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The Future of Nuclear Weaponry and Our Civilization

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MOTTO: quos Deus vult perdere dementat (whom God wants to ruin, He makes act as fools)

SUMMARY

We speculate on the future, on the time scale of one-two decades. We argue that catastrophic use of some kind of nuclear weaponry is likely, unless drastic measures towards the total and effectively enforced prohibition of such devices are undertaken by international society. It is therefore mandatory to plan for such a global regime and to advocate forcefully its introduction. But it is unlikely this will be fully realized *before* nuclear weaponry are indeed used with catastrophic effects. Hence it is important to prepare for the aftermath of such a catastrophe, at which moment it might become feasible to institute a global regime which will make the repeated use in anger of nuclear explosive devices sufficiently unlikely to be compatible with the preservation of our civilization.

Many believe that probabilistic concepts are properly applicable only to the type of events for which a many-fold repetition can be envisaged. This is far from being true, even in a purely mathematical context. It is even less true in everyday life, where most decisions must in fact be taken on the basis of *a priori* assessments of the likelihood of events which are unlikely to be repeated many times. Such assessments tend of course to be personal, but rational argument about them is possible and may in fact be enlightening and useful. It is in this spirit that the following personal considerations are proffered.

When discussing future developments it is essential to be clear about the order of magnitude of the time scale one has in mind. Here we focus our discourse on the time scale of one, or at most two, decades.

It is our firm belief that, *rebus sic standibus*, namely unless drastic steps (to be discussed in more detail below) are quickly taken towards the total and effectively enforced prohibition of all kinds of nuclear weaponry, the probability is high that one or more such devices will explode with catastrophic consequences in the time frame under consideration. By high probability we mean definitely larger than even odds, without being able to provide any more precise characterization. A more precise specification of what we mean by this statement, as well as the evidence that we believe justifies its validity, are now given.

Our statement refers to any use of nuclear explosive devices causing a major disaster. By "nuclear explosive devices" we mean real nuclear weapons as well as "garage-made" contraptions, whose devastating effects are mainly caused by nuclear reactions. By "major disaster" we refer to events causing casualties in the thousands or beyond and property damage in the billions of US\$ or beyond; in both cases, probably way beyond. Among the events we include accidents, inadvertent or mistaken or deliberate use by military personnel (be it sanctioned or unsanctioned by decisions taken by the appropriate leadership), and use by terrorists or other "crazy" groups (sects, lunatics). To the extent these three categories of events can be kept distinct, we consider the third as by far the most probable one and therefore focus hereafter mainly on it. We also explain why we think this risk can only be managed (albeit not altogether eliminated) in the context of a total prohibition of nuclear weaponry.

To assess the probability that, *rebus sic standibus*, some kind of terroristic or "crazy" group produce a nuclear explosion in an inhabited environment (possibly in a major city) within the next decade, two relatively separate aspects must be considered: (1) Is there an adequate abundance of such groups, who would be motivated to perform such a dastardly act? (2) What is the likelihood that they would indeed be capable to do so?

There is ample abundance of known terroristic and/or "crazy" groups around the world (including inside advanced societies, in particular in the USA); moreover past experience (for instance with "religious" sects in Japan) suggests that several, perhaps many, other such groups exist whose mischievous potential is as yet unknown. Several such groups are quite likely to include one or many subgroups of a few people (say, from one to five) who are prepared to commit acts of ultimate destruction, because they are crazy, and/or motivated by religious zeal, by the belief to be the instruments of some God, by extreme hatred (possibly caused by previous traumatic experiences, such as the loss of relatives or friends), by the conviction that such acts are necessary to achieve some goal. An objective assessment of the world around us suggests that the abundance of such groups is now large (dozens) and far from waning. Their mischievous potential is well demonstrated by current events, and it is obviously augmented by the ever increasing ease of international communications and travel as well as, in several contexts, by large sources of funds, whose trickle to all sorts of loose subgroups of committed individuals is unlikely to be tightly controlled by the political authorities or financial tycoons at the source, who might be expected to themselves shun acts of ultimate large-scale violence. Let us, however, emphasize that, from this point of view, we do not claim a drastic qualitative change with respect to a situation which has prevailed already for some decades -- although a certain increase in the risk, for some of the reasons outlined above, is now clearly in process.

