacturing industries are overwhelmingly dependent for their inputs of raw or semi-processed materials upon the earnings of the export-oriented sector. They sell their final products to the consuming public of the rural and urban areas, to a public in part dependent upon these protected industries for its livelihood and its high standard of living"(448).

The only substantive change in the picture since the 1959-60 inter-industry tables were published has been a wider array of manufacturing, and a marked increase in manufacturing as a component of exports(449). This has not, however, changed the overall picture, which has been summarised by Sutch in the following way:

"If an economic geographer joined the economic historian to help place New Zealand in its international trading context, he would probably say that the country had such special colonial economic characteristics as to group it with Sierra Leone, Ghana, Malaya, Bolivia, Chile, Honduras, El Salvador, Venezuela, and some others. The common characteristic of these countries is a dependence on the cultivation, exploitation and export of one or at most two products"(450). The one product being referred to here is, for New Zealand, grass.

The complexity of New Zealand's dependence has not been fully demonstrated. However, the material presented supports the view that the New Zealand economy will be significantly, and seriously, affected by any disturbance in the world economy for good or ill. The disruptions that a nuclear war could bring to the New Zealand economy, even though direct effects would not occur in the sense of blast and fire damage,would be comprehensive.

11.4 Assessments of Immediate and Long Run Effects of Nuclear War

Recent disturbances in the world economy were the 1973 and 1979 oil shocks. These have severely disrupted the world and New Zealand economies, have contributed to a depression second only to that of 1931 in this century, and have made economic management during the recovery period a most challenging task. Yet compared with a major nuclear war, these were minor events.

A simple analysis of the effects of nuclear war on New Zealand's external trade is represented by Table 11.2. It has been assumed that imports from, and exports to, all targeted countries identified by the three nuclear war scenarios B1, B2, C are abruptly terminated(451). The 12 major commodity imports (34.7% of total imports) and 9 major commodity exports (57.4% of total exports) are listed in the table). To a first approximation

- a nuclear war between the superpowers (Scenarios B1, B2) would cut four-fifths of New Zealand's present trade (imports and exports),
- a Middle Eastern war (Scenario C) would cut one-fifth of imports.

Scenario A (global war, New Zealand attacked)

A major nuclear attack on New Zealand would be, incomparably, the worst disaster which could befall this country(452). The opinions expressed below (relating to

"On the 6th August 1945 ... the United States dropped a small atom bomb on the Japanese city of Hiroshima. Survivors described the blinding flash, the concussive blast, the raging wind and the searing fire storms that followed. They spoke of the charred bodies, of the dead piled high, of the screams of the dying stripped of flesh, their eyeballs burned in their sockets, of children dying in agony without parents to comfort them"(455).

"Suckling infants cling to charred mothers; a man holds his eyeball in his palm ... a mother driven half mad while looking for her child was calling his name. At last she found him. His head looked like a boiled octopus ... 'Survivors' wandered about, their skin hanging peeled from their hips".

Notes by Hiroshima victims(456)

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(453) Assumptions
(i) 13 x 1 Mt non-MIRVed airbursts on urban areas (SS-N-6).
(ii) 50% deaths inside 7 km radius viz. 3850 ha exceeding 5 psi overpressure, 250 km/h wind blast (refer OTA Report, 'The Effects of Nuçlear War', (OTA, 1979) p18).
(iii) New Zealand urban population density of 20/ha.
Calculation
13 x 0.5 x 3850ha x 20/ha = 500,000 prompt deaths.
(Underestimation - high density areas in excess of 20/ha. Overestimation - lack of contiguous urban areas of 3850 ha each.)

(454) Committee on Banking, Housing, and Urban Affairs, US Senate, 'Economic and Social Consequences of Nuclear Attacks on the United States' (US Government Printing Office, 1979).

(455) Katie Boanas et al, 'Survival' (Survival 81, Christchurch, 1981).

(456) 'Unforgettable Fire' ed. Japan Broadcasting Corporation (Wildwood House, 1981).

(457) Table 5.02, Monthly Abstract of Statistics (Statistics Department, Oct. 1981). There are two other mechanisms for working out the sector distribution of the labour force. S.H. Frankin's four-sector distribution figures (for 1971) are: EXO (export-oriented sector) rounded to 18%, IMD (import-dependent sector) 13%, UBS (urban-based sector) 63.5%, LRB (local-resource based sector) 5.5%. (ref. S.H. Franklin, op cit, p51). Additionally, M.P. Conway's four-sector figures (from 1976 census figures) are agriculture (including forestry, logging, fishing, hunting) 10.4%, industry (including mining and construction) 33.1%, services (including armed services) 20.7%, and information occupations 35.9%. See 'Information Occupations: the New Dominant in the New Zealand Workforce', (Commission For the Future, 1981).

a nuclear attack on the United States) may be somewhat optimistic in the New Zealand context. The New Zealand state is tiny by comparison. For instance it has one oil refinery, one onshore gas-field, one satellite ground receiving station, and one seat of state government. A single (obsolescent) Delta-class submarine could kill half a million New Zealanders outright(453), and a similar number by disease and fallout within a month. Whether the surviving two million would envy the dead is a moot point.

> "The complex, interdependent relationships that characterise modern industrial societies make them especially vulnerable to nuclear attack... The process of post attack economic recovery ... requires the production of surpluses to support expansion beyond the limited, surviving economic base ... The factors that make rapid recovery from a small-scale disaster - limited damage, modest casualties, surviving leadership and technical skills, and the availability of external, easily mobilised human and material resources - will almost certainly be absent...
>
> "The experience of nuclear war is likely to have devastating psychological effects. The loss of material and institutional resources in urban-industrial attacks will make survival in the post attack period difficult ... compounding the psychological stresses ... Even the simplest requirements of survival will become major tasks ... Families will be particularly vulnerable ... they will be broken up by death, severe injury or disease, evacuation, or military and labour conscription. The young, elderly, and handicapped will suffer disproportionately ...
>
> "Antagonisms will develop between hosts and evacuees or refugees ... Major, possibly permanent changes in social values and institutions can be expected as society seeks to adjust to a radically altered environment ... more authoritarian methods of political, social and economic control are likely responses to post-attack conditions"(454).

Scenarios B1, B2 (global war, New Zealand survives)

Some indication of the scale of the economic disruption which could arise from a B1-type nuclear war in which New Zealand escapes attack is to be found in Table 11.3 (p142) which gives estimates of agricultural surpluses which would arise from the disruption of trade. As for Table 11.2, it has been assumed that all trade with targeted countries is abruptly terminated. The results are immediate and massive surpluses.

There are a number of ways of describing how the working population of New Zealand could be affected by external disruption caused by nuclear war. Franklin and others have demonstrated that virtually all employment (due to the inter-industry linkages) is in some way dependent upon both export earnings and on the continued flow of imports. The export-oriented sector is as dependent upon the urban based sector for services and other functions as the urban based sector is dependent upon the export-oriented sector for capital flowing from the export/import system of capital exchange around the world. Thus, all employment will be affected by a nuclear war of the type described by Scenarios B1 and B2.

The present work-force can be divided into sectors as follows: a primary sector (agriculture, hunting and forestry, fishing, mining and quarrying) which employs 11.1%; a secondary or manufacturing sector which employs 22.9% and services (including armed forces) which employ 62.3%. In addition, the registered unemployed make up 3.7% of the work-force(457). The complexity of the inter-industry relationships make it impossible, within the scope of this report, to give an accurate assessment of effects through the three employment

Table 11.3 Agricultural surplus after a nuclear war (Scenario B1)

Commodity Export	% of Exports	% Exported	Loss of Exports (B1)	% Surplus to local consumption
wool	18.1	91	96	970
cheese	2.1	90	91	820
milk	4.2	86	39	240
lamb and mutton	11.3	81	95	280
butter	7.0	78	79	90
beef and veal	10.2	49	95	
	(52.9)			

Table 11.4 Type-B2 war modelled by EMILY(462)

Model Run		C220	C225	C226	C227
Private Consumption		$32.4b	$16.3b	$1.8b	$18.1b
Investment		8.4b	3.7b	2.0b	4.1b
Imports and Exports		13.7b	5.7b	1.8b	5.6b
GDP		45.4b	24.2b	7.3b	26.2b
Unemployment	(skilled)	nil	nil	432,000	nil
	(unskilled)	nil	201,000	868,000	30,000

(458) J.L. Robinson, pers. com. It was developed as a United Kingdom Department of the Enviroment Systems Analysis Research Unit Model.

(459) J.L. Robinson, 'The Effect of a Limited Nuclear War on the New Zealand Economy - a SARUM Experiment' (June, 1981). See also J.L. Robinson, 'Trade Pattern Scenarios Investigation by SARUM', Technical Report 81/2 (Department of Information Science, Victoria University of Wellington, 1981).

(460) 'Contexts for Development: Clarifying Values' (Commisson For the Future, 1981).

(461) B.P. Philpott, A. Stroombergen, S. Burnell, 'Economic Aspects of the Commission For the Future's Scenarios of 2010', Project on Economic Planning, Occasional Paper No.45, (Victoria University, Wellington, 1981).

