Conflict, Science and the Garden of Eden

The Second Keith Roby Memorial Lecture in Community Science
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DR. BRIAN EASLEA
UNIVERSITY OF SUSSEX

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Thank you, Chancellor, very much for those words of welcome. Chancellor, Vice-Chancellor, Cathie, ladies and gentlemen, it is a very great privilege for me to be here at Murdoch University to give this second Keith Roby Lecture. As the Chancellor said, I met Keith and Cathie in 1978 and several times I enjoyed hospitality at their home. With Keith then at the University of Sussex, he and I had many discussions, principally about the misuse of science in society, the mechanical philosophy which we both disliked very much, and Keith told me about his vision of community science. Tonight I want to talk about the misuse of science, a topic which relates to the theme of conflict, the mechanical philosophy which connects with the theme of science, and I want also to talk about community science.

Pessimism and the nuclear arms race

In 1902 when the natural transmutation of elements was discovered, the nuclear physicists were very excited, in fact they were overjoyed. Almost immediately Rutherford's collaborator, Frederick Soddy (and this is where I All introduce the theme of the Garden of Eden), published an article saying that the new alchemy had arrived. The new alchemists would make not gold but energy, and with the release of abundant supplies of energy it would be possible to bring into being, as Soddy put it, a smiling Garden of Eden in which the world's problems would obviously all be solved. Of course Soddy was not naive. As early as 1904 he went to a military school in England and told the no-doubt-astonished military that the nation that first put its finger on the nuclear button would control the world.

As we know, uranium fission was discovered in 1938; a plutonium weapon was tested in July, 1945; two nuclear weapons dropped on Japan in August, 1945; fusion weapons were then developed, and the nuclear arms race has just gone on and on. And it's now reaching a new high of instability with exceedingly complex, scientifically-sophisticated first-strike missiles being developed and presently deployed in western Europe and elsewhere. Moreover, one physicist has recently pointed out that about 55 percent of American physicists are doing research and development work directly related to weapons systems. As Professor Birch appropriately said in the first Keith Roby Lecture, such a fact as this `brands scientists and technologists as among the most destructive people in the world today'. It is interesting that the physicist who did this survey came to a very pessimistic conclusion. Not the kind of conclusion I think Keith

would have come to. In his paper which was sent to the editor of the *American Journal of Physics,* who to his credit published it, the physicist said that `. . . In summary, we can say that a member of the physics enterprise can minimise his possible contributions to military needs by either not teaching or teaching poorly, and by either not doing research or by doing research unrelated to winning advances in basic or applied knowledge'. Well now, if you are not allowed to teach or if you do teach you should teach poorly; or if you are not allowed to do research or if you do research you shouldn't win advances in basic or applied knowledge, then it is not at all clear what you can do! So this is, really, a very pessimistic conclusion arguing, in effect, that physics must be brought to an end in order to bring the nuclear arms race to an end.

Certainly the nuclear arms race seems to be heading inexorably towards nuclear holocaust. Last year a woman published an article titled "An End to Technology: A Modest Proposal", in a book called *Machina ex Dea: Feminist Perspectives on Technology.* In her article Sally Gearhart come to the modest conclusion (it is a bit more modest than you think!) that it would be a good thing for the biosphere if the human species simply stopped reproducing itself. Not physics brought to an end, but the human species! Her very modest proposal is that, from the point of view of our fellow species and the earth itself, the best that can now happen is that human beings never conceive another child, that the child being conceived at this very moment be the last human being ever to exist. Of course, not all human beings are bad, Sally Gearhart agrees, but it seems that there will always be one group or one nation that develops science and technology in destructive ways and, as in the case of a barrel of apples, one bad apple will spoil all the rest. Thus unless the human species ceases to exist, human beings will, she believes, eventually blow up the biosphere. "The greater virtue of my solution," she declares, "rests in the fact that when we go, we will have the decency not to take the rest of the planet with us." Her conclusion is sombre:

> *I find in this solution of our species suicide, an integrity of the calibre that humanists have longed claimed as possible for the human race, though such a solution may not seem at first glance to be expressive of such integrity. If some still ask `Why?', I suggest that the burden of proof has shifted, that in terms of our biosphere the question is `Why not?'.*