A qualitative change has instead occurred as regards the likelihood that a small group such as those mentioned above might indeed succeed in manufacturing and exploding a nuclear device, if they decided to do so. The point is, that the only significant barrier against being clandestinely capable to do so is the difficulty to acquire the required fissile materials, Plutonium or Highly Enriched Uranium (HEU). It is in particular well known that, given the availability of, say, 100 Kg of metallic HEU (whose bulk size is much less than a football - and less than half that quantity would also be sufficient), a fission "gun-type" device can be manufactured with little personal risk (other than that of being discovered via intelligence) even by a single (intelligent) individual working in

a small "garage" and having the manual competence of an ordinary do-it-yourself person, complemented by widely available information and blueprints, as well as other easily available materials: good quality conventional explosives, an electrical initiator of conventional explosions, a heavy steel tube such as an army surplus artillery piece, and perhaps a neutron source -- although the latter is not quite necessary for a gun-type device. (Apparently the 6 gun-type nuclear bombs assembled in South Africa contained 50 Kg of 90% HEU and no neutron source -- and nobody doubts they would have worked). Such a bomb might release an Hiroshima-size yield (order of magnitude, 20 KT, namely the energy released in the explosion of twenty thousand tons -- twenty million kilograms -- of high explosives), resulting in the total destruction of a city such as New York if exploded in the downtown area, or might "fail" and only yield a "fizzle," still producing an explosion equivalent to that of tens or hundreds of tons of conventional explosive, as well as substantial radioactive contamination: at the center of a city, still a very major catastrophe. And it would not be beyond the means of a small group including only one individual with a widely available professional competence and still working in a "garage-type" clandestine environment, to achieve the same goal starting with HEU in oxide (powder) form, which is probably easier to steal.

Incidentally: our reference above to New York is not meant to suggest that city is necessarily the most likely target of a major terroristic act; although, for a number of reason, it might indeed be an appealing target for groups whose hatred is directed towards the USA -- or perhaps towards the USA federal government and the "East-coast ruling establishment": there indeed are quite a few militant US citizens who entertain such feelings, and who might be attracted by the nuclear option because they are bent on maximizing the "public relations impact" (!) of their action and/or because of some possible connection with nuclear establishments someone from these groups might have which might facilitate getting the required materials and know-how. Another likely target is perhaps Moscow, indeed there are rumors there that, for instance, Chechen groups already possess the capability and would not hesitate to use it if, in their own perception, they felt pushed to do so.

In any case it is well known that there has occurred recently an enormous increase in the potential (clandestine) availability of nuclear-bomb material, for several reasons, including, most importantly, the fission of the Soviet Union and the sore state of the ex-Soviet nuclear complex, as well as the nuclear disarmament process that has yielded and will yield much excess weapon-grade material, and finally the continuing production of potential nuclear-weapon material (for instance, reprocessed Plutonium) by the civilian nuclear-energy industry. It is for instance estimated (most likely underestimated) that there are now over 1,000 (one thousand) tons of HEU available worldwide (in fact, most likely such a quantity is available in Russia alone!), namely the equivalent of at least 10,000 (ten thousand!) easily realizable Hiroshima-size bombs. Let us emphasize that these figures, to the extent they are not precisely known (this being in itself a major problem), have been here underestimated, perhaps by more than a factor of 2.

In principle all this material should be well accounted for and securely guarded. Reality differs from this rosy picture; most probably quite drastically so. Incidentally, a (small) part of this material is earmarked as fuel for nuclear-powered submarines rather than as

weapon stuff, and therefore probably subject to less stringent controls, although it could also be used to produce nuclear explosive devices. And, as regards the material in the former Soviet Union, account must be taken of the tremendous transformation the societal environment is generally undergoing there, including the widespread habit of not paying on time the salaries to governmental employees, including those who work in the nuclear complex (there is one such complex in Russia, which includes both the civilian and the military components; it employs overall as many as one million individuals).

