WAGING PEACE SERIES

As far as is known, the term "Waging Peace" originated with Warren Wells, late husband of Ethel Wells of Santa Barbara, in a letter to President Eisenhower. It was a long-standing practice of Mr. Wells to keep in close touch with key national figures and give them his views on peace issues as well as other vital matters. This series is dedicated both as a memorial to him and in gratitude to Mrs. Wells for her continued efforts in this cause.

In this series the Foundation publishes and distributes short booklets stressing ideas for attaining peace. Concepts expressed will include views of many authorities, and will not necessarily be those of the Foundation. Suggestions for topics and your ideas about this issue are welcome. Booklets in this series and two anthologies of **Waging Peace** booklets are available from the Nuclear Age Peace Foundation.

ABOUT THE FOUNDATION

The Nuclear Age Peace Foundation, founded in 1982, is a non-profit, non-partisan, international, educational organization dedicated to:

- achieving a nuclear-weapons-free world;
- creating a permanent International Criminal Court and strengthening international law;
- teaching peace;
- promoting nonviolent resolution of conflicts; and
- creating a world based upon liberty, justice, and human dignity.

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Published by the Nuclear Age Peace Foundation
First Printing, November 1994
Printed on Recycled Paper

NUCLEAR WAR:

THE PERSPECTIVE OF A PLANETARY ASTRONOMER

by

Carl Sagan

Carl Sagan receiving the Nuclear Age Peace Foundation's 1993 Distinguished Peace Leadership Award from Foundation officer Dr. Diana Hull. Photo © James King

Booklet 36
WAGING PEACE SERIES

Nuclear Age Peace Foundation

NUCLEAR WAR:
THE PERSPECTIVE OF A PLANETARY ASTRONOMER

by Carl Sagan

To my surprise, I spent a lot of the 1980s studying nuclear weapons and nuclear war. My involvement in this central issue of our times was accidental. It came about from three quite different directions, all emerging out of my professional activities — which are mainly exploration of the planets using interplanetary spacecraft, a matter as remote from the short-term political agenda as you could imagine. After all, by definition, planetary exploration isn't even concerned with this planet. You would think there's no way that it could involve me in worrying about nuclear war.

We have pretty much now completed the preliminary reconnaissance of the solar system. It's an astonishing accomplishment. It only happens once in the history of the human species, and we are lucky enough that it happened in our time. I'm very fortunate that I was able to be a part of it. We have flown by, orbited, or landed on some seventy different worlds — magnificent worlds, diverse worlds, no two alike. Enormous amounts of new information on their surfaces, their atmospheres, their interiors have been acquired. We've learned things in geology, seismology, volcanology, climatology, meteorology, but there's one "ology" we have not had anything to learn about, except its absence. That's biology.

The Preciousness of Life

These worlds, as nearly as we can tell, so far at least, in this solar system only, are lifeless. You can have seventy worlds, and life on only one of them. This, to me, says something about the rarity and preciousness of life.

You find just the same thing in the geological record. Sixty-five million years ago, the proud possessors of this planet were the dinosaurs. They were everywhere, land, sea, air. If you had dropped down on the Earth then, you would of course have predicted that they and their descendants would continue into the far future. They had already been around for one hundred and twenty million years.

They are all gone. They were snuffed out, all over the planet in what in geological time is an instant. It makes you wonder, if they, so immensely

successful for such a long period of time could be destroyed, what about us? Our genus has been around for only a few million years; our species for only a few hundred thousand years — we who have created world-transforming technologies.

The key difference is that the dinosaurs, whatever else you want to say about them, were not responsible for their extinction. If there's an epitaph for us, it very likely will not be, "They bore no responsibility for their own demise." That's not what it would say.

We find a similar lesson in space and in time. Nothing is guaranteed. No organism on Earth has its tenure warranted. And so, out of such research findings, I developed a sense of our vulnerability.

I want to stress that the Earth itself is not in danger. The Earth abides. The Earth has seen species come and go. Of all the species that have ever lived, 99.9% are extinct. Extinction is the rule. Survival is the exception. The worst of our technology — blow up all the nuclear weapons, all at once on cities, whatever you want to do — doesn't affect the Earth. It goes around the Sun, it spins, it is carried by the motion of the Sun around the center of the Galaxy, oblivious of what happens in this thin film of life that coats the surface of this obscure planet.