(462) B.P. Philpott and A. Montrivat, pers. com., 1982.

sectors. However, on the assumption that 80% of primary products are exported, and 80% of these exports are lost, then 64% of the GDP generated by the primary sector (80% x 80%) is lost as a result of a B1-type war. This would amount to $1,800 million in 1980 dollars, or 8.5% of total GDP. Another 1% loss in GDP could originate in lost manufacturing, since few industries are based exclusively on local resources. Thus at least 10% of GDP would be lost directly, as a result of a B1-type war. Internal linkages would almost certainly multiply this loss several times but are difficult to quantify. (A computer modelling of a B2-type war suggests, under favourable circumstances, the loss in GDP is more like 50%, as discussed below).

Almost everybody, through their jobs and their lifestyles, will feel some impact from the cut-off of imports, and the overwhelming surplus of goods produced by the primary and secondary sectors which cannot be absorbed by the local market. It is difficult to assess the impact of nuclear war on GDP generated by the services component of the New Zealand economy, which makes up about two-thirds of all employment irrespective of the analysis adopted. However, much of the activity within that sector relates to services provided for manufacturing and for primary production. It is important, therefore, to realise that effects on primary and secondary production will have ramifications throughout the services sector.

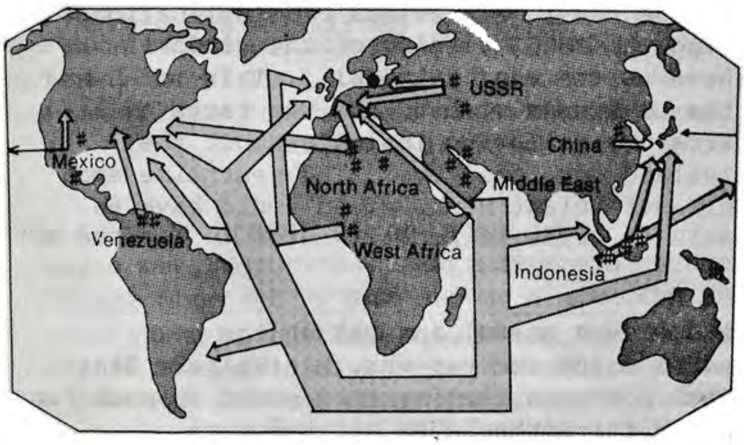
Two major econometric modelling projects have produced information on the longer run effects of a major change in New Zealand's trade relationships.

SARUM is a computer model of the world economy, based on neo-classical economic assumptions, and free of any particular New Zealand bias(458). A New Zealand response to a B1-type war, simulated by SARUM, was reported as follows:

"As a response to a massive shift in trading patterns, in this case forced by a limited global conflict, New Zealand moves to increased self-sufficiency in manufactured goods which results in an overall strengthening of the economy ... New Zealand can cope with and indeed may benefit from such a policy of self-reliance"(459).

The four 'contexts for development' presented in a previous CFF publication(460) have been quantified and examined using the EMILY version of the Victoria Planning Model adapted to project ahead to the year 2010(461). This model was set to maximise consumption, given the constraints which are the facts of life for the New Zealand economy. It offers the following insights about the prospects of a self-sufficient New Zealand developed over a 30 year time span "... it appears that a relatively self-sufficient New Zealand could have an active growing economy without emphasis on trade if people wanted to (or had to) change their lifestyle".

The Victoria Planning Model EMILY also offers useful insight on the socioeconomic impact on New Zealand of a major nuclear war. A 'Welfare State Scenario' (Context C in ref.(460)) was chosen as the 'system' - not so much for its full-employment goal, but rather for its emphasis on agricultural development and external trade. The 'stimulus' chosen was a B2-type nuclear war. Rather ominously, B1-type nuclear wars produced consistently disastrous outcomes (i.e. in 'Context C' analyses New Zealand's survival in a nuclear war is linked with Australia's). The 'response' for the year 2010 is summarised in Table 11.4 (facing page): figures for any other year may be obtained by simple interpolation. Four different programme runs were obtained(462): viz



World oil flows

(463) G.F. Preddey, 'Fast-Track Self-Sufficiency: an Alternative Energy Plan', (Commission For the Future, 1980).

(464) McDermott Associates, 'The Social and Economic Effects of a Disruption to Energy Supplies', (New Zealand Energy Research and Development Committee draft final report to contract 3206, Nov 1981), pp6, 55.

- C220 Base Run (Context C).
- C225 Run C220 subject to loss of agricultural trade resulting from B2-type war.
- C226 Run C225 plus oil cut-off of 75% (corresponding to B2-type war).
- C227 Run C226 except that ethanol and methanol substitute for loss of oil (B2-type war with energy self-sufficiency).

For C227 (B2-type war with energy self-sufficiency), private consumption is halved indicating a substantial decrease in the standard of living. Unemployment increases among skilled workers, but to manageable proportions. However C226 (B2-type war) can only be described as a socioeconomic disaster, with 1.2 million out of work. This model points to the importance of energy self-sufficiency, if an oil cut-off due to nuclear war (or any other cause) is a possibility. The same point has been made in a previous CFF publication(463). The New Zealand economy in the future may not emphasize agricultural development to the extent assumed in these model runs. Further modelling is required to explore the sensitivity of other development paths to nuclear war.

Given the curtailment of traditional exports, it is difficult to imagine New Zealanders short of food. The present housing stock is of good quality, and could be maintained using locally produced materials (wood products, clay tiles, corrugated iron, glass). Although many synthetic and woven fibres are imported, the large domestic wool clip has potential (given imaginative processing) to provide for a much larger proportion of New Zealand clothing needs. A proportionally large, semi-skilled workforce exists, and although perhaps untested for adaptability has obvious potential when a response to nuclear war is considered. Given the overall interdependence of the economy, a realistic assessment is that, although basic needs of food, shelter and clothing can be met, almost everybody, through their jobs and their lifestyles, will feel some impact from the cut-off of imports, and the large surpluses of goods produced for export by the primary and secondary sectors which cannot be absorbed by the local market.

Scenario C (Middle Eastern war - oil cut-off)

Events in the 1970s have shown the vulnerability of Western economies to any disruption to the flow of oil from the Middle East.

New Zealand's energy system is presently very vulnerable to any interruption to world oil supplies; petroleum imports meet all but a small fraction of liquid fuel demand and just under half of the total energy demand. "The imports are largely in the form of crude ... dominated by just one or two countries of origin since the Marsden Point oil refinery was commissioned in 1964 ... Future disruptions to supply arising from political events outside New Zealand are almost inevitable. There is the strong possibility that oil exports by OPEC members could be subject to further embargoes. Even more likely is war or revolution in the Middle East or Africa resulting in a loss of production. Both events would probably lead to cuts in New Zealand's level of oil imports. As well, any event which upset the fragile balance of world politics could result in panic moves by some countries to secure their oil future and so endanger world oil supplies"(464).

Nuclear war also threatens New Zealand's indigenous energy supplies. "The indigenous energy system that New Zealand is developing is characterised at a number of points by an exceptionally high degree of concentration, and it is important to consider the potential for breakdown within the system and the

"The common perspective is that a major and prolonged disruption to energy supplies will produce severe deprivation and social and economic regression. However, while energy disruptions will always create uncertainty and fear of the unfamiliar, it need not evoke a resistant response. A disruption could produce a shift from the present pattern of material consumption to other, less energy-intensive patterns. Admittedly, New Zealand's response to the oil crisis has been to shore up existing energy-economy relationships at almost any expense, and there has been no fundamental shift in attitudes and behaviour"(467).

"Obviously there is an urgency for New Zealand to become more self-sufficient in transport fuels. Personally I cannot see our economy being restored to robust good health until our imported oil bill is reduced significantly. I doubt that export-led growth alone can correct our economic problems; to me there is a complementary requirement to reduce imports, and substitution of imported oil from indigenous sources offers good prospects"(468).

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(465) Ibid, p1. A case in point is the Marsden Point refinery and the Taranaki Synthetic Gasoline plant; both installations will require catalysts for their operation, and these could become unavailable in the event of a B1-type nuclear war.

(466) Ibid, p101.

(467) Ibid, p106.

(468) C.J. Maiden, 'Activities of the Liquid Fuels Trust Board', The Energy Journal, Dec 1981, p5.

(469) E.M. Ojala, 'New Zealand in the Future World Food Economy', (Massey University, 1980).

(470) Present recipients of New Zealand's traditional high-value exports (meat, dairy products) are likely to be hardest hit (viz. populations of North America, Europe and perhaps Japan). Populations most likely to survive relatively unscathed (in South and Central America, Africa, India, South East Asia) represent at present a small market for New Zealand's traditional products. A shift from meat, dairy and horticultural products towards more cereal production, reflecting shifts in demand, is possible.

possible conseqences. Local disruptions could threaten the country's social and economic stability as much as any further upheavals in the international oil market"(465).