In conclusion, we assess as highly probable that significant quantities of nuclear materials have leaked out and/or will leak out, and that they already have or eventually will soon fall in the hands of mischievous groups, especially since there certainly are such groups who have access to considerable funds. This is not a certainty, but we believe such an assessment to be well founded, especially because it takes account of a context of extraordinary neglect of the risks entailed by this situation. This is a very important point, and we now proceed to elaborate it.

Superficially, there appears to be much concern about the risk that materials suitable for manufacturing nuclear explosive devices fall into the wrong hands: books are written by well meaning, competent and influential individuals, the US Congress has allocated substantial funds (up to US\$ 400 million per year over the last few years, under the Nunn-Lugar legislation) to strengthen the custodial system of nuclear materials in the former Soviet Union, some funds have also been allocated by other countries to prevent the leakage of nuclear-weapon know-how from the former Soviet Union, the Non Proliferation Treaty (NPT) is now permanently in place and it enjoys the support of all but three countries in the world (the only significant exceptions are the three *de facto* but, according to the NPT, not *de iure*, nuclear-weapon states: Israel, India and Pakistan); the International Atomic Energy Agency (IAEA) in Vienna administers worldwide (except for few exceptions) nuclear safeguards meant to guarantee that no diversions of nuclear materials from civilian nuclear fuel cycles remain undetected; and all main political leaders throughout the world are unanimous in stating that the prevention of nuclear-weapon proliferation -- of any sort: by governments as well as by subgovernmental groups -- is a very high priority of their governments. But all these worthwhile activities and initiatives falls quite short of the goal; as explained above, the present situation justifies the expectation that a catastrophic usage of nuclear explosive devices will occur within a decade or so. To prevent this from happening a much fuller and universal awareness of the danger would be required, and a much more global, drastic, focused commitment to address this problem. Indeed, let us tersely describe the most glaring evidence of the substantial neglect of the nuclear danger now prevalent.

As indicated above, enormous quantities of HEU -- sufficient for the easy manufacture of many thousands of nuclear explosive devices, each one of which will be capable to destroy a city with all its inhabitants -- are now available in the former Soviet Union (mostly in Russia). It is certain that not all this material is perfectly accounted for and absolutely well guarded. (Incidentally: there also are large uncertainties -- in the guise of many tons of Material Unaccounted For (MUF) in the HEU inventory of the USA). Moreover, even if all that material were now perfectly accounted for and absolutely well guarded, there is no guarantee that, in the near future, societal developments in

that area of the world will not jeopardize any kind of arrangements which might be now put in place: the best organized custodial system will cease to work if the personnel managing it starve or gets caught in widespread civil strife. Few out of the many persons knowledgeable on this matters question this assessment; most of them agree that this situation entails an enormous risk for the survival of our civilization, indeed, I would say, the most serious immediate danger for the survival of our civilization. Hence one should expect an enormous mobilization of all available resources to focus on this risk. This is far from happening. In fact there are some obvious, quite effective measures that could and should be immediately taken and which would go a long way towards alleviating, and eventually even eliminating, this risk. The fact that they are not pursued with any persistence is so weird as to appear ridiculous, were it not for the fact that it is likely to result in utter tragedy. Let me outline what the situation is, and then try and analyze what this neglect demonstrates and entails.

The obvious goal should be to eliminate as quickly as possible all available HEU. From a technological point of view there is an obvious and easy route to do so: dilute the HEU to LEU (Low Enriched Uranium), which can still be used for energy production, but not any more for manufacturing nuclear explosive devices. The re-enrichment from LEU to HEU is a hard task, way beyond the capability of subgovernmental groups, indeed beyond the technological capabilities of most countries, with few exceptions: USA, Russia, France, UK, and to a lesser extent a few others: Pakistan, perhaps Israel and India, Japan, South Africa,.... Hence the transformation of HEU to LEU provides a technological barrier which is quite effective in eliminating the risks of misuse of this material.