To say the least, this is an extremely depressing conclusion to come to but, when in Melbourne, I was shown an article which claimed that in a recent survey of 400 young Australian students some 300 had expressed the belief that there would be a nuclear war in their lifetime and that Australia would be hit by nuclear missiles. This, then, is really a very depressing state of affairs that the advance of science has brought us to. To put it into some sort of perspective, I want to look at selected comments of three philosophers: the first will be Bertrand Russell, the second Donald MacKinnon and the third J. Glenn Gray.

Life on the precipice

In 1952 Bertrand Russell published a book in which he said the despair that humanity was then apparently feeling, or some people were feeling, was irrational. The situation humanity was in, Russell declared, could be likened to that of a man climbing

a difficult and dangerous precipice. The goal of the ascent, Russell reassured, was to reach `a plateau of delicious mountain meadows', which sounds very much like Frederick Soddy's smiling Garden of Eden. However, Bertrand Russell went on, with every step that the climber ascends, his fall, if he does fall, becomes more terrible. At last there is only one obstacle left. But the weary climber doesn't know this because he can't see around the rocks jutting out above his head. And this obstacle - in fact the last one left before our ascending, rest-seeking humanity reaches the desired plateau of delicious mountain meadows - is the conflict between the Soviet Union and the United States. Russell at the time wanted the United States to triumph in this conflict. Indeed, in 1948 he was actually prepared to accept the idea of a pre-emptive nuclear strike against the Soviet Union.

Over thirty years later this conflict not only still exists but the Union of Concerned Scientists in the United States has just published a report in which great anxiety is expressed at President Reagan's proposals for laser weapons in space. The writers of the report maintain that it is difficult to imagine a more hazardous confrontation or what would be a more perilous time for humanity. Yet the path towards a less-dangerous world, they declare, the path towards a safe world, is there for all to see, namely, the banning of weapons in space combined with equitable and verifiable deep cuts in strategic offensive forces and so on.

Now this makes me wonder whether all people who work in the Pentagon, and not only people who work in the Pentagon, actually want to take the safe path, the less-dangerous path. For perhaps they have come to enjoy life on the precipice, perhaps even to need life on the precipice. Recently I read a booklet by Donald MacKinnon which was published about two years ago. MacKinnon, for thirteen years Professor of Moral Philosophy at the University of Aberdeen and for eighteen years Professor of Divinity at the University of Cambridge, is a believer in unilateral nuclear disarmament. However, he advises in this booklet that we have to acknowledge that there really is no chance at all of ever arriving at a smiling Garden of Eden, a delightful plateau of delicious mountain meadows, a 'never-never land of love and tranquillity'. For he painfully emphasizes: "We deceive ourselves if we deny that there is an element of the sheerly exciting in these possibilities (such as laser weapons in space). We may feel ourselves a little giddy when we read or hear of them but the giddiness is not all a matter of fear. The human world remains a wonderful place if it is also a terrifying one." And he went on:

> *We are concerned with the race for technological mastery that is going on all the time. It is a situation of striving which is a once exultant and desperate. And the two elements, the element of exultation and the element of despairing fear are both alike important.*

Indeed the physicist Freeman Dyson, who knows many men who work in the Pentagon and also many physicists who design weapons, has written that there is no doubt at all that the designing of space defences is great fun, that the men who work in the weapons industries enjoy their work if they are on the frontiers of research. But, he warns, "the happy nuclear and missile warriors cannot imagine the totality of the

disaster towards which they are headed". Nevertheless, life on the precipice appears to be fun.