What's more, life is also very hard to wipe out. It is resilient and widespread. Again, blow up all the weapons. It hardly matters. Some kinds of life will survive — grasses, social insects, the worms that inhabit submarine vents on the ocean bottoms and live out their days altering the oxidation state of sulfur. They don't care about nuclear war. The species that is vulnerable to our technology is us. We are a danger to ourselves. It is easy to talk about this endangered planet, life on Earth at risk, and so on. I sometimes find myself doing so. But this is an inaccurate way of talking. What's at risk is us.

Nuclear Winter

The second way I became involved in the matter of nuclear war emerged out of a dust storm on Mars in 1971. The first spacecraft ever to orbit another planet, Mariner 9, was injected into orbit around Mars in December of that year. Instead of a world of wonders, we saw a completely featureless planet— because it was obscured by a global dust storm. We were sitting there twiddling our fingers, able to see nothing. I was involved with the cameras, the imaging system. But the infared people got data. So, for want of anything else to do, my colleague Jim Pollack and I sat around and tried to understand it. The data showed that in the midst of the dust storm, the Martian surface

was much colder than it ordinarily is and the atmosphere much warmer. We tried to work out what was happening; how atmospheric dust blocks the sunlight and cools the surface. We succeeded in correctly estimating — roughly — how much the surface had cooled.

Eventually the dust settled. The storm was over. The wonders of Mars were revealed, and all this was almost forgotten. A few years later, though, we began to apply the computational armamentarium to a terrestrial problem: the slight cooling of the Earth following a major volcanic explosion via the fine droplets of sulfuric acid injected into the stratosphere — something like what the dust storm had done to Mars. Only around 1982, 11 years after that Martian dust storm — in collaboration with Richard Turco, Brian Toon and Tom Ackerman — did we finally get around to realizing that we had the ability to calculate what would happen to the Earth's climate in a major nuclear war. You burn cities, you put fine particles up high and they also are going to block the sunlight. No one had ever calculated what the consequences would be.

What we found was profoundly disturbing. We discovered that the nuclear weapons establishments of all the nations had totally missed what seemed to be a major consequence of global thermonuclear war; something that we since have called "Nuclear Winter" — the darkening and cooling of the Earth for a period of a few years, cooling to temperatures significantly below the lowest in the last Ice Age. Global agriculture is extremely vulnerable to such temperature declines, and estimates now, by many international groups of biologists and agricultural scientists, indicate that enormous numbers of people, perhaps most of humanity (according to some estimates), would die as a result.

There are only about 2,300 cities on Earth (population 100,000 or more). You needed only a few hundred weapons to induce nuclear winter. The United States and the Soviet Union had amassed well over 60,000 nuclear weapons.

The implications of Nuclear Winter challenged the then-prevailing military doctrine. Make a massive attack on your enemy's cities, and even if your adversary does nothing to retaliate, you're dead; you've destroyed your own nation. This is a serious reversal of conventional thinking. It unravels the threat of massive retaliation and global thermonuclear war.

I was in this way drawn into issues of nuclear war from the most innocent activities: studying dust storms on Mars. I had never intended to do it. When it turned out that the long-term consequences of nuclear war of the sort I've just described challenged the prevailing strategic postures, the

wisdom of deterrence, I was willy-nilly caught up in debates on nuclear strategy. It's been a very interesting time for me.

The United States was very resistant to this information, the Soviet Union much less so. There is evidence from several directions that the Soviet General Staff, Soviet Ministry of Defense leaders and President Mikhail Sergeyevich Gorbachev were influenced by the prospect of Nuclear Winter. At a meeting of the General Staff, one Soviet general said of the nuclear arms race as they discussed Nuclear Winter, "Well, it's all over, isn't it?" There are so many streams flowing into this river. I can't be sure how much nuclear winter contributed, but it seems to have played a role.[1]

"Star Wars"

The third factor was "Star Wars." The idea, to put it at its most grotesque, to stress how far from reality the United States drifted — the bill of goods Edward Teller sold to Ronald Reagan — was that the United States could put a desk-sized hydrogen-bomb-driven x-ray laser in space which would shoot down all 10,000 Soviet warheads in case of a full-scale attack by the Soviet Union on the United States. Don't you want to have this kind of protection, Mr. President? Since I know something about spacecraft, and had an interest in keeping space accessible for exploratory purposes, I was again drawn in.