One should therefore expect the affluent countries of the world, and in the first place the USA, to be willing to buy all HEU available in the world, and in particular that available in Russia, under terms which guarantee its transformation as quickly as technologically feasible into LEU. LEU has economic value, so this operation might even yield some financial gain; but this aspect of the affair should obviously be considered of negligible relevance, relative to the overriding goal to get rid of the, potentially extremely dangerous, HEU. And let us emphasize that financial considerations should play no role, not only because the danger one is facing is so great, but also because the financial investment involved in the total elimination, once and for all, of this risk (namely, getting rid of *all* the HEU now existing in the world, including all that which will be made redundant by complete nuclear disarmament), are certainly less than a tiny fraction (say, 5-10%) of what the USA spends *every year* for its military; it would also be a tiny fraction (say, less than half of a percent) of what the USA alone has spent up to now in nuclear weaponry; it would be comparable to the cost of a few (say, less than ten) B-2 American bombers.

Of course, being prepared to invest such amounts of money is a necessary, but not a sufficient condition, to solve this problem. The other necessary condition is willingness by those who possess the HEU -- in particular by Russia -- to sell it. The miraculous thing is that, for a number of reasons -- mainly the drastic change after the end of the Cold War of the relationship between Russia and the West from confrontational to potentially cooperative, as well as the eagerness of Russia, and in particular of her nuclear establishment, to get much needed cash -- it has turned out to be possible to

struck, at the highest political level, a deal -- the so-called "HEU deal" -- involving the sale, to begin with, of some 500 tons of HEU from Russia to the USA -- an enormous quantity of material, sufficient for the easy manufacture of many thousands of nuclear weapons. The incredible development is that this deal, after having been agreed at the highest political level, has been implemented extremely slowly, and might even end up in being altogether canceled, because its management has been put, on the American side, under the supervision of an institution -- the US Enrichment Corporation (USEC) -- whose operating principles are mainly motivated by commercial, rather than security, considerations.

This is not the place to go into details about the substance of the HEU deal, of how it could perhaps still be salvaged and executed much more quickly than now envisaged (over twenty years!); much important as this question is. The point we wish to make here is that this episode is a glaring demonstration of the lack of understanding, and low priority, that the nuclear danger in fact evokes worldwide, and in particular in the USA. This is clearly confirmed by the lack of success of those few (outside as well as inside the Clinton Administration) who tried to bring this matter to the attention of decision makers, in order that a decisive intervention drastically redress the mess that had been created by assigning the execution of the HEU deal to USEC, namely to a governmentally-owned corporation in the process of being privatized, which had the remarkable property of being the one institution least likely to be sympathetic to the acquisition of HEU or LEU from outside the USA, being the main producer of precisely these commodities -- of which there is at present a glut --in the USA. It is also confirmed by the inability of the arms control community at large in the USA to raise hell about this matter, which is in part due, I am sorry to say, to inattention, but much more so to the feeling that one was facing a losing battle: as it was put to me by experts who minced no words about their dismay about the neglect of such a serious risk, there was however in their view no chance whatsoever that the US Congress would authorize such a short term transfer of funds (of the order of, say, US\$ 10-20 billion) to Russia, as would be needed to deal with this problem as a dramatic security emergency (which it obviously is), to solve it quickly and drastically.

This situation shall completely change *after* a nuclear catastrophe. It is unlikely to change *before* such an event. We will return to this crucial point below.

We have focused on the danger of a nuclear catastrophe occurring as a result of the acquisition by a subgovernmental group of a supply of HEU sufficient to destroy a city (easily transportable by a single robust person in a suitcase, or rather two for better walking balance and to avoid criticality problems). We have done so because we are convinced that this represents a clear and present danger, and we believe the figures given above confirm our hunch. We also feel the time scale we mentioned -- one decade -- is realistic indeed overestimated in terms of the times required to manufacture a device and, most importantly, of the times required for the leakage of the necessary quantities of HEU to happen. Personally we will not be surprised -- we will of course be horrified -- if a catastrophic nuclear explosion occurs tomorrow. We are prepared and interested to discuss in detail the *a priori* probability of this happening, on the basis of what is known about the likelihood of leakage out of custodial systems of significant quantities of HEU and of other nuclear bomb materials. But we are also fully aware of the difficulty indeed impossibility to convince a

sufficiently influential collection of individuals that the danger is so high as to require exceptional attention and extreme interventions. For one thing, the main argument to prevent the required mindset transition will be the fact that nothing of the kind happened yet.