"A further point to be emphasised is that the strategy of replacing imported oil with indigenous energy sources only reduces vulnerability to the direct impacts of price or supply disruptions. New Zealand's integration into the world economy through the trading sector means that irrespective of the degree of independence from oil imports that is achieved, the country will still be greatly influenced by events in the international oil market. Most industrialised economies will remain heavily dependent on oil for the rest of the century, and New Zealand cannot escape their dependence. In the extreme event of a major oil disruption causing the collapse of the international trading order, then the level of economic activity within New Zealand would be seriously constrained, even if complete energy self-sufficiency had been attained"(466).

11.5 Possible External Determinants of New Zealand's Future After a Nuclear War

The following scenarios describe how some events, and opportunities, in the outside world could affect the recovery of New Zealand after a major (B-type) nuclear war:

B(i) 'breadbasket' scenario

New Zealand has an important place in the world food economy, especially in exports of high value foodstuffs (meat, dairy products). World market prospects for meat and milk through the next two decades make it feasible to envisage further expansion in the pastoral industries, particularly sheep and beef, but not excluding dairying(469). A major nuclear war will result in large areas of the Northern Hemisphere becoming contaminated by direct fallout. New Zealand's ability to provide uncontaminated foodstuffs for surviving populations in the North offers opportunities for food aid, and in time food trade if the North recovers sufficiently(but perhaps at a reduced level or in different commodities) (470).

B(ii) 'refugee flood' scenario

A large number of refugees from the North is a possibility. These could be from targeted areas of Europe, North America, and perhaps Australia, arriving by an assortment of aircraft, ships, yachts, and submarines. Alternatively, or as well, they could arrive from densely populated developing countries of South East Asia, themselves displaced by refugees from the North, or by the curtailment of trade or aid from the North. Further consideration of this possibility is given in section 12 ('Strategic Crisis' p 163).

B(iii) 'invasion' scenario

In the event of a B2-type war, Japan survives but both superpowers do not. Japan presently meets the needs of its large population through world trade, and this is likely to be disrupted by the loss of trading partners, and by the loss of oil. It could respond by a military thrust towards Australia and New Zealand, two countries rich in resources but relatively sparsely populated. Alternatively, the complementary Japanese and Australasian economies might be exploited co-operatively by the three countries.

"Few of us believe that there would be much left of our highly urbanized, economically tightly integrated and desperately vulnerable societies after even the most controlled and limited strategic nuclear exchange ... Whether the survivors be many or few, in the midst of a land scarred and ruined beyond all present comprehension, they should not be expected to show much concern for the further pursuit of politico-military objectives"(471).

(471) M.E. Howard, 'On Fighting a Nuclear War', International Security vol 5, No.4, 1981, p3.

(472) For further discussion of these planning modes, see E. Trist, 'The Environment and System-response Capability', Futures, April 1980, p118.

B(iv) 'recovery of the South' scenario

Economic recovery could occur first in the South, since these countries are likely to experience minimal consequencs of blast and fallout. In time, trading links could develop between Australasia, Central and South America, the ASEAN countries, Southern Africa, and pockets of survivors in North America and Europe. The survival of Japan (Scenario B2) would assist this process, as it has the heavy industrial base lacking in many of the other countries. A shortage of oil could hinder, if not prevent, this type of integration.

11.6 Possible Response of New Zealanders to the Threat of Nuclear War

For the purposes of this discussion, four planning modes have been identified. These are linked to how different people think about the future(472).

Planning Mode 1: Some people live in the present. They prefer to let the future take care of itself. If this is the predominant response of New Zealanders and their Government to the threat of nuclear war, then it seems likely that institutional paralysis would occur in the aftermath of a nuclear war. The public could lose confidence in government and other institutions, and in money as an exchange device. Urban collapse and anarchy could very likely follow at least for a time.

Planning Mode 2: Some people prefer to react to events as they occur using lessons learnt in the past. Their response to the threat of nuclear war would be to wait till it happened and then try to restore the situation to normal. They would be likely to support martial law to maintain law and order and provide for the essential needs such as food, shelter, and energy which could be at risk during the period of economic disruption following a nuclear war. For the longer run, they might support measures similar to those taken in 1942 during World War II. Essentially, government took powers to allocate resources and manage the economy in order to ensure a steady supply of essential goods and services at stable prices to all New Zealanders.

Planning Mode 3: Provided they are convinced that nuclear war has a high probability in the near to medium term future, a third group of people will prefer to make contingency plans now. These could take many forms. A simple contingency plan would be to stockpile some commodities of strategic importance for the period following a nuclear war. Examples of these are oil, medical supplies and a good supply and variety of seeds. An example of a more far-reaching contingency plan would be to start now to move towards a two-tiered economy. This has been suggested as a 'fall back' position in a deteriorating international environment.

Planning Mode 4: A fourth way of dealing with the possibility of nuclear war is to decide now to create a future for New Zealand which would reduce disruption to a minimum. People who prefer this approach are prepared to give up some of the opportunities for development and growth in overall living standards which could come from building a strong trading economy. Instead, by opting for self-sufficiency they would have the security of knowing that life in New Zealand would be relatively unaffected by a nuclear war elsewhere.

11.7 Outcomes of Different Planning Modes

Trist (ref.472) introduces technical terms for the four planning modes characterized above viz. inactive, reactive, preactive, and proactive. It should be noted that the modes are not ranked or rated in any way. They are

linked to how different people think about the future. Notwithstanding this qualification, the socioeconomic impact on New Zealand of a nuclear war will depend to an extent on the planning mode operating in the intervening period. Planning in the 'real world' (unlike the 'abstract world' of models) will most likely contain elements of all four modes.

Planning Mode 1: (inactive)

In the inactive response, the effect of a B-type nuclear war on the New Zealand economy would be prompt shortages and surpluses. Percentage surpluses to local consumption have been listed in Table 11.3 for a number of commodities. In this mode, New Zealand would be largely paralysed. Government at all levels would be overwhelmed by the tasks ahead of it. There would be psychosis and all kinds of neurotic behaviour, including mass panic. The identification New Zealanders feel with the Northern Hemisphere, which today is still very apparent, would not have changed sufficiently for the situation to be controlled easily.

However, the farming community would, by and large, be able to support itself. In this inactive mode, it is likely that those near cities would be overrun by floods of urban refugees. Large numbers of livestock would be slaughtered in order to satisfy the short-term needs of food supply. The more isolated farming areas would be less affected, particularly those which would be able to institute some form of local control. Undoubtedly some remote boroughs and counties would be able to achieve this by closing the access roads into their regions.

Manufacturing, services, and unemployed sectors of the economy (representing 88.9% of the present workforce) may be worse affected by a nuclear war than the agricultural sector (which is less dependent on specialised imports). In an inactive planning mode, urban collapse seems inevitable. The first crucial month or so, in which fuel, raw materials, and distribution systems are still available, is likely to be wasted. A gradual, and visible, deterioration would lead to a loss of confidence. Direct barter, a black market, and systematic crime would flourish as desperation set in. In the cities, looting and other violence (especially near food outlets) would encourage an exodus. The only outcome which can be reasonably portrayed is a total breakdown of society.

Planning Mode 2: (reactive)

In this mode, government would respond to crisis or disaster as they occurred. Usually in a reactive situation, the responses would be directed at maintaining continuity of a society. It is unlikely, however, given the scale of this disaster, that continuity could be maintained, unless government assumed greater powers. These would be required to avoid the outcome already described for the inactive mode. A crucial aspect would be the recognition that the time scale involved for recovery is not just a few months or several years but the foreseeable future. To all intents and purposes, the Northern Hemisphere would no longer exist. Government would undoubtedly have to ensure continuity of supply of foodstuffs, particularly to urban centres. In addition, some form of currency for exchange would have to be maintained, so that barter on a direct basis did not return. A strong reaction would occur immediately to control such deviance as rioting, looting, etc.

An appropriate precedent is the allocation economy adopted during the Second World War. In the sense that goals were established and achieved, this was the most successful period of economic management the country has ever seen. The key feature of this period was the economic stabilisation scheme introduced in December 1942. "This attempt at detailed stabilisation of the economy was a

(473) J.F.V. Baker, 'War Economy: Official History of New Zealand in the Second World War', (Department of Internal Affairs, 1965), p298.

(474) Ibid.

formidable administrative task, but it was one which offered some hope of success if tackled with sufficient determination. This was more than could be said of attempts to stabilise prices alone or even to stabilise prices and wages. Such limited attempts were doomed to failure from the start because the attempt at stabilisation was undermined by the infiltration of cost increases in items which escaped the net of price and wage control. Sharply rising costs of imported goods for example, had helped to defeat stabilisation plans in the early war years"(473).

For the period 1940-45, literally all physical goods in New Zealand were allocated by central authority. The capital-labour ratios were determined, and the ability of all sectors of the economy to produce were effectively controlled by central government. A result was an essentially stable wage and price regime from 1942 to 1945. The consumer price index was essentially constant for this period. Production was geared to ensure a steady supply of selected utility articles at stabilised prices(474).

An early reactive response to a B1-type war might be the establishment of a Ministry of Supply. Its first functions could be to produce (from scratch) an inventory of New Zealand's remaining resources, and some form of allocative distribution system. Public confidence would be crucial, especially for the survival of the services sector (62.3% of the workforce). A collapse of banks, insurance companies, and lending and investment institutions would be extremely disruptive, and undermine confidence in money. Manufacturing for export would survive only in as much as a switch to alternative markets or to import substitution were possible.