I didn't mean to be. But, I have children. I have a grandchild. I have, for all sorts of reasons, an interest in the future. The thought kept recurring to me that, probably, I could do nothing since the momentum was so enormous. Still, I didn't want to recriminate to myself in my old age that I might have done something to stop it and did not.

I hadn't planned to get involved. It took a great deal of time away from primary areas of scientific research, but its been, in many respects, a wonderful learning experience and, who knows, maybe I was able to help a little bit.

Roots of the Nuclear Arms Race

In this same period, after the *Cosmos* television series, Ann Druyan and I thought that we had an obligation to try and understand the ultimate roots of the nuclear arms race. What was this about? We looked each other in the eye and made a vow that we would follow this inquiry wherever it led, even if it might challenge our own deeply held beliefs. We shook hands on it.

I think I had the idea that to understand the nuclear arms race, you

would have to go back to the Second World War, the cauldron out of which nuclear weapons certainly emerged. But even on brief inspection it was clear that the issue between the two nuclear superpowers was in large part, not just about a conflict of ideologies, but a conflict of nations. Nationalism was the key. The conflict of nations in the Second World War surely had its origin in the First World War. But you go back to the First World War and you have learned absolutely nothing, because nothing new happened to human behavior between the first and second world wars. You have to go back further. And so we were carried back, back. Perhaps the origin of the nation-state is the place to really understand what this is about, we thought. So you're back there at two thousand B.C. or so, and you're learning about Sumer and Egypt and Assyria and China, India, Meso-America. And there they are, recognizably the same guys. Different head-dresses, different languages. But they're all talking about killing one another! The enemy is outrageous; they wear ocelot skins instead of quetzal head dresses. They are worthy of being destroyed. You hear how they talk? They can't even talk proper Nahuatl or Hebrew or Chinese. It was very familiar. We hadn't gone far enough back.

Eventually, our quest took us back to the origin of the human species, a few hundred thousand years ago. But as far as we can tell, even that wasn't far enough back. There are, for example, skulls bashed in from that period of time, all in the same way, from which the principal conclusion drawn by some paleo-anthropologists is that our ancestors were right-handed. But, there's another important conclusion that can be drawn from these bashed-in heads. Our journey took us back — and we really had not imagined from the beginning that would be where we'd wind up — to before humans had ever evolved on Earth.

Let me mention the perspective that emerged. It's in our book, **Shadows of Forgotten Ancestors.**[2] I can't summarize the entire book here, but let me give you a flavor of what we're talking about: First, let's consider chimpanzee society in Tanzania or Sierra Leone, or any of that broad belt across central Africa where chimpanzees still live in the wild. Chimpanzees share 99.6 percent of their active genes with us, as is understood by DNA sequencing analysis; whatever differences between them and us are in that 0.4 percent. That's a very little difference. We might be able to learn much about ourselves by studying our closest relatives.

They live in small groups of a few dozen, each group in its territory, in its own region of the forest. They have very active social lives. They have technology. They have ethnomedicine. They can communicate subtle ideas. They show compassion and altruism. They tenderly raise their young. The males abuse the females. There's all sorts of sexual exploitation. There's a

dominance hierarchy with an alpha male on top who has sexual privileges with all the females. Occasionally, a bunch of scheming subordinates try to remove him from alpha-hood so one of them can take over, and impregnate all the females. Like David Koresh, the alpha impregnates most of the females, his genes pass on, and that is, in large part, what they are after — although they, full of passion and testosterone, don't explicitly recognize what drives them.

What is the nature of interaction of adjacent groups? It's not main force combat, but it is something like guerilla warfare. There are skirmishes. Consider, for example, the patrol. A small group — two, three, four, mostly males, occasionally a female — goes out and patrols the periphery of their territory. They are extremely attentive to spoor — sleeping nests, droppings, bent leaves and other traces — left by members of adjacent groups. They are very quiet, tiptoeing skillfully through the forest when they approach enemy territory. They dislike humans accompanying them on patrol — even humans who have accommodated to them over the years — because humans are just too clumsy; we break branches, we step on leaves. This is serious business. They look reproachfully at the anthropologists.