The danger we have discussed is not the only one entailed by our present nuclear predicament. There are other serious risks flowing from the enormous nuclear arsenals still available, mainly to the USA and Russia, with thousands of nuclear warheads many of which are capable of reaching their targets in less than half an hour and are still kept on hair-trigger alert, so that they could be launched within minutes. The risk that not only nuclear materials, but also nuclear weapons might have got lost to resurface in mischievous hands has been advertised by individuals who held positions of high responsibility, such as general Lebed in Russia (his assertions might be downplayed by pointing out he is irresponsible; but then what about the prospect, whose probability is far from negligible, that he become the next democratically-elected President of Russia and therefore be put in charge of those enormous nuclear arsenals on hair-trigger alert?). And the overt nuclear-weapon proliferation of India and Pakistan obviously increases the danger that nuclear weapons be used in local conflicts, and makes it evident even for those to try desperately to stick their heads in the sand, that the present nuclear-weapon nonproliferation regime is at risk of crumbling unless the nuclear-weapon countries clearly take the lead in a drive to stamp out nuclear weapons from the face of the Earth, including of course their own.

It is important to underline this multitude of risks, lest the illusion continues to be sustained that our nuclear predicament can be managed for much longer -- how many decades? -- by a series of *ad hoc* measures: improving the accounting and the security of nuclear materials and weapons, designing more sophisticated command and control systems for nuclear weapons, hoping for impossible breakthroughs in the defense against some types of delivery vehicles, sustaining by diplomatic means the present nonproliferation regime... Of course some of these things should be pursued: those that are likely to do some good and not instead much damage. But the evidence of the matter, as documented above in the extreme, and extremely important, HEU deal case, is that even these piece-meal policies are in fact not implementable, due to lack of understanding of the real risks at stake, as long as the officially prevailing mindset is generally favorable to keeping nuclear weaponry as a key element of the national security of a few (and only a few!) key countries. Suffice here to quote three other glaring examples of institutional stupidity in addressing nuclear-weapon matters.

(1) *The nuclear de-alerting issue*: never really trying to balance the risks of having "our", and *their*, nuclear weapons on hair-trigger alert, against the advantages this posture supposedly provides (in terms of increased deterrence?).

(2) *The "hedge" issue*: to be prepared for the contingency that a potential adversary become again a real adversary, is it more important now for "our side" to keep a large capability of quick nuclear rearmament (marginal as its significance would be), or to obtain now that the "other side" reduce more substantially its nuclear arsenals, including the capabilities left in reserve? And there is also the "second-order," but essential, related question: what is the influence of one or the other attitude on the prospect that the potential adversary be pushed towards becoming again a real

adversary? And again, if one needs a clinching proof of utter stupidity/irresponsibility: how else should one characterize a military establishment who claims the need to keep a "hedge" military capability so as to be prepared for an eventual change of attitude of the potential adversary from co-operative to antagonistic, and at the same neglects to take advantage, at a marginal cost, of the possibility to eliminate the concrete capability for that potential adversary to build thousands and thousands of nuclear weapons in the future (not to re-emphasize the much greater risk that such material -- I am obviously refer again here to the HEU in the former Soviet Union eventually leak out to mischievous hands).

(3) *The general attitude towards nuclear weaponry of the ruling elites (not the general public) in the USA*: it seems obvious that the total elimination of nuclear weaponry should be seen as a most desirable goal, since it would affect the security of the USA in a profoundly positive way. Nuclear weaponry are the only real danger to American society, which might now be obliterated by them in a matters of minutes because of decisions taken by others, or because of mistakes made by others. No comparable danger would be remotely in sight if nuclear weapons were eliminated. Hence their elimination should be perceived as a most desirable goal. This does not necessarily entail favoring immediate progress towards the total elimination of nuclear weaponry: some will argue that this goal is simply not achievable now, that it will be possible to proceed towards it only if and when its realization becomes feasible. But there is a difference between an attitude which views nuclear weapons as a tremendous evil which should be gotten rid of if this were at all possible -- probably the prevalent view among the American people -- and the notion that nuclear deterrence constitutes now and for an indefinite future the cornerstone of American security -- still the prevalent view for the American political *elites* (although one that begins now to be widely challenged).