New Zealand is a major participant in world agricultural trade. Not surprisingly, most local production is destined for export; viz. raw wool 91%, cheese 90%, dried milk 86%, lamb and mutton 81%, butter 78%, and veal and beef 49%. The loss of export markets according to the three war scenarios has been estimated already in Table 11.2. A useful factor would be the large surpluses (see Table 11.3). There need be no problem in providing low-cost food for all New Zealanders for a very long period. The availability of food would depend on production and distribution; both would be weakened in the post-disaster period, distribution perhaps more so. The production of crops and livestock depends on manpower, fertilizer, pesticides, irrigation, fuel, farm machinery, and electric power. Agricultural manpower is likely to be more than sufficient, especially if urban depopulation occurs. Fertilizer loss, however, will have a substantial impact on crop and livestock production. Nitrogen fixing is presently achieved by the application of superphosphate to encourage clover. In a reactive mode, greater efforts would be made to ensure that supplies of superphosphate from Nauru and Christmas Islands were maintained. The output from the ammonia-urea plant, presently destined for export, would be diverted to local use. The Chatham Rise phosphate deposit, presently under consideration as a substitute for imported phosphate, is likely to remain untapped, because of the loss of Northern Hemisphere technology required for its extraction. Obviously, without fertilizer, crops and grass could be grown for several years, but soil depletion would occur after a time. It would be particularly important that fertilizer is available for horticultural production, because crops such as potatoes, fruit and vegetables would tend to reduce soil productivity very quickly without nitrogen.

Extensive pastoralism is least likely to be affected. However, decisions in the period following the nuclear disaster would undoubtedly relate to the total stock carrying capacity of New Zealand. Given the changed circumstances, a reduction in the number of livestock seems likely. Nevertheless, even taking a

(475) Recent research on the production of ethanol from milk by-products by the Forest Research Institute (Rotorua) is an excellent example.

(476) Dairy farms run by the Amish sect in Pennsylvania produce more milk per hectare than farms run on conventional methods, and use 80% less energy. Amish farms are broadly diversified, and are less vulnerable to pests or climate than orthodox farms. See The Futurist, Dec 1981, p36.

pessimistic view of the decline of production, it is still likely that at least two or three times the total amount of calories required for adequate nutrition in New Zealand would still be produced. A further margin is provided by a likely increase in human consumption of cereals, which previously had been used inefficiently as animal feed. Food wastage would also be decreased by a decline in food processing, much of which is done for export markets. The production of home-grown food is also likely to increase.

A great deal would depend on how self-sufficient in liquid fuels New Zealand had become at the outbreak of hostilities. Diesel fuel, in particular, would be crucial, if it retained its importance for all forms of bulk transport and agricultural machinery.

Planning Mode 3: (preactive)

In the preactive mode, emphasis is placed on contingency planning. This requires a preparedness to initiate change, now and in the future, to avoid the foreseen consequences of nuclear war. It is not suggested that New Zealand should undertake large programmes of shelter construction, because New Zealand will not experience dangerous levels of fallout unless it is directly attacked. It may, however, be prudent to set up some form of stockpiling of processed goods, and contingency measures by which fresh agricultural produce could be distributed in a crisis.

A more serious problem arises over the predominance of agriculture in the New Zealand economy. Preactive planning would note the likelihood of a shift of resources out of the agricultural sector into other sectors of the economy. This shift could be necessitated by the initial loss of export markets for agricultural products, and a need to manufacture goods with local resources. How it might be achieved preactively is a perplexing problem. A useful starting point might be increased research and development on ways primary exports could be reallocated as inputs to domestic consumption(475).

The agricultural sector is likely to experience a multitude of more specific problems which contingency planning could mitigate. The loss of pesticides, for instance, could result in significant losses of pinus-radiata to dothistroma pinea, and the loss of potatoes to blight. Shortages of imported veterinary supplies could cause poorer health of livestock, perhaps manifest as more internal parasites, brucellosis, and tuberculosis. Noxious weeds and animals could become an increasing problem. Many New Zealand crops are potentially vulnerable because of their lack of genetic diversity: for example, important crops include pinus-radiata, one type of hybrid maze, and one type of hybrid wheat.

Environmental modifications may also impact on production. Increased levels of ultraviolet radiation may cause damage, especially to sensitive crops, and a significant short-term decrease in average temperature is also a possibility. Preactive planners would move towards self-sufficiency in essential vaccines and pesticides to maintain production and animal health in the aftermath of a nuclear war. Biological pest control measures may become increasingly cost-effective. Through the greater use of human labour, horses, and organic fertilizers, some farms in the United States are producing more at less expense than surrounding farms which use pesticides and diesel-driven implements(476). The problem of plant pathogens could be reduced by a shift away from monocultural practices. The establishment of a seedbank would ensure the maintenance of genetic diversity in the event of a Northern Hemisphere nuclear war. The development of species resistant to the environmental modifications mentioned earlier would be a preactive response.

(477) J.M. Hunn, 'Development Prospects for New Zealand Industry', Decision Analysis Group paper B4, (Commission For the Future, 1981).

(478) Ibid, p5. This line of reasoning requires that Australia and New Zealad continue to trade (viz. if nuclear war occurs, it is not A- or B1-type).

(479) J. Hoadley, 'Sweden's defence policy: Six dilemmas', NZ Int. Rev. Jan/Feb. 1981, p23.

An example of a more far-reaching contingency plan would be to start now to move towards a two-tier economy. This has been suggested elsewhere(477) as a 'fall back' position in a deteriorating international situation, and was originally designed to cope with adverse terms of trade, but it appears also applicable to the context of a nuclear war:

> "... the approach should be aimed at 'getting the logic right'. The world has entered a period of considerable uncertainty, so a mixed approach allowing for a diversity of development and the ability to change direction should be prepared for. A two-tiered approach could be the most appropriate: establish a modest subsistence level economy, topped up by a Panglossian 'best of all possible worlds' economy which in times of war or recession could be scaled back relatively painlessly and quickly.
>
> The modest economy would aim for a level of self-sufficiency which could be sustained in difficult international periods. New Zealand industry should be capable of producing all products required for a 'subsistence' level: food, shelter, clothing, fuel and maintenance of essential capital assets. Aspects of the modest economy would be:
>
> - energy independence,
> - foundry and machining capability to provide spare parts for maintenance of all essential capital assets,
> - expansion of steel making facilities,
> - stepped up exploration for essential raw materials and stockpiling of quantities of imported materials.
>
> A second phase of development would be to utilise production capacity installed for this purpose to move these industries into exporting. Imports in these product areas should be allowed subject to normal tariff protection, in order to stimulate diversity, choice and quality, but mainly at the luxury end so that they can be curtailed easily, if necessary. The higher, but terminable, standard of living would be developed on a philosphy of increased world trade and interdependence of nations. This would involve the development of trade in products derived from our natural advantages, but recognising the volatility of trade barriers, commodity variations, transport costs and the disadvantages of distant markets. The principal thrust would be the processing, to various stages, of indigenous products utilising medium levels of technology, and in manufacturing, a concentration on small run/high value products. Tourism and export of services would also form part of this level of activity.
>
> New Zealand's recent trading experiences indicate that in a deteriorating international environment it is likely from time to time that we will have great difficulty in maintaining a viable economy which is totally committed to export earnings. It is cerainly in our interests to establish maintainable fall back positions. In this context New Zealand/Australian links should be strengthened and both economies developed to support each other"(478).

There are two working examples which approach preactive planning for nuclear war; both are found in Europe, an area in which the population has a high expectation of one being fought locally. Sweden offers a good example of the logic underlying a preactive mode. "One of the major tenets of Swedish defence is economic self-sufficiency, so Sweden can withstand economic pressure in blockade"(479). Similarly, the Swiss have chosen to assume that nuclear war is as likely as any other foreseeable future event, and have adapted their economy

"A country enjoying comfortable distances from the world's troubles, ample food, enviable social welfare, energy abundance, participatory civil traditions, and a highly skilled and homogeneous population has advantages other rightly envy. Curiously New Zealand does not readily discern many of the opportunities these beneficial traits confer. Distance, in particular, permits a variety of policies in international affairs. It also gives small states many purely diplomatic opportunities; they may offer brokerage services, undertake tasks in sensitive regions or simply stay out of other peoples' trouble ... Distance allows resilience, flexibility, more rational choice of policy and even self-sufficiency in event of trade disruption"(484).

(480) 'Contexts for Development: Clarifying Values', (Commission For the future, 1981).
(481) Ibid, pp41-49.
(482) B. Philpott, A. Stroombergen, S. Burnell, 'Economic Aspect of the Commission For the Future's Scenarios of 2010' Project on Economic Planning, Occasional paper 45, (Victoria University of Wellington, 1981).
(483) J.M. Keynes, 'National Self-Sufficiency', (1933).
(484) See for example, E.L. Wheelwright, 'Capitalism, Socialism or Barbarism? The Australian Predicament', (Australia and New Zealand Book Company, 1978). The quote above is from J.C. Clad, op cit.

to include the construction and furbishing of fallout shelters sufficient for the entire population.