When they make contact with members of the adjacent group, they assess their chances. If they come upon one or two, they attack. If it's roughly an equal number, they bluff and try to intimidate: deterrence. If it's a much larger number, they flee in confusion. The patrol, it seems clear, is a means to protect the territory from encroachment by foreigners. Our nation über alles.

There are cases that Jane Goodall has documented, in which successive skirmishing over the years depletes the adjacent group; they're wiped out, and the group that's wiped them out expands into their territory.

There are dreadful stories. A female and her infant from Group A wander into the territory of Group B. They are pounced upon and killed. The baby is torn from the mother, its head dashed upon the rocks. "Where does an A-er come off coming into our territory? Serves it right," I imagine them saying to themselves.

There is also a very active incest taboo in chimps. I mention this because it is key to a certain aspect of their behavior. This is, by the way, one of the few so called cultural universals among human cultures. We differ in all sorts of things, but every human culture has an incest taboo. Every chimpanzee culture also has an incest taboo. If one male impregnates many females, and there are a number of other more or less random matings, it's impossible to know, for sure, who your father is. For this reason, females at

puberty, develop a kind of "Wanderlust." Despite all the intergroup hostility, they find the males of the despised foreigners unaccountably attractive. It's **Romeo and Juliet.**

There's a way of understanding this behavior, as not just eerily familiar, which it certainly is, but as serving an important evolutionary purpose: the production of genetic diversity in separate groups, each of which has a different constellation of genes, and therefore, a different potential response to environmental change. If a disaster happens, there is now a chance that one, at least, of these groups is fortuitously pre-adapted. But that's not enough, because if only a group of a few dozen survives (with its incest taboo intact), the chimps in the forest as a whole are in trouble. Most of them are not pre-adapted. It's important for them to have occasional exogamous matings, so that if there's a group best adapted in the catastrophe, their genes can propagate through the forest and be implanted in many different groups.

So here's a way to enhance survival: Break them up into groups. Have them think that their group is the repository of all the virtues (ethnocentrism); and that other groups are hateful and worthy of being despised (xenophobia). Then stir in a little illicit sexual contact. Also, exaggerate any differences between the groups, so that they can distinguish one from the other. They look just the same, they don't wear any clothing, and they lack our kind of language. But they do have different cultures. That's enough to tell who belongs to which group.

Now imagine those same groups, but add in spoken language, costumes, hats, ceremonies, religions. Isolation engenders cultural diversity, and the more cultural diversity, the easier it is to distinguish one group from another, and the more readily they can maintain the ethnocentrism and xenophobia.

Something like this, we think, applies not just to chimpanzees, but to our remote ancestors, somewhere around the time that chimps and humans bifurcated from a common ancestor. That's something like four to six million years ago.

Then the two species continued to evolve. There is no reason why we must, in all respects, be like chimps. In fact, we can think of respects in which we are not (although human vanity has greatly exaggerated the differences, as we describe in **Shadows**). We now are not divided up into small groups, but are part of a global civilization. Cultural differences are swiftly eroding. But something that is built into us for reasons which made enormous sense a few million years ago, but do not apply any longer, I think possibly may provide an important insight into why we are the way we are. I have simplified

the argument in **Shadows** in the interest of time, but it's a way of looking at things which, I think, helps us to understand what the nuclear arms race is about: Take those chimps, give them a shave and a haircut, give them bigger brains, get them down from the trees, reduce the testosterone levels a little, and present them with nuclear weapons.

Ethnic Hatreds and Nuclear Weapons

The Soviet Union collapses. Yugoslavia collapses. Suddenly, unexpectedly — nobody predicted it — ethnic conflict starts bubbling up all over Eastern Europe. "Those Azerbaijanis, aren't they nauseating. Oh, yeah, well, the Armenians, they're worse!" All sorts of ancient hatreds froth to the surface. The Serbs say it's all the fault of the Bosnian Muslims, because Turkish Muslims shouldn't have invaded four hundred years ago. So we have every right to hate and kill their remote descendants. Four hundred years ago they did terrible things. The Serbs haven't forgotten. The Bosnian Muslims, and the Croats and the Macedonians, and many other groups all have a bill of particulars, the accumulated national grievances. The chimps also bear grudges and have vendettas, but they tend not to remember their grievances for such long periods of time.