Incidentally: when pointing out what I perceive as glaring mistakes in facing the nuclear predicament, why do I seem to focus mostly on the American side? Primarily because any initiative to redress the situation can only come from the USA, *after* they recognize that they have an overwhelming interest in the elimination of nuclear weaponry. Moreover, charity should begin at home, and I feel I belong to the American (or perhaps the Atlantic?) arms control community, to the extent it still exists.

What is the point of emphasizing some absurdities of nuclear-weapon policies? Of course, one is thereby arguing for changes. But my main point here is rather to justify a realistic, if sad, conclusion: there is no chance of such changes occurring overall, and resulting in a positive outcome, unless they are embedded in the context of a drastic mindset transformation.

The elimination of nuclear weaponry, including a drastic reduction of the risk of terroristic or crazy uses of nuclear explosive devices by small clandestine nongovernmental groups, is indeed a very difficult task to achieve.

The difficulty is not intrinsic in the nature of such a regime or in finding the route to it. Indeed the steps to realize such a happy state are relatively obvious, moreover some kind of experimentally tested blueprint will even be available soon, in the guise of the

demonstrated viability (or weakness) of the regime of total abolition of chemical weaponry which is now being realized (the Chemical Weapon Convention prohibiting the development or possession of chemical weapons entered into force recently). Of course an analogous convention banning the development or possession of nuclear weaponry shall institute a much tighter global regime, which shall eventually cover *all* countries, irrespective of their willingness to accept it, and shall be backed by a very stringent and universal verification regime.

But, on the basis of the evidence outlined above, I repeat that all this can be achieved, and sustained, only in the context of a drastic change of mindset, essentially based on a very widely shared feeling of strong revulsion against nuclear weaponry.

It is unlikely that such a feeling prevail on a large scale unless some shocking event or events contribute to imprint it into the human psyche at large. Hiroshima and Nagasaki have not been enough, in part because they occurred at the end of a bloody war which had made large scale killing by advanced technology an accepted means of warfare, in part because it was associated with the end of the last World War (a happy event), in part because the major molders of public opinion at large -- the media, the religious leaders, the political *elites* in the most affluent parts of the world -- all were unanimous in hiding the hideous reality of the ultimate weapon of mass murder, or in packaging it in a strategic jargon ("deterrence") that managed and was indeed proud to make thinkable the unthinkable, and in part because the fight against nuclear weapons was hijacked and cynically used by Communist propagandists as an anti-American and anti-Western political tool, while the Soviet Union, ruled by a totalitarian regime purporting to realize the Communist ideology, was in fact secretly developing its own nuclear arsenals (in the late forties and fifties). The opposition to nuclear weaponry was thereby discredited, so effectively that only now it is being recognized again a respectable political and ethical stand.

The abolitionist opinion supporting the total elimination of nuclear weapons has made great progress recently; it is now almost universally recognized as a thesis worth serious scrutiny. It is moreover the only project for the future of international society that is considered acceptable by the International Court of Justice (ICJ). This clearly entails that all countries and world leaders are committed to strive for that goal, at least to the extent they accept the opinions of the ICJ as representing a dictate of that international rule of law upon whose prevalence is predicated the survival of our civilization. It is however hard to believe that the abolitionist view will prevail soon, in the context of the present mindset about the role of nuclear weaponry. And I would even submit that prevalence of such a political project is unlikely to be successful in preventing an eventual use or uses in anger of nuclear explosive devices, unless it is coupled with the emergence of a widespread feeling of revulsion against nuclear weaponry.