Planning Mode 4: (proactive)

If New Zealand were self-sufficient, it could avoid (except for the psychological impacts) the consequences of B1-, B2- and C-type nuclear wars. People who prefer this approach would have to give up some of the opportunities for development and growth in overall living standards which would come from building a strong trading economy.

As a first step towards proactive planning for nuclear war, New Zealand might adopt 'negative design criteria'. This, simply, would involve doing nothing further which would increase New Zealand's dependence on external trade. A key focus would be on ways of reducing imports wihout adversely affecting exports. Some bilateral trading agreement would need to be sacrificed to reduce import dependence. Trade barriers would be required to protect local industry against foreign competitors.

Possible developments in New Zealand, if this mode of planning for nuclear war were to be adopted, could lead to a 'Context D' future, described in a previous CFF publication(480). In a 'Context D' society ..."basic requirements for all are satisfied at the community level ... Exports and trade are no longer the driving force of the economy"(481).

The Victoria Planning Model EMILY has shown that a reasonably self-sufficient New Zealand could have an active growing economy without emphasis on trade if people wanted to (or had to) change their lifestyle. Nevertheless, Gross Domestic Product (for the year 2010) would be $26 billion, which can be compared with $37 billion for 'Context A' (high growth - large-scale industrial economy); $33 billion for 'Context B' (sustainable - mixed-scale economy); $33 billion for 'Context C' (agricultural growth - welfare economy) (482). The comparison does not take into account a large 'informal' economy which is a feature of 'Context D'.

The reduced consumption reflects the trade-off between self-sufficiency (which provides security against the impacts of a nuclear war or other global calamity, at the cost of reduced consumption) and efficiency (which provides the benefits of an internationally-linked trading economy and maximum overall growth).

Some economists have suggested that the trade-off may not be clear cut. Keynes(483) has argued that world peace, prosperity and freedom could best be achieved by emphasising national self-sufficiency rather than international market capitalism: "I sympathise, therefore, with those who would minimise, economic entanglement among nations. Ideas, knowledge, science, hospitality, travel - these are the things which should of their nature be international. But let goods be homespun whenever it is reasonably and conveniently possible, and above all, let finance be primarily national". Keynes, in part, based his argument on economic efficiency. He argued that the spread of modern technology makes it increasingly easier to produce locally the basic needs of a community, and makes the argument for international specialisation and export-oriented growth less compelling(484). Toffler, in 'The Third Wave', makes the same point.

Some options raised in the above discussion are summarised in section 13 (p.169) - 'Directions'.

Appendix 11.1: Methodology Used for Deriving Table 11.1 (p136)

Two values indicating import dependence have been calculated for 14 selected industries. 'Simple Dependence' is the percentage value of total transactions within each industry that imports represent. Some transactions of a purely financial nature (viz. categories 104 to 138, 140 in ref (447)) add value rather than augment content. These have been subtracted from total transactions within each industry in the calculation of 'Linked Dependence', so giving a more realistic dependence of each industry on imports. Categories 1 (agriculture and livestock production), 3 (other farming), 10 (meat freezing and preserving), 57 (chemical products), 63 (petroleum and coal products), 68 (plastics), and 82 (agricultural and pastoral machinery) have been selected as key factors influencing agricultural production. Categories 38 (wearing apparel) and 50 (pulp, paper and paperboard) are examples of manufacturing industries, the first representing a highly-protected industry and the second an industry based on New Zealand resources. Categories 109 (road frieght) and 112 (air transfport) represent transport networks.

A disruption to imports will have a direct impact on activity throughout the economy. For example, within industry 1 (agriculture and livestock production) the following transactions take place with other industries:

1.0% with Category 57 (chemical products, 'Linked Dependence' = 49.4%)
4.3% with Category 58 (chemical fertilizers, 'Linked Dependence' = 85.1%)
0.5% with Category 63 (petroleum and coal, 'Linked Dependence' = 71.6%)
0.2% with Category 68 (plastics, 'Linked Dependence' = 49.0%)
0.4% with Category 77 (base metal industries, 'Linked Dependence' = 45.8%)
0.5% with Category 82 (agricultural and pastoral machinery, 'Linked Dependence' = 47.0%)

For these six industries, the cumulative total of transactions within Category 1 is only 6.9%, yet they are all crucial in strategic terms. Since the average 'Linked Dependence' is 58.0%, the continuation of inputs to agriculture and livestock production from these six critical industries is largely dependent upon the maintenance of imports. With these cut off by a nuclear war, New Zealand may experience difficulty in maintaining agriculture and livestock production at present levels.

(485) The Philippines and Vietnam harbour United States and Soviet nuclear weapons (see Defence Monitor Vol 4, No.2, 1975, p9). Controversy exists over the presence of nuclear weapons in Japan. However, in a war situation, United States weapons (e.g. in B-52 bombers) could well be moved there.

(486) "A Few Explosions Will be Necessary", The Bulletin of the Atomic Scientists, Oct 1977, p51.

(487) "And if (nuclear war) should come to pass - what then? No more war? That would seem possible only with a fundamental change in humanity and that most would agree, seems extremely unlikely. If then war is part of the human condition, so now is the nuclear weapon. As Koestler concludes:

> ... an invention once made, cannot be disinvented. The nuclear weapon has come to stay .. Man will have to live with it permanently: not only through the next confrontation-crisis and the one after that; not only through the next decade or century, but forever - that is, as long as mankind survives" (Arthur Koestler, 'Janus: A Summing Up' (Pan, 1979), p2).

(488) It is of note that the only successful sea invasions this century were from close land bases e.g. China and Indonesia by Japan (1939-40), France by the Allies (1945) and Japan by the United States (1945). All these relied heavily on huge navies (with aircraft carriers), strong air support and large armies.

(489) The rapid deterioration of sophisticated military equipment if not regularly resupplied has severely restricted the capacity of the Iranian military within a matter of only 3 years.

(490) '1978 Defence Review', New Zealand Department of Defence, (Government Printer, 1978).

(491) Present day regulations on immigration are already restrictive. Also, Northern Hemisphere residents did not flock southwards during the Cuban missile crisis nor when Afghanistan was invaded.

12. STRATEGIC CRISIS

12.1 New World Maps

Assuming that the events outlined in scenario B1 occur in 1990, and that the nations not devastated slowly recover their economic and military power, the state of the world in the year 2000 might be:

Viable economic powers: India, Brazil, South Africa, Argentina, New Zealand, Indonesia, Mexico, Pakistan, Venezuela. (Australia, Japan and China may be the first attacked nations to recover, if any do so. The poorer countries of Africa and South America may suffer greatly from the abrupt terminaton of development and investment aid.)

Nuclear weapon capability: India, Brazil, South Africa, Argentina, and Pakistan will have at least the weapons they produced by 1990. Other nations such as New Zealand, Australia and Japan might well acquire unused weapons from 'refugee' United States or Russian ships and aircraft after the war. Devastated areas of the world that may still contain nuclear weapons, but lack the military organisation required to retarget and deploy them include present-day NATO and Warsaw Pact countries and China, Vietnam, the Philippines and Japan(485). From these areas, nuclear weapons or weapons-grade plutonium (from reactor or reprocessing facilities) could be scavenged by neighbouring countries e.g. Mexico, Iran, Algeria. Weapons are also likely to survive on undetected submarines.

Leading economic powers would continue to have the greatest capacity to deploy nuclear weapons, and to manufacture conventional and chemical weapons. How these post-war weapons might be used has an historical precedent viz. deterrence, aggression, terrorism. Some commentators believe the demonstrated horror of nuclear war would provide the necessary impetus for nations to collectively destroy all nuclear weapons(486). Others disagree, and believe nuclear war would occur again in the future(487).

There would be little chance of any nation invading New Zealand for at least a decade after the war. The present navies of potential invaders such as Indonesia, Vietnam, Japan or China are dependent on diesel fuel, are unsuited for landing troops or armour, and could not provide air support from carriers(488). Even if they wished to invade New Zealand (whose only strategic material is grass), the termination of the present arms trade would cause them major difficulties in maintaining their remaining military equipment(489). Nations which survive the nuclear war may also have to use their military forces against separatist movements. It is likely, therefore, that New Zealand's present defence posture would continue viz. "For the time being there is no obvious threat to New Zealand's security. The problems this country (faces) are economic rather than military". Remoteness in the future, as now, confers some insulation against international tension (490). A possible qualification is represented by the 'invasion' scenario (see p147).

12.2 Refugees

It is probable that people will want to emigrate from the Northern Hemisphere to New Zealand in greater numbers immediately prior to a nuclear war. Such a movement could, however, be managed by New Zealand's present immigration controls, and if these continue it is unlikely that large numbers would be let in(491). After a war, migration may be restricted by damage to fuel infrastructure, aircraft and ships, port facilities, airports, and from casualities and absenteeism among transport crews. For the countries not

(492) 'Vietnamese Refugees' National Geographic, Nov. 1979.

(493) This action is historically a common way in which human society deals with the problem. Most recently, this was how the Malaysian navy dealt with some Vietnamese refugees.