The concatenation of ethnic hatreds and proliferating nuclear weapons is of course a heady mix. In 1967 I visited Prague, Czechoslovakia, for an international scientific meeting just before, as it turned out, the Prague Spring. Then in 1968, I visited again for a different scientific meeting, just after the Dubcek revolution was crushed by Soviet tanks. I had acquaintances and friends among Czech scientists. In my second visit, a leading Czech scientist, high up in the Secretariat and Presidium of the Czech Academy of Sciences, took me aside and explained to me the absolute necessity for the United States to drop nuclear weapons on the Soviet Union, because of the abomination they had committed in Czechoslovakia. They had committed an abomination, no question about it, but was it worth global nuclear war?, I asked my friend. Absolutely, he said. He knew how bad the Soviet invasion had been, he told me. I didn't. I hadn't been there.

I think it was bad advice, myself. Much as I despised the Soviet crushing of Czech democracy, I did not think it was worth the destruction of our planetary civilization. The lesson I draw is how otherwise sober people — even scientists, as if, somehow, we imagined they were immune to such feelings — can be caught up in blinding hatreds. As when a revolver kept around the house, when one partner in a marriage commits what the other momentarily considers an unpardonable transgression, the combination of passions and nuclear weapons can be very dangerous.

The Global Nuclear Threat

Today, not only has the nuclear arms race ended, it has reversed. The American president says to the Russian president, Let's reduce our strategic arsenals to 5,000 on each side. I'll raise you, says the Russian president, or, better, lower you, to 3,000. So then they compromise at some intermediate. Warheads are being destroyed. The Pantex facility in Amarillo is on three shifts a day, dismantling tactical and strategic warheads.

This is a sign that the hopes of the Nuclear Age Peace Foundation, along with the hopes of many other organizations, are actually coming to fruition. There's one distinction that is important to make. Of course, horizontal proliferation of nuclear weapons is perilous. One nuclear weapon can destroy a city, can kill hundreds of thousands, or millions of people. The Hiroshima bomb, at twenty kilotons, killed hundreds of thousands of people. A two-megaton weapon in the center of a large city could kill millions.

But, the real dangers to the global civilization (even if you ignore nuclear winter) come from using hundreds or thousands of nuclear weapons, especially on cities. While there are people who worry about Libya getting the bomb, or Iraq or Iran or North Korea, the global danger is from nations with hundreds or more nuclear weapons — the United States, Britain, France, China, Israel, Russia, Belarus, Ukraine and Kazakhstan. That's the list. These are, in no particular order, the nine nations that pose the greatest danger to our civilization. I emphasize again that a nation with a handful of weapons, of course, can produce enormous human tragedy, but it cannot produce a global thermonuclear war. Only these nine nations can.

There are many people who have a different view. Oh, *our* nation is very reliable, they say. Don't worry about us. Those unstable nations, especially the ones with distinctly different cultures, especially the ones that don't like us, they're the danger. But, of course, citizens of those nations say the same thing about us. If you believe that accidents happen, that there are unauthorized launches, that madmen can come to power in any nation including ours, if you recognize that this is the century of Stalin and Hitler, then you have to worry, not about intent, not about the high moral standing of this nation or another, you have to worry about capability. And those nine nations are where the capability is.

Clearly we should be steeply reducing the weaponry, the strategic and tactical inventories, to much below 3,000 weapons each for the United States and the former Soviet Union. Clearly we should stop nuclear testing. Clearly we should make every effort to prevent horizontal proliferation.

Clearly we should resist the deployment of Star Wars systems that provide the inducement to increase the arsenals so as to overwhelm the defense. Clearly we should aim at a regime of minimum sufficient deterrence, by which I mean enough nuclear weapons to discourage any nation that has nuclear adventurist intentions, but not enough to destroy the global civilization. This is minimum prudence. And you have to get to that point before you get to zero. If you think zero is safe (I don't myself), at least get to minimum sufficient deterrence.

Reasons for Hope

There are reasons for pessimism. This has always characterized the human condition. There are also reasons for hope. We can't help it; we have contradictory propensities. There's an evolutionary advantage to this because everything is changing. You want to be able to adapt to a changing social and physical environment. Surprisingly great changes have been made in the last few hundred years, changes that you might think were impossible.