The third philosopher I wish to mention, J. Glenn Gray, published an influential book in 1959 called *The Warriors: Reflections on Men in Battle.* He grew up, evidently, after the First World War. In this book he relates that as an adolescent and young man, even though he presumably knew, only too well, about the carnage of the First World War-that ten million combatants had been horribly killed in this war - he nevertheless longed for another war in which he could participate. Gray wrote that although he never told anyone of these longings, that he kept them to himself and that he looked back on these feelings with considerable dismay, what he could not do was deny that such feelings were an important part of the aspirations of his youth and, he added, he had no reason to believe that his case was in any way unique or singular. And on the very day he received his doctorate in philosophy from Columbia University, he also received his call-up papers for the American army to participate in the Second World War. Happiness for him on that day was, in one hand, a doctorate in philosophy, in the other hand call-up papers for the army! He participated in the Second World War, he survived the Second World War, and he doesn't want a third world war. But how, he asks, can we avoid a third world war? Can scientists help us to avoid such a war by making weapons so horrible that war becomes unthinkable? The answer, he says, is No. Scientists will continue, unfortunately, to make horrible weapons but war will never become unthinkable. Gray actually believes that were a nuclear holocaust to happen, there would be men who would watch it entranced and enthralled. If men are truly sincere about their desire to prevent war then, he declares, the way to do it is surely to eliminate the social, economic and political injustices that are always the immediate occasion of hostilities. Even then, he says, we shall still be confronted with what he sees as the spiritual emptiness and inner hunger that impel many men towards combat.

So what are the conditions that, in the opinion of Gray, would provide the spiritual fulfilment which would make war unthinkable? Glenn Gray argues that spiritual fulfilment can only be found in community life and not just community life between human beings but a community life in which there is concern for all those things that, for example, are not of human origin and for which no human use can be found. He writes, movingly:

> *Before expecting man to spare his brother (or sister), we must persuade him to spare those things around him that contribute to his life as greatly as his brothers (and sisters) do. The growth of that preservative love and care, which is in strongest opposition to destructive lusts, involves an intimacy with things of which too many of us have as yet hardly an inkling.*

"The gift of nearness to the familiar and evident is happiness", Gray argues, and a happy people will not go to war and will in no way want war. Gray is, of course, far from alone in avowing such sentiments. Nel Noddings, for example, has recently written in her book Caring that there is real joy to be experienced in developing increasing competence in daily life. Indeed, if one learns to appreciate what she calls `the magic of daily life', then there is no need to search for adventure. Life on the precipice then becomes completely unnecessary. A person who truly relates to and

connects with others and with the non-human environment does not ask `Is this all there is?' but, Noddings exclaims, ". . . wishes in hearty affirmation that what is might go on and on".

Of course, Glenn Gray, as an American citizen, wrote how he appreciated the force of the arguments that nuclear weapons testing is necessary. However, he also stressed how he totally objected to the manner in which weapons tests were then being carried out, how they completely violated his conditions for peace. For the weapons tests, he wrote, demonstrated a complete indifference and lack of concern for all that is not deemed to be of value for humans. I think, certainly with respect to British tests in Australia, Gray is being generous in the extreme. The test I want to discuss, however, is the American test in 1954 of the biggest hydrogen bomb yet exploded. The task force to explode the bomb, the scientist in charge relates, consisted of 10,000 men and no women at all. Exploded on a test site in the Bikini Atoll, the bomb simply destroyed the test island and all life within it. On the control island, twenty miles away, the test scientists were housed inside a concrete bunker surrounded by massive protective sand walls some ten feet thick. And when the bomb went off, the chief scientist candidly writes, "I began to dance in my excitement". Life on the precipice, it seems, can clearly be joyful and very exciting. When radioactivity dangerously developed over the control island - twenty miles away remember - the scientists, however, were safe:

> *We were safe behind the massive concrete walls and ten feet of protective sand but there would be no other living thing left on the island. The fallout had started an hour ago, which meant any bird or animal that had survived the tremendous blast would be sick from radiation. Two hours of such exposure would begin to kill humans.*

Well, no wonder Gray sees such weapons scientists as directly contributing to the violation of his conditions for peace. The question is, can science contribute not to the violation but to the successful realization of Gray's conditions for peace? The answer is obviously Yes. There is surely nothing intrinsic to science that causes science to be used so readily for destructive purposes. And yet something, somewhere, is clearly wrong.