(494) Australian refugees would be the most likely ones to provide skills useful for New Zealand society. Others, such as Indonesians, could provide useful skills in low technology agriculture, craftsmanship, entertainment and the arts. Language and cultural differences could, however, raise problems.

(495) At present, New Zealand defence policy emphasises the importance of nuclear weapons control and New Zealand has ratified the Non-Proliferation Treaty (see 1978 Defence Review, op cit).

(496) Examples of such military action abound in history. Winston Churchill suggested that nuclear weapons belonging to the Allies should be used to destroy the Soviet Union before it too had possession of them.

directly attacked, the problems of continuing military and civil conflicts, and shortages of supplies, would make long distance travel very difficult. Governments could well prevent their elite from leaving, (and thereby taking away expertise, wealth and transport facilities). It is difficult to predict whether people would elect to leave their homes for a long and perilous voyage to an alien country which may show hostility to arriving refugees.

Refugee ships are likely to be attacked by pirates and foreign military vessels seeking fuel, food, sex or gold. Grossly overcrowded and poorly equipped ships could have high mortality rates from disease, malnutrition and dehydration. About half of the recent Vietnamese refugees are thought to have perished during their 2000 km journey(492). Although Northern Hemisphere refugees may tend to go to Southern America, Southern Africa, South East Asia, the Pacific Islands and Australia, rather than remote New Zealand, many thousands may still arrive here, especially if Australia was attacked.

Seamen from remnants of the merchant marines and navies of targeted countries may elect to return to their home ports to seek surviving relatives. Many vessels may simply be unable to reach New Zealand, unless additional fuel was somehow obtained. If, however, one-tenth of the United States submarine fleet elected to come to New Zealand, 11 submarines would arrive, carrying about 1,300 crew. They could also bring several hundred nuclear weapons.

12.3 New Zealand's Strategic Response to a Post-War World

In the inactive mode, New Zealand would make no attempt to re-establish links with the rest of the world. Refugees would be able to land unchecked, possibly attacking civilians or spreading communicable diseases throughout the country. In a reactive response, fast patrol boats would sink refugee vessels or restrict landings to makeshift quarantine areas(493). Refugees escaping from insecure quarantine areas may readily spread epidemics.

In a preactive mode, quarantine areas would already exist to cope with the refugee influx. Offshore islands (such as Stewart, Waiheke, and Great Barrier) would provide adequate security. After individual refugees had been immunised, and certified free of disease, their assimilation into society, and the economy, could proceed(494). Limited international trade could be re-established, although merchant ships travelling in escorted convoys might be required. Renewed trade links could complement efforts by New Zealand to achieve dismantling of remaining nuclear weapons, and initiatives towards a lasting world peace(495).

As an interim measure, New Zealand may elect to incorporate nuclear weapons (e.g. from surviving United States tactical or strategic submarines) into its defence forces, and become a nuclear power! It could even use these weapons pre-emptively against any nation it perceived as a threat(496). Alternatively, the hazards of being a nuclear target (through the possession of nuclear weapons) may spur the dismantling of such weapons.

Relief expeditions to North America and, if necessary, Australia could be mounted by New Zealand, to supply humanitarian aid to survivors. Expeditions seeking essential resources in short supply (e.g. catalysts, silicon chips, pharmaceuticals) might also be required.

New Zealand's current defence forces would be of limited effectiveness in meeting such new challenges. Defence spending, as a percentage of GNP, amounts to 2.1% (or $114 per capita), compared with 3.3% ($272) for Australia and 6.0% ($644) for the United States. "Countries like Switzerland, Sweden, Yugoslavia

"The most persistent sound which reverberates through man's history is the beating of war drums. Tribal wars, religious wars, civil wars, dynastic wars, national wars, revolutionary wars, colonial wars, wars of conquest and of liberation, wars to prevent and end all wars, follow each other in a chain of compulsive repetitiveness as far as man can remember his past, and there is every reason to believe that the chain will extend into the future"(498).

'Yuugumo' (Japan) and 'Ivan Rogov' (Soviet Union) - foreground

(497) J. Turner, 'What Price New Zealand's Security?', <u>NZ Int. Rev</u>. Vol 6, No.6, 1981, p14.

(498) Arthur Koestler, op cit.

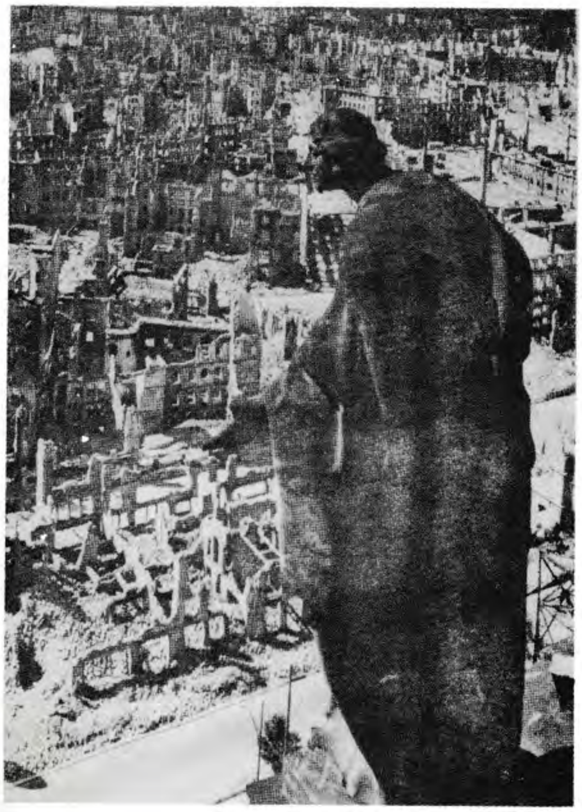
and France are convinced that meaningful national security can only be bought at the national level, and at considerable cost ... These countries ridicule any belief in the fidelity of an alliance now that the nuclear age is with us ... Should the United States or Australia deem it necessary to deny this part of the world to a would-be aggressor, then (New Zealand's) military mite will not count for much. Should they not deem it necessary, then not only does (New Zealand) have an ineffective defence force, but (it has) one that is geared to the wrong type of conflict"(497). The problem, then, may not be the size of the defence vote, but how it is spent.

The Leander- and Whitby- class frigates may usefully complement the anti-submarine defences of a carrier task force, but could prove overly-complex for the interception of refugee-laden fishing boats. Fast, ocean-going patrol craft could prove equally adequate, and more cost-effective. The P3B Orions could continue to provide useful maritime reconnaissance, but larger numbers of less sophisticated aircraft similarly may prove more cost-effective. The A4 Skyhawks may prove ideal in dealing with uncooperative intruders. M41 battle tanks, armoured fire support vehicles, and 105 mm howitzers are unlikely to serve any function at all.

Far enough South to escape the worst of global fallout, far enough East to escape direct fallout, far enough to the South-East of densely populated countries not to be overrun by refugees, New Zealand has the option of planning to survive a worst-case nuclear war (scenario B1). By doing so, New Zealand would be in a position to offer at least some humanitarian assistance to the survivors in the North.

Who speaks for Earth? (cont. from p12)

"... we are the local embodiment of a Cosmos grown to self-awareness. We have begun to contemplate our origins: starstuff pondering the stars; organized assemblages of ten billion billion billion atoms considering the evolution of atoms; tracing the long journey by which, here at least, consciousness arose. Our loyalties are to the species and the planet. Our obligation to survive is owed not just to ourselves but also to that Cosmos, ancient and vast, from which we spring. We speak for Earth" (499).



Dresden after firestorm

13. DIRECTIONS

In the past New Zealanders have preferred to cope with disaster either by dealing with it on the basis of past experience, or by predicting its outcome and implementing contingency measures in advance. These two responses (reactive and preactive) reflect how most people think about the future, and imply no major change of direction in the country's development.

The preferred response to the threat of nuclear war will depend on how people assess its probability and its likely impact on New Zealand society. This Report attempts to provide an objective basis for such an assessment.

We, the contributing authors, have analysed the implications of nuclear war for New Zealand. In researching, and living with, the subject for some time we have reached our own consensus on some of the issues.

- We believe New Zealand's position in the world gives it the opportunity to avoid the worst consequences of a Northern Hemisphere nuclear war.
- We believe, by proactively planning to survive a Northern Hemisphere nuclear war, New Zealand would be making a statement of greater impact than the past forty years of debate on nuclear disarmament conducted in the international forums of planet Earth.
- We believe such planning, while being the most effective contribution New Zealand could make to world peace, would require a new direction in this country's affairs, both internally and internationally.

What is your answer to the questions raised by this Report:

- Should New Zealand continue to ignore the possibility of nuclear war?
- If not, what measures should New Zealand take now to reduce its effect?

Hiroshima 1945

Part Four : a Fictitious Account

14. Apocalypse 1989

No Ordinary Sun

> *"Tree let your naked arms fall*
> *nor extend vain entreaties to the radiant ball.*
> *This is no gallant monsoon's flash,*
> *no dashing trade wind's blast.*
> *The fading green of your magic*
> *emanations shall not make pure again*
> *these polluted skies ... for this*
> *is no ordinary sun"(500).*

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(499) Carl Sagan, 'Cosmos', (McDonald, 1980), p345.