Consider, for example, the Divine Right of Kings, the contention that kings are intended by God to rule over us. The Judeo-Christian-Islamic religion encourages acceptance of this doctrine. All the great philosophers said that — at least, until the Enlightenment. Scientists said it, religious leaders taught it, and needless to say, kings endorsed it. Kings like the Divine Right of kings a lot.

Thomas Jefferson, who was our minister to France during Washington's administration, came back and was aghast to find that the Federalist party of Alexander Hamilton was toying with the idea of making George Washington king. They liked the idea of kings. It was orderly. Kings get things done. And it was natural. Also with kings, subjects can get titles, while the Constitution specifically forbids titles. For a reason. But many Americans, even heroes of the revolution, were unhappy with democracy. They wanted kings. You might think, given our evolutionary history of dominance hierarchies and obeisance to the alpha male, that there would be no chance at all of breaking out of self-serving claims that God insists that one human should rule millions. But quite the contrary. We were able to do it. There are hardly any advocates of the Divine Right of kings anywhere on the planet today. The pathetic remnants of the English monarchy are collapsing on the tabloid pages, and I don't think even Queen Elizabeth believes in the Divine Right of kings (or queens) anymore. This is a very great change.

Or consider chattel slavery, the self-serving notion of slave-owners that it is right and proper for some people to own other people, the contention

that some people should be property. That's what Aristotle said. That's what the Bible says. That's what great religious leaders, great philosophers, great political leaders all vehemently argued. Look at the vested interest the slave owners have in the institution of slavery. And yet it is almost all gone. I don't mean to say that there isn't still wage slavery, enforced prostitution, and other kinds of slavery still left, but by and large, chattel slavery is gone from the planet. We can make major change.

Look at the status of women. The Tailhook naval aviators proudly announced on their tee-shirts, "Women are property." We haven't made the transition fully yet. But at the same time there is a stirring worldwide revolution that you can find in the most distant and unlikely countries. You can find in Egypt or Burma that the status of women is changing — a key aspect of controlling world population growth: When women have no say in anything, the birth rate is high. When women have prospects, ambitions and education, and especially political power, when they can talk back to the men, then the population growth rate falls. If we're concerned about population, we should be concerned about the status of women.

All these changes have happened lately. And there's another cause for hope, and that is the processes leading to the unification of the planet — communications, transportation, the linked-up economies of almost all the nations on the planet, even the spread of epidemic diseases like AIDS, global environmental issues, such as the depletion of the ozone layer and global warming.

Mutual Dependence and Change

The world is linked up. We are mutually dependent. We rise and fall together. There is no way that we can survive by disintegrating into large numbers of small mutually hostile groups, touting our group as marvelous and the others as abominable. This ancient attitude is now the very opposite of what is needed for us to survive. Again, it's an issue of natural selection. If we figure out what we have to do and do it, we will survive. And if we don't, we won't. Nature doesn't have any long-term plans, and is not inconvenienced if we decide to destroy ourselves.

But we are capable of figuring things out. It is perfectly possible to understand what is at stake, and to do something about it. These are human problems. They are created by people, and they can be solved by people. There is a real chance that we can make the additional changes needed — political, social, religious, technological, educational changes. But it won't happen by itself. It requires dedicated and committed action.

A Pale Blue Dot

I was involved with Voyager, the two spacecraft that swept through the Jupiter, Saturn, Uranus and Neptune systems, and are now, astonishingly, on their way to the stars. They have achieved escape velocity from the solar system, two artifacts of the human species that will wander forever through the Milky Way galaxy. When humans have destroyed themselves or have evolved into something else, when there is no product of human technology left on Earth, when the continents have changed unrecognizably, when five billion years from now the Earth is burnt to a crisp by the swelling Sun, the two Voyager spacecraft will sail on.

After Voyager 2 passed Neptune, I got a chance to do something I had wanted to do for many years: turn the cameras around and photograph the distant Earth — so far away that it takes radio waves six hours to travel from the spacecraft back to Earth, carrying the data from which the pictures could be reconstructed.[3]

I look at that picture and I see a pale blue dot. One pixel, one picture element, just a dot. I think, that's us. That's where we live. That's our home world. Everybody you know, everybody you love, everybody you've ever heard of, everybody who ever lived, every human being in the history of the universe lived on that blue dot. Every hopeful child, every couple in love, every prince and pauper, every revered religious leader, every corrupt politician, every ethnocentrist and xenophobe, all of them there on that little dot.