Science as an armed assault on nature

What I want to stress is that from the early seventeenth century. onwards there has existed a tradition in science whose objective appears to be nothing less than the conquest of the universe. Perhaps this is very unfair to Francis Bacon, but when I think of the Bravo test of the hydrogen bomb, which I have just described, I think of what Francis Bacon predicted when he was calling for the inauguration of his new science. For his new science would not, like the old, he wrote, "merely exert a gentle guidance over nature's course". His new science "would have the power to conquer and subdue her, to shake her to her foundations". The Bravo test certainly did that.

Now this tradition, with its goal of conquering nature, of shaking nature to `her' foundations, has, I think, very much remained a leading aspect of the scientific enterprise. I will give just a few examples. The famous British marxist scientist, J. D. Bernal, declared in his first book that the aim of science was to conquer the universe

and that if the rest of humanity did not agree with the scientists then they could have their smiling Garden of Eden - their Melanesian existence of love-making and singing and dancing and so on. But the scientists would have to leave them to vegetate in their boring Melanesian existence as they, the scientists, set out from the earth to conquer the universe. In the 1930s, in complete harmony of spirit with J. D. Bernal, the Nobel-prize winning American geneticist H, J. Muller published, at the age of 45, the following striking paean to science:

> *And so we foresee the history of life divided into three main phases. In the long preparatory phase, it was the helpless creature of its environment and natural selection gradually ground it into human shape. In the second, our own short transitional phase, it reaches out at the immediate environment, shaking, shaping and grinding it to suit the form, the requirements, the wishes and whims of man. And in the long third phase, it will reach down into the secret places of the great universe of its own nature, and by aid of its ever growing intelligence and cooperation, shape itself into an increasingly sublime creation, a being beside which the mythical divinities of the past will seem more and more ridiculous, and which setting its own marvellous inner power against the brute Goliath of the suns and planets, challenges them to contest.*

And so this spirit of challenge and conquest has continued. Defending the decision to initiate a crash programme to make the hydrogen bomb, Edward Teller wrote in 1955 that "we would be unfaithful to the tradition of Western civilisation if we were to shy away from exploring the limits of human achievement". In a 1965 article entitled "Man's Place in the Physical Universe" the Nobel-prize winning physical chemist Willard Libby asserted: "Man's place is to be its master or at least to be the master of the part he inhabits. It is his place by controlling the natural forces with his intelligence to put them to work to his purposes, to build a future world in his own image. The possibility of doing this is exciting. This to me is man's place in the physical universe, to be its king through the power he alone possesses: the principle of intelligence." In 1979, in similar spirit, the then chairman of the United Kingdom Atomic Energy Authority, Sir John Hill, in an invited talk to nuclear engineers commemorating the 25th anniversary of the formation of the Authority, sternly rebuked critics of the nuclear industry: "We will be judged upon the facts and upon our achievements," he proclaimed, "and not upon the plaintive cries of the fainthearted who have lost the courage and ambitions of our forefathers which made mankind the master of the earth."

Finally, we should note that this goal of conquering nature, of becoming masters and possessors of nature, is not confined just to `bourgeois' or marxist scientists working in capitalist societies but that it also exists in the Soviet Union. For example, in a book published in 1980 called *Man and Nature* the Soviet author informs his readers that man is growing into a mighty geological force and is destined to take over the universe in due course. "This idea may sound preposterous now," the author admits, but only "for the same reason that prophecy to the effect that man would be able to organise the natural environment on a global scale would have sounded preposterous to our ancestors who lived a mere one or two thousand years ago."

Thus it is reasonably clear there exists a tradition within science whose goal is not a smiling Garden of Eden, certainly not a plateau of delicious mountain meadows, but a tradition whose defining goal is very much conquest of the universe, nothing less than a dangerous, exciting ascent to the very summit of the universe and that - let us remind ourselves - is not likely to be an entirely hospitable place. An article by the then Dean of Engineering and Applied Physics at Harvard University, Harvey Brooks, published in 1973, pursued this mountaineering metaphor and somewhat enthusiastically described the risks:

> *Living with technology is like climbing a mountain along a knife edge which narrows as it nears the summit. With each step we mount higher but the precipices on either side are steeper and the valley floor further below. As long as we can keep our footing we approach our goal but the risks of a misstep constantly mount. Furthermore, we cannot simply back up or even cease to move forward. We are irrevocably committed to the peak.*

This, then, is obviously a very dangerous enterprise but it is one that is being very explicitly pursued within this particular scientific tradition. J. D. Bernal recognised and welcomed the dangers. After a marxist world society had been created the dangers confronting humanity would, Bernal believed, increase rather than decrease because a marxist society would be in a better position to promote scientific advance. Clearly, it may well be the case that humanity will kill itself in this exciting scientific endeavour to reach the summit of the universe (unless it foolishly prefers to vegetate in a Melanesian erotic stupor). But Bernal insists: "This daring, this experimentation is really the essential quality of life".

Thus it is not just Friedrich Nietzsche who exhorts us to live dangerously, to send our ships into uncharted oceans, to build our houses on the slopes of Vesuvius. It is also all kinds of natural philosophers within the scientific enterprise. Even Alfred North Whitehead welcomed the fact that modern science necessarily makes the transition through time `a true migration into uncharted seas of adventure'. And he explicitly welcomed the belief that it is the business of the future to be dangerous and that it is among the merits of science to equip the future for its duties.

Now, from my point of view, I would like to see humanity reach what appears to be a very elusive plateau of delicious mountain meadows and live for at least a few hundred years in a smiling Garden of Eden before setting out to explore, not conquer, the universe. Thus this compulsion, as it seems to me, to conquer the universe, this compulsion to risk life, this compulsion to violate Gray's conditions for peace - such a compulsion is really very problematic indeed. Why on earth do some men, some scientists, apparently experience such a compulsion to conquer not just the earth but indeed the universe. Undoubtedly there are many factors at work, many explanations possible. But I was particularly struck by one explanation of the conquering spirit which I read in a book entitled *Man Against Nature,* in particular in the account by Maurice Herzog of his expedition's conquest of the Himalayan mountain named Annapurna.

Rebirth by conquest of the feminine

Conquered in 1950, Annapurna was the first of the mountains over 8000 metres high to succumb to the climbing fraternity. However, when Maurice Herzog and his successful companion reached the summit of Annapurna they found it, as they had expected, an extremely inhospitable place and were able to remain there no longer than a minute or two. On their descent tragedy overtook them and they were lucky to escape with their lives. Herzog was badly frostbitten and he ultimately lost all his fingers and toes in a series of painful operations. Asked many, many times the question `Well, was it worth it?', Herzog has replied in the following way, which I find very striking: "A man who has triumphed over mortal danger", he informs the doubting questioners, "is born again. It is a birth without indebtedness to anything on earth. It endows one with a serenity and independence which are truly unutterable."

Now if we think to whom we owe indebtedness in our `first' birth, it is clearly to our mother, the woman who bore us in her womb, who gave birth to us, who nurtured us; we are indebted to our father and other adults; we are indebted, clearly, to the biosphere in general; to the rocks on which we stand and on which myriads of creatures have stood, lived and died over eons of time; we are indebted to those myriads of creatures which have produced the biosphere we have now; in short, we are indebted not only to our mother and other adults but more generally to Mother Earth as the earth and the biosphere were called prior to the seventeenth century. But Maurice Herzog is describing a rebirth without indebtedness in any way to what is feminine. No woman, no female womb, is involved in this rebirth and it is not just without indebtedness to `Mother Earth' but rather by conquest of `Mother Earth'; in fact the name Annapurna can be translated as the Goddess Rich in Sustenance. Herzog's lines immediately rang a bell for me because I thought of Francis Bacon's early work in which Bacon passionately calls for the inauguration of the new science - the new science that will announce `the truly masculine birth of time'. Appropriately, Francis Bacon jeers at the Greeks whom he called mere children. A half century later, the first secretary of the Royal Society, Henry Oldenburg, declared that the Society's aim was none other than to raise a `masculine philosophy'. H. J. Muller, the geneticist I quoted earlier, called his book *Out of the Night* and the chapter from which I quoted his description of conquering the universe is entitled "Birth and Rebirth".