(500) Hone Tuwhare, 'No Ordinary Sun' (Longman), p23 (excerpt).

(501) This account, written by P.C. Wilkins, was first published in the collection 'Pictures of the Future' (Mallinson Rendell, 1980), and is reproduced here in abridged form with the kind permission of the publishers.

(502) Nostradamus was a sixteenth century astrologer and prophet (see 'The Prophesies of Nostradamus, ed. Erika Cheetham, Corgi 1975); Aldridge is best known for 'The Counterforce Syndrome' (Transnational Institute, 1978); R.F. Ryan is a former director of the Commission For the Future who has written widely on the subject of nuclear war; General Sir John Hackett is author of 'The Third World War: August 1985' (McMillan, 1978).

14. APOCALYPSE 1989(501)

Thirty years ago, in 1982, New Zealand was bucking along in the midst of another economic and social crisis, one of many experienced since social and economic theories were first applied to the business of managing a trade-dependent economy. Few people in the boisterous early eighties, seriously considered that the world as they knew it was going to end ... within their lifetimes! Few seriously imagined that a new society with a quite different base was a real possibility within a generation.

Dominating debate and political dissension in the early eighties was the question of growth - how was economic growth to be achieved? This question was pursued with vigour by successive governments through the seventies and into the eighties without any one answer being found. There were concentrations on external diplomacy, internal structural changes and population support at various times and in varying combination. At every stage, new factors intervened to frustrate the orderly pursuit of one economic schema after another. In the seventies the escalation in the price of oil and subsequent world currency fluctuations proved to be the bogies. As the eighties moved on internal conflict rose to new heights around the questions of wage relativities, inflation, the introduction of new technologies, the degree to which Parliament had the right to direct the inhabitants of the country, and whether or not minority groups should function only at the behest of the majority.

Foremost in New Zealand producers' minds was the realisation that competition, tariff barriers and spiralling transportation costs were rendering New Zealand exports both unattractive and unsellable to traditional markets particularly in Europe. The opportunities being created by improved marketing techniques did not prove sufficient for an economy still geared to the European palate and incapable of the necessary rapid change. This lack of adaptability proved to be an ideological barrier that was quickly broken down during the reconstruction period out of sheer necessity.

Internal conflict was to a large extent regarded as insignificant when ranged against international problems. Chief amongst these was the growing antagonism between the major military alliances. Nuclear arms testing proceeded, although always officially denied by the governments involved and sporadic revolutionary struggles took on ominous overtones as more and more powerful weaponry became available to the various protagonists. ANZUS began seriously to be questioned when heavy fighting erupted on the borders of Afghanistan, Kashmir and China over possession of a small valley. This incident would normally have been passed off as of little importance but the three major powers, the United States (as ally of Pakistan) the USSR (as de facto ruler of Afghanistan) and China all decided on a heavy propaganda exercise in which various scarcely veiled hints were made regarding the use of nuclear weaponry (these events took place July-August 1983).

Amidst such tensions the 1984 elections took place in New Zealand. Voter turnout was the highest ever.

One of the first acts of the incoming government after its victory was the severing of all mutual defence ties with other nations. It opted for a non-aligned political role in international politics and support for a nuclear-free South Pacific. This meant that ANZUS became AUS, the few American installations of a military nature were dismantled and the New Zealand armed forces stationed in various parts of Asia were recalled. Reorganisation dealt mainly with the formation and training of a civilian self defence corps partly armed by the state and clothed by private sponsorship. A notable feature of this corps was the inclusion of many devotees of martial arts as non-armed units.

Together with most of the Polynesian nations and such geographically spread countries as Tanzania and the Maldive Islands, New Zealand founded an association of non-nuclear trading nations with the express purpose of overcoming many price and supply barriers dogging primary producers. By 1988 this association had some forty-six member states and was beginning to exert significant economic leverage. Given twenty years of trading opportunity this organisation (ANNTAN) could possibly have caused redirection of major profit flows between 'first', 'second' and 'third' world countries. The implications that such a change suggested in the late eighties were of such magnitude, that had such a body been established a decade earlier, Apocalypse 1989 might have been avoided. That is unsubstantiated speculation, however.

Many conflict theorists (Nostradamus, Aldridge, Ryan, Hackett(502)) had predicted nuclear war in the mid-eighties, before the signs became incontrovertible as they did in 1983. By that time nuclear proliferation was so advanced that security measures were ineffective in preventing 'unauthorised' use. Theft of nuclear devices and 'illegal' construction of various nuclear mechanisms increased following the first incident in the USA in June 1978. Various ransom demands had been made using such devices, the most extensively publicised being that in Brazilia in April 1984. On this occasion a group opposing the ruling military junta released a statement saying they had planted a nuclear device (20 kilotonnes) in the newly completed House of the Ruling Assembly; they demanded the resignation of the government, the release of all political prisoners, the redistribution of land title and the disbanding of the armed forces. Acting on the advice of their American military advisers President Suàrez and the junta refused the publicised demands. The President and a large number of his neighbours died when the device was triggered. It had actually been planted in a villa fifty yards from his own on the outskirts of Brazilia. The small size of this device meant that only one eighth of the city was badly damaged by the explosion. Continuing radiation problems are being experienced, however.

The nuclear scene was not dominated by such isolated acts. Tensions between the main blocs, i.e. Warsaw Pact, NATO and China were rapidly intensifying, a situation that was much alluded to when New Zealand withdrew from ANZUS in 1984. The SALT agreements were not considered binding by the signatory nations and all military efforts were poured into enlarging the tactical ICBM forces available and developing defence mechanisms capable of ensuring the success of a pre-emptive strike. As world-wide economic inequalities grew, uneasy detente gave way before the desires of the military-industrial complexes in each bloc, hastening the aforementioned proliferation. The Soviet invasion of Iran in December 1986 ostensibly in support of the Kurdish fighters, led to a series of very strongly antagonistic statements between Washington, Moscow, and Peking (USSR and China were involved in heavy border clashes along the Assur River at that time) and the Russians withdrew after a protracted period of political manoeuvre.

Ironically, poor security conditions were the factor of crucial importance in June 1987 when the first international nuclear event took place. A 'Fascist' political group in West Germany captured a military installation and made off with a nuclear warhead as fitted to tactical missile systems. With a homemade delivery system the warhead was targeted on Magdeburg, a city which it largely destroyed. The East German response was immediate - Kassel was selected and obliterated. A total nuclear debacle was avoided by swift diplomatic action, protestations of innocence and immediate prosecution of the 'alleged' West German offenders. Throughout the entire episode the major nuclear powers, the United States and USSR, remained relatively unmoved although much threatening dialogue took place. The non-involved world mopped its feverish brow while NATO and Warsaw Pact forces renewed their ostentatious preparations for a land based war in Europe. The next year and a half saw a world remarkably free of major conflict although, like the heavings of the volcano prior to its cataclysmic eruption, it was obvious that the world was experiencing a false peace. Only a few non-aligned governments pronounced themselves hopeful that 'the balloon might not go up' (to employ a colloquial New Zealand phrase). They were, however, like people addressing two opposing thunderstorms, black of brow and lightning crowned, that rush head on towards each other - mindless of consequences, feeling only the forces driving, towards the ultimate confrontation.

At 3.00 a.m. GMT on Tuesday 17th September 1989 the President of the United States ordered a pre-emptive strike against all military and industrial targets in the USSR (and against its known bases around the world), a move that effectively destroyed the entire Soviet population.

Lack of data has hampered a complete and accurate explanation of that decision. It does seem reasonably clear, however, that the American military were worried that Soviet expansionism was proceeding faster than they could strategically accommodate; that USSR armed forces had achieved clear superiority; and that a land war in Europe could not be won. It is also fairly clear that the Americans firmly believed that they then possessed a defensive system capable of neutralising any Soviet retaliation following a pre-emptive strike, and that their intelligence was good enough to ensure them an eradication of almost the total Soviet ICBM capability.

The Americans were misinformed on two counts: the accuracy of their intelligence and the efficacy of their defensive systems. Soviet response was effective and widespread. Mainland United States defence systems were overwhelmed by vast numbers of multiple warhead deliveries. Chinese population centres were destroyed and every American ally from West Germany and Britain to the Indonesians and Australians found themselves denuded of population concentrations of 'strategic' significance. Second and third wave replies by all sides effectively ended the first nuclear and third world war. It has been estimated that approximately 1.3 billion (a figure 400 times that of New Zealand's current population) people died immediately or from resultant radiation sickness.

The sheer magnitude of destruction was illustrated to New Zealanders first by the sudden loss of news and other current affairs programmes of overseas origin and, shortly thereafter, by a specially equipped Orion overflight of Australia. High altitude photographs showed catastrophic destruction from Adelaide, Melbourne, Hobart, Sydney and Canberra all the way to Brisbane. Their glowing, irradiated centres at night and the truncated twisted and fused Sydney Harbour Bridge by day will live as visions of horror for all who lived at that time.

Additional millions of people died in the following decade as spasms of violence swept through the majority of Asian, African and South American countries that had been supported by one or other of the major powers. Governments fell regularly although the 'conventional' (non-nuclear) weaponry generally employed did not significantly extend the destruction caused by the apocalypse.