It speaks to me of fragility and vulnerability, not for the planet, but for the species that imagines itself the dominant organism living as part of a thin film of life that covers the dot. It seems to me that this perspective carries with it, as does so much else we know, an obligation to care for and cherish that blue dot, the only home our species has ever known. ■

NOTES

1. See **A Path Where No Man Thought: Nuclear Winter and the End of the Arms Race**, by Carl Sagan and Richard Turco (New York: Random House, 1990).

2. **Shadows of Forgotten Ancestors: A Search for Who We Are**, Carl Sagan and Ann Druyan (New York: Random House, 1992).

3. Described in more detail in **Pale Blue Dot: A Vision of the Human Future in Space**, by Carl Sagan (New York: Random House, 1994).

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Carl Sagan is the David Duncan Professor of Astronomy and Space Sciences and Director of the Laboratory for Planetary Studies at Cornell University. He has played a leading role in the Mariner, Viking and Voyager spacecraft expeditions to the planets.

In addition to more than 600 published scientific papers and popular articles, Dr. Sagan is author, co-author or editor of more than twenty books, including his most recent book, **Pale Blue Dot: A Vision of the Human Future in Space.** In addition to this booklet he has also authored the Nuclear Age Peace Foundation's **Waging Peace Series** booklet # 11, "The Great Peace March."

For his contributions to science, literature, education, and the preservation of the environment, Dr. Sagan has received the NASA Medals for Exceptional Scientific Achievement and (twice) for Distinguished Public Service, the Tsiolkovsky Medal of the Soviet Cosmonautics Federation, the John F. Kennedy Astronautics Award of the American Astronautical Society, the Pulitzer Prize, the Oersted Medal, the Public Welfare Medal — the highest honor of the National Academy of Sciences —, and many other awards including the Nuclear Age Peace Foundation's 1993 Distinguished Peace Leadership Award.

WAGING PEACE BOOKLETS

(November 1991 — November 1994)

29. **Supranational Decision-Making: A More Effective United Nations** by Jan Tinbergen, Ph.D.
30. **A Magna Carta for the Nuclear Age, Universal Declaration of Individual Accountability** by David Krieger and Robert Woetzel
31. **A Nonviolent Political Agenda for a More Humane World** by Mairead Corrigan Maguire
32. **Toward Post-Cold War Global Security: A Legal Perspective** by Burns H. Weston
33. **Challenging the Nuclear Addiction: Citizen Participation In Environmental Review of Nuclear Weapons Production** by John Burroughs and Andrew Lichterman
34. **Toward Universal Sovereignty in the Twenty-First Century** by David Krieger
35. **Global Governance In the Global Neighborhood** by Shridath Ramphal
36. **Nuclear War: The Perspective of a Planetary Astronomer** by Carl Sagan

SELECTED PUBLICATIONS

- *Preventing Proliferation by Nuclear Weapons Abolition - Supporting a Limited Extension of the NPT* —by David Krieger and Bas Bruyne, Global Security Study #20, September 1994.
- *A Student's Guide To Global Responsibility* (1993) — A brief overview and list of resources in key areas such as population, environment, development, human rights, peace and security, and global governance.
- *The Nuclear Age: A Chronology of Significant Events* (1993) edited by David Krieger — A listing of significant events leading up to and throughout the Nuclear Age.
- *Nuclear Age Peace Calendar: Days of Remembrance, Days of Renewal* (1993) edited by David Krieger.
- *Students Speak for Peace* (1993) — This volume contains the winning essays by high school students in the Foundation's annual Swackhamer Prize Peace Essay Contest from 1985 to the present.
- *Waging Peace II, Vision and Hope for the 21st Century* (1992) edited by David Krieger and Frank K. Kelly — An anthology of articles looking to the future by some of the important peace leaders of our time, including the XIVth Dalai Lama, Archbishop Desmond Tutu, Linus Pauling, Jacques-Yves Cousteau, and Jan Tinbergen.
- *Accidental Nuclear War and Global Security* (1991) edited by Dean Babst — Contains thirteen technical reports written by authors of the Foundation's Accidental Nuclear War Prevention Project.
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