Thus there is to be found this striking imagery of rebirth in the writings of at least some of the scientists who wish to conquer the universe. Science, as you know, has been for a long time a male-dominated activity, so much so that for much of its modern history women were explicitly excluded from the brotherhood of science. One can, then, perhaps see this kind of masculine enterprise as constituting a rebirth without woman and it is going to be a rebirth achieved through conquering the universe. Moreover, rebirth imagery in science is, I think, not unrelated to the kind of rebirth imagery that one finds in the writings of certain soldiers like Ernst Junger, the German warrior who fought in the First World War. We read in Junger's dramatic description of the battles in which he fought: "War is the experience of blood. So all that matters is what men have to say about it ... War is our father. It has given birth to us in the glowing womb of the trenches as a new race, and we recognise our origins with pride."

Now it has often been suggested- Francis Bacon, Saint Simon, William James all suggested - that men's war on nature would prove to be an effective substitute for men's war

on their fellow men. However, it seems to me that men's war on nature and men's war on each other have common roots and thus I find it not at all surprising that men's war on nature has fed into men's war on men and in particular into the nuclear arms race. Furthermore, men's war on nature will clearly tend towards ecological disaster because the aim of this war is the conquest of nature, even - as Carolyn Merchant reminds us by the title of her important book - `the death of nature'.

I want to conclude this part of my talk by illustrating that, indeed, this idea of war on nature, on `Mother Nature', does entail, both cognitively and physically (metaphorically speaking anyway), the death of nature. Cognitively, men can achieve maximum disconnectedness from nature by declaring themselves alive and nature dead. In the seventeenth century this was relentlessly declared by Descartes to be the case. Contrast Descartes' views with those of Gerrard Winstanley, the famous English `Digger' who, in the middle of the seventeenth century, appealed to landlords to allow the poor to suckle the breasts of `Mother Earth'. Descartes, on the contrary, declared `Mother Earth' dead, that everything non-human, including the human body, consists of mere matter without sentience, without consciousness, without any interesting properties at all! This was not only an incredibly violent attack on the life of the universe, an incredibly violent cognitive act, but it was also regarded as incredibly violent by his contemporaries. One of his admirers, Henry More, wrote to him that:

> *For the rest, my spirit through sensitivity and tenderness turns not with abhorrence from any of your opinions so much as from that deadly and murderous sentiment ... whereby you snatch away, or rather withhold, life and sense from all animals, for you would never concede that they really live. Here, the gleaming rapier-edge of your genius arouses in me not so much mistrust as dread when, solicitous as to the fate of living creatures, I recognise in you not only subtle keenness, but also, as it were, the sharp and cruel blade which in one blow, so to speak, dared to despoil of life and sense practically the whole race of animals, metamorphosising them into marble statues and machines.*

Descartes' response to Henry More was unrepentant: "My opinion is not so much cruel to wild beasts as favourable to men whom it absolves of any suspicion of crime however often they may eat or kill animals". Here, then, in Descartes' influential views one sees this complete separation between men, human beings, and the rest of nature. Only men, human beings, are alive; the rest of nature is completely dead.

Now one might think that after Darwin's theory of evolution this sort of maximum disconnectedness between human beings and nature would no longer be in any way cognitively tenable. However, we read, for example, in Jacques Monod's *Chance and Necessity* (and he seems to be a true son of Descartes) that according to modern evolutionary theory evolution cannot be seen as a property of living beings for the reason (which he emphasizes) that evolution stems from the very imperfections of the conserving mechanism which, he claims, constitutes the unique privilege of living beings. "Even today," Monod remarks, "a good many distinguished minds seem unable to accept or even to understand that from a source of noise natural selection could quite unaided have drawn all the music of the biosphere.... The universe was not pregnant with life, nor the biosphere with man. Our number came up in the Monte Carelo game". Finally his readers are required to recognise that modern science `ended the ancient animist covenant between man and nature, leaving

nothing in place of that precious bond but an anxious quest in a world of icy solitude'. "Man," Monod writes, "must at last wake out of his millenary dream and discover his total solitude, his fundamental isolation".