Many immediate effects for New Zealand had been predicted in the event of such warfare. World trade certainly was completely disrupted, an event having profound structural implications for New Zealand as will be discussed later. There was no massive movement of refugees to New Zealand. Indeed world wide there was very little migration, due to the spread of destruction and the breakdown of high speed communications networks. Migration did occur from Asian countries, but that only returned the population to 1980 levels from which it had dropped markedly during the 'austere' eighties (as the first six years of the decade were known).

The years immediately following the war were chaotic. Although some infrastructural adjustment did occur (1985-9) it was in no way designed to cope with a New Zealand that suddenly was totally isolated from the world in a way it had never been before: 17 September a member of a living functioning world community ... 19 September a survivor in a charnel house!

The event was totally shattering - many thousands of New Zealanders suicided or went insane in the traumatic few weeks that occurred when the sheer extent of destruction became apparent. Internal communications were largely unaffected by external events and government continued to function. Mobilisation of the self defence corps proceeded quickly and emergency legislation ensured continuation of society (Parliament extended itself by regulation for an indefinite period immediately following the events in September 1989).

It soon became apparent that life could not continue as it had for much longer. The only information garnered from around the world originated in a few of the intact surviving nations in Asia and South America. Australia no longer had any coherent structures still functioning.

A period of stocktaking took place. In New Zealand's favour were its energy supplies, agricultural base and adaptable industries, plus a largely untried commodity - the productive adaptability of the populace. It was obvious that the pre-deluge debate over the advisability of emphasising trade was defunct. Government did recognise that decision-making by the executive was not necessarily the most creative course of action to follow given the changed realities. New Zealand was an isolated country thrown on its own resources, reliant on itself, with no one else to do the trail blazing.

Consultation and opinion-forming went on over a period of eighteen months; it was the sole concern of over thirty thousand government employees and some twenty thousand private individuals. At the end of this period, in August 1991, the Joint Parliamentary Commission put forward a series of measures designed to streamline and co-ordinate the societal change that would occur in the next decade. There was an interesting mixture of regulations which emphasised strict control of the economy and widespread dispersal of authority regarding social issues. Selected features were:

- The current legislative assembly to continue in operation until November 1994 at which time a revised system of proportional representation would be introduced. (It is important to remember that many party standpoints had been rendered irrelevant by the elimination of the trading economy).

- A new regime of manufacturing production was instituted emphasising a range of 'essential' goods and mechanisms. Significantly energy saving devices such as solar panels, windmills and clivus multrum-type waste disposal devices were given high priority as was the production of portable communications devices. (The importance of such an emphasis had become apparent because of the impossibility of maintaining the huge network of electrical cables throughout the country and of the piped waste disposal system).

- Research emphasis was placed on developing mineral and chemical extracts from the plentiful supplies of biomass available, especially for medical use.

- Agriculture was to be gradually revolutionised. Horticultural diversity especially was to be encouraged as was the cropping of as much arable land as possible in an effort to extend the production of ethanol fuel. Erosion-prone land was gradually abandoned. Programmes of encouragement for labour-intensive, self-sufficient farming were instituted and proved highly successful.

- In order to make reconstruction feasible a new paper money issue was created - the Kiwi. All pre-1991 currency was recalled, the paper money destroyed and coinage returned for use as raw materials in industry. Government established the level of currency in circulation and made it roughly equal to the value of goods and services available. The international money base, gold, was no longer important.

- All foreign owned and controlled companies were to be acquired by the state.

- The Joint Parliamentary Commission decided on a number of measures in the social field. Most resented of these was the running down of the breweries and tobacco industry. Home brewing and the legalisation of herb cultivation ameliorated some of the dissatisfaction, however.

- Regulations were made more flexible, notably those concerning energy use. Active encouragement of migration to rural areas and of co-operative title to land was given. This was especially significant for Maori and Polynesian people who wished to re-establish close relationships with the land.

- Networks as large as the education system were rapidly broken down. Curriculum decisions were transferred to local communities. Health care received a proportional increase in resources and personnel, as well as being gradually decentralised. (It is now organised on a township medical centre basis).

- Regional authorities were modified and became completely dependent on locally gathered revenue.

- Extended suburban areas were seen as unsupportable and to be gradually dismembered. Residents thus displaced were either assisted to take up a rural lifestyle or joined the centre city redevelopment programmes in high-rise buildings. (Many companies, whose only reason for existence disappeared with international trade, either voluntarily liquidated themselves or donated their buildings).

- A standard wage in kiwi currency was to be paid to every person to provide them with the necessities of life until 1995 at which stage a gradual shift towards private acquisition would again be tolerated. Work itself underwent redefinition at this time. Unemployment through lack of skill became almost unheard of.

Many co-operative ventures in every area of socio-economic endeavour led to this redefinition and channelled energy usefully. By the time the 1994 elections were held vast efforts had been made to successfully inititate the original 1991 programme. The new legislative assembly gradually took control amid an upsurge in political repartee, and a resurgence in representative sporting fixtures, coincidental perhaps!

In order to eradicate black market profiteering, particularly in spare car parts, currency with an eighteen month lifespan was introduced. This measure had some effect since speculation was rendered extremely difficult. Bartering continued to grow in importance as the nineties unfolded and still remains a major source of acquiring goods.

'Reconstruction' has continued apace with mixed success, huge sacrifices, many readjustment problems and the occasional power struggle, until the present day. A number of significant events must be detailed before an overview of current conditions is given. The year 2000 AD (or 11 PA - Post Apocalypse as it is commonly known) was notable not only as the end of the second millenium after Christ but as the year in which the basic work of reconstruction was mainly accomplished and the frantic pace of work began to diminish. It marked the year in which diversity of endeavour began once more to expand dramatically as people resumed interests long abandoned as unwarranted luxuries in the crisis. For the first time in twelve years the work-scarred legions of the self defence force found a reduction in demand for their extra labour in various parts of the country.

It was the year of the first official visit by another Head of State, the greatly aged Julius Nyerere, President of Tanzania. One of the few long distance jets still in operational condition served as transport powered by New Zealand turbine fuel from Taranaki. (The lifespan of the Maui field was extended to forty years by careful rationing). Sea-borne trade also found its rebirth in 2000 AD with the launching of the first solar and sail merchant vessel in Auckland. Such vessels, of which there are now fourteen in service, manage a return trip to Africa in a month and through South Asia and Polynesia in a similar time. Through international agreement trade is now strictly by barter with pre-agreed exchange rates.

Channelling effort and energy into research in the nineties proved its worth not only in the areas of industrial and medical development, but also in a vitally important field - that of communications technology. New Zealanders have always been an information-hungry group of people and though the pursuit of external information was reduced in favour of internal unity during the nineties, maintenance of surviving international communications links and installation of new types of links still were accomplished.

An early expedition to Singapore resurrected several score crates of microprocessors, sufficient for the expected New Zealand demand to 2020 AD (31 PA). Research priority has been allocated to the production of domestic versions to satisfy need beyond that date.

These have been used in a further level of industrial development including that generation of the word processors from which this report has been produced. Since President Nyerere's visit there has been an upsurge of diplomatic activity around the globe. It is sobering to remember that it is confined almost entirely to the southern hemisphere although Central America, Northern Africa and areas south of Burma have continued to function as national entities having been spared radiation counts of significance. It is known that some North American and Chinese people exist in communities of sorts but few efforts at contact have been made by individuals and none by governments. A sense of self reliance and insular strength is the most important characteristic among nations in today's world. While trade does occur and while messages of goodwill are frequently exchanged, most modern New Zealanders are unwilling to travel and discover world conditions first hand; the desire to know has been largely submerged by the desire to be informed. The post-apocalypse generation, however, are freer from this unwillingness than their older fellows.

The apocalyptic event and thirty years of hard work based on a detailed yet flexible plan have created a New Zealand that will survive and prosper in the years to come. Adjustments in lifestyle have, it seems, produced a nation which values its cultural diversity and has a less emotional view of the pre-1989 world than did the people living at the time. Population is also less concentrated than it was before the deluge, with between thirty and thirty-five per cent now living outside the major urban areas. Architectural layouts have undergone much change. Open spaces in the cities have been largely utilised for the provision of necessary foodstuffs. Bulk commodities including grains, rice, meat and some fruits are still 'imported' from farming districts. Diversity in cropping has meant both a 'cheaper' and wider selection of foodstuffs than previously. The enforced insularity of communities has meant that cultural interchange has occurred in some at an increasing rate, in others hardly at all. Minority languages such as Maori, Samoan and Cantonese are now taught and learnt at a majority of the formalised educational institutions throughout the land.

Thus as the second decade of the new millenium looms ahead, New Zealand society and its position in the world are infinitely stronger and less demanding than could have been imagined only thirty years ago. The country is a united whole, inward-looking it is true, yet more sure of itself as a result. Obviously in time the living will no longer include any people who can remember the actual events which ended last century in tragedy. It is certainly to be hoped that people will in the future possess the ability to look at a map of the world, see the death in the iridescent yellow areas and vow - never, never again - and have the humility to keep the vow.

McGuinness 2009
FNZ