Only in the context of such a strong and widespread feeling of revulsion is there much likelihood that the regime of nuclear abolition will be successful in preventing nuclear usages, because only in such a context the international community and all human societies (or at least most of them: the others will have to be coerced!) will accept and support the major interventions that will be necessary, and perhaps sufficient, to exclude any future catastrophic nuclear explosions. To mention just a few: of course,

to begin with, total elimination of all nuclear weaponry; a strong supranational regime of prohibitions and stringent verification, with global range (applicable to all countries, if need be by force); active worldwide societal verification, and the rooting out of any national regime that will interfere with it; total elimination of all infrastructures, and eventually, over time and to the limited extent possible, of all know-how specifically aimed at nuclear weaponry. The effectiveness of the verification regime will require maintenance of some cadre of experts with some knowledge about nuclear weaponry; in the context of the general feeling of general revulsion about nuclear weaponry that we envision, their status will be analogous (like it or not) to that of the executioner in nineteenth century European societies where the death sentence was still considered a necessary element of civilized life, yet killing in cold blood, in circumstances other than war, was considered a shameful activity, and therefore anybody doing so was treated as an outcast.

Incidentally, if the transition to a regime of widespread virulent repulsion for nuclear weaponry will occur as a consequence of a major catastrophe caused by a nuclear explosion -- which might easily be the largest in human history -- its consequences are likely to invest indiscriminately everybody who had anything to do with nuclear weaponry -- possibly including even those who actively advocated their elimination. I am reminded here of the cop who intervened in a scuffle at an American University in the sixties among "Communist sympathizers" and "pro-American" students; he was beating up a young man who cried out "But I am an anti-Communist!," to which he gingerly replied, while continuing the beating, "I don't care what kind of Communist you are."

The consequences of the feeling of revulsion may also impact negatively on nuclear physics as a science, indeed on science in general, which might be perceived as the root cause of the disaster -- and on all practitioners of science.

I am mentioning these gloomy prospects because I think one must prepare for them. Most importantly, one must prepare for the great opportunity for change which will materialize after the next nuclear catastrophe. This might be a change for the good, inasmuch as it will increase the chance of major progress towards the elimination of nuclear weaponry. But it is far from certain that the aftermath of a nuclear catastrophe will necessarily set in motion a trend leading quickly to the institution of that regime of total abolition of nuclear weaponry which we have outlined above and which would make future recurrences of nuclear catastrophes less likely. It is instead possible that the reaction -- for instance to a catastrophe caused by a terroristic act, which I consider the most likely modality -- would be an attempt to strengthen the present regime, with a confirmation of many of the stupid policies now in place, and only a focused effort to stamp out some specific terrorist groups. We are instead convinced, and we have tried to provide above convincing arguments, that only a drastic overall rejection of nuclear weaponry can provide the context to create a new world regime which will drastically reduce the probability of future nuclear catastrophes, thereby allowing a continuation of our civilization.

It seems indeed obvious that the alternative course, characterized by endemic usage of nuclear weaponry, is hardly compatible with the continuation of our civilization. Moreover, if such usage will eventually escalate, one way or the other, to large scale

employment of the huge nuclear arsenals which are still now operational, even the prospect of a termination of the *Homo sapiens* experiment on this planet might be evoked. But in any case it is hard to imagine how our civilization could cope with several nuclear catastrophes, and the prospect of more to follow.

To sum up. An objective analysis of the present nuclear predicament indicates a high probability that a nuclear catastrophe will occur soon. An important aspect of this assessment is recognition of the evident inability of those in charge to cope with this situation, as manifested by their neglect of real and present dangers and by the overall stupidity of nuclear-weapon policies, which are focused on potential risks having very low probability and on actions having a marginal effect of decreasing them (and often a larger prospect of increasing them), but ignore the dangers which have a high chance to materialize, hence fail to address them even when there are opportunities to do so with major impact at relatively low cost. While efforts should continue to be made to change these foolish policies, it appears unlikely that they will be successful sufficiently quickly and significantly to avert the looming catastrophe. It is therefore reasonable to prepare for its aftermath. It is then likely that a new mindset prevail, based on a strong widespread revulsion against nuclear weaponry, in which context a drastically new course might become feasible, with some chance, but no certainty, to institute a world regime, based on the total enforced prohibition of any kind of nuclear weaponry, which might prevent a recurrence of nuclear catastrophes. The alternative, as the Russell-Einstein Manifesto proclaimed more than four decades ago, is universal death.