So here we have, it seems to me, first in the seventeenth century and then at the end of the twentieth century two cognitive attacks on nature that clearly seek to maximise disconnectedness between human beings and the rest of nature. Now I will give just two or three examples of the direct physical attack on nature, the killing off of `Mother Earth, of `Mother Nature'. First of all, an example from Russia and the Soviet Union. We read in one book on Russian religion that it is `in Mother Earth, who remains the core of Russian religion, that the most secret and deep religious feelings of the people converge'. And the author goes on to explain how in general the Russian people venerate `Mother Earth'. Thus it is particularly poignant to read in the first congress of Siberian writers in 1926 one Soviet member making the exhortation:

> *Let the fragile green breast of Siberia be dressed in the cement armour of cities, armed with the stone muzzles of factory chimneys, and girded with iron belts of railroads. Let the taiga be burned and felled, let the steppes be trampled. Let this be, and so it will be inevitably. Only in cement and iron can the fraternal union of all peoples, the iron brotherhood of all mankind be forged.*

This quotation is taken from a book by a Soviet author using the pseudonym Boris Komarov and the title of his book is *The Destruction of Nature in the Soviet Union.*

Now I have already referred to the Bravo test in which the test scientists are enclosed within their massive concrete bunker surrounded by protective sand walls with all living creatures outside killed and nature virtually destroyed as much as possible. This test seems to me to be a very striking kind of attempt at a physical, albeit localized, realisation of the Cartesian cosmology.

Finally, I will give one more example from the nuclear arms race. William Laurence was the only reporter privileged to witness the atomic bomb test in the Nevada desert and also to witness the atomic bombing of Nagasaki. On one of his wartime visits to Los Alamos he writes that Oppenheimer showed him a container with an ingredient for making a hydrogen bomb. This is his description of that dramatic moment: "It was the first highly diluted minute sample of superheavy water, composed of tritium and oxygen, ever to exist in the world, or anywhere in the universe, for that matter. We both looked at it in silent, rapt admiration. Though we did not speak, each of us knew what the other was thinking. Here was something, our thoughts ran, that existed in earth in gaseous form some two billion years ago, long before there were any waters or any forms of life. Here was something with the power to return the earth to its lifeless state of two billion years ago." Here, then, is something with the power to reurn the earth to its lifeless state of two billion years ago and, according to Laurence, he and Oppenheimer are looking at it with `silent, rapt admiration'. Not with horror but with admiration.

The conclusion I arrive at when one considers these examples and many others that could be given is that it is indeed not surprising to find a military historian Sue Mansfield, in

her book *The Gestalts of War*, severely assessing this particular scientific tradition and the way it has been incorporated into the nuclear arms race. Her final indictment is thoughtprovoking indeed: "The stress on `objectivity' and the quantitative approach as a guarantee of truth, as well as the relegation of emotions to a peripheral and unconscious existence, has carried from its beginnings in the seventeenth century the burden of an essential hostility to the body, the feminine and the natural environment." Certainly it would seem that this particular tradition within science all too readily fuels men's making war on themselves and it especially fuels the nuclear arms race. Now we are rapidly approaching, it seems, a point where perhaps, in the opinion of some of the authors I mentioned at the beginning of this talk, it will not be possible to prevent nuclear holocaust. Sue Mansfield ominously concludes: "Though the reenslavement of women and the destruction of nature are not conscious goals of our nuclear stance, the language of our bodies, our postures, and our acts is a critical clue to our unexamined motives and desires."

Reasons for hope

Well, are there reasons for hope? I would like to suggest at least four reasons. First of all, one needs to understand why men, some men, some scientific men, wish to conquer the universe, why they wish to be reborn without the participation of women, why they wish to conquer `Mother Earth', and possibly to risk death, an exciting death, in so doing. What has nature done to these men, or rather what do these men perceive that nature has done to them, so that they wish to `distance' themselves as much as possible from nature. And here we need to turn to the writings of feminist authors like Nancy Chodorow, Dorothy Dinnerstein, Sandra Harding, Evelyn Fox Keller, Carolyn Merchant, Mary O'Brien and many others in order to try to find answers. Now this is very dangerous territory for a man to tread on and I have said I don't want to live dangerously. I'd like to live in a smiling Garden of Eden. And time is running out. So I don't want to attempt to outline these feminist analyses of masculine science. But they do exist and I am very glad to see that they are now existing in rather large numbers. I think their existence can do nothing but good.

The second reason for hope is, of course, that science is not monolithic. There has always been a tradition within science of respect for the natural world, even of reverence. One can think of the writings of Johannes Kepler who always expressed reverence for the divine universe. Even in the work of Galileo - for example, in the first day's dialogue of his famous *Dialogue Concerning the Two Great World Systems* - one finds Salviati, Galileo's mouthpiece, defending the planet Earth against the criticism of the Aristotelians who apparently regard the Earth as merely the sink of the refuse of the cosmos. How movingly and beautifully Galileo writes about a pot of humble earth in which a jasmine plant can grow. One thinks of the writings of Einstein where one always finds great love and reverence shown for nature. I would, however, especially like to refer to the biologist who last year received the Nobel Prize for her work in plant physiology, namely Barbara McClintock. Her basic work was done in the 1940s but her achievements were not recognized until something like the 1970s. Happily, a few years ago McClintock gave a series of interviews to the feminist philosopher of science,

Evelyn Fox Keller. In the resulting biography that Evelyn Keller has written of McClintock's life and work, appropriately called A *Feeling for the Organism,* the central question is posed: "What enabled McClintock to see further and deeper into the mysteries of genetics than her colleagues?" Keller replies: "Her answer is simple. Over and over again she tells us one must have the time to look, the patience to `hear what the material has to say to you,' the openness to `let it come to you'. Above all one must have `a feeling for the organism'." McClintock tells Keller: "No two plants are exactly alike. They are all different. And as a consequence you have to know that difference. I start with a seedling," she explains, "and I don't want to leave it. I don't feel I really know the story if I don't watch the plant all the way along. So I know every plant in the field. I know them intimately and I find it a great pleasure to know them." McClintock sees herself as "a mystic in science", a "mystic" whose work has just been recognized with a Nobel Prize! McClintock's aim, Keller writes, is "to embrace the world", to embrace it "in its very being, through reason, and beyond". Now to embrace the world is something very, very different, of course, from the desire to conquer it. Clearly there exists within science a very different tradition from the conquering tradition and it is very much this tradition in science that Keith Roby was helping to develop.

My third reason for hope is that as the nuclear arms race escalates yet further, so opposition is growing. Peace movements, green movements, ecology movements, women's movements are all coalescing it seems to me (well, to some extent; I know there is a very powerful separatist tendency in the feminist movement); they are all working towards a global community in which human beings express not only their connectedness to each other but to the biosphere in general. After all, it is up to the peoples of the world, particularly in the European countries and in the United States, also of course in the Soviet Union, to say `No' to their leaders. With this in mind, I would like to end by referring very briefly to Mary Shelley's novel *Frankenstein or The Modern Prometheus.* Remember how the man of science Dr. Frankenstein wanted to make, and did make, a male creature without, once again, the aid of woman. Remember how he is picked up by Captain Walton, with whom Frankenstein shares so much in common, while pursuing his hapless, murderous creation in the Arctic Ocean. And remember how Captain Walton had set off on what was a mad mission to discover the secret of the magnet at the North Pole. Already we read in the novel, several sailors have died of cold and exposure. The ship is temporarily trapped in the ice; the sailors mutiny and they persuade or rather inform the captain that when the ice breaks the ship must and will turn back. And that, I want to believe, is what will happen as the peace movements, the green movements, the women's movements grow stronger and coalesce. The ice will break and we will turn back from death-risking life on the precipice. I am certainly optimistic, I have to be optimistic because I have known Keith Roby and I have enjoyed the hospitality of Keith and Cathie.

My fourth reason, then, for optimism is the publication of this beautiful book, *Challenges for Einstein's Children.* This also can do nothing but good.

Thank you very much.