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Disarmament By Pit-stuffing: Bomb Disablement Need Not Await Bomb Dismantlement

Post-Cold War U.S.-Russian relations provide a unique window of opportunity for disarmament. How frustrating then to find that political leaders on both sides are failing to seize these opportunities, and to discover that bottlenecks in dismantling warheads, or storing them securely, can turn potentially rapid progress in disabling nuclear weapons into eyeball glazing decade-long disarmament processes.

In fact, there is good reason to believe that in Russia, as in America, nuclear weapons could be securely and permanently disabled in a verifiable fashion without awaiting the eventual dismantlement of a weapon (i.e., removal of its high-explosive and other parts) or its eventual storage.

New Idea for Disarmament

In this PIR, Matthew Bunn of Harvard University describes how a tried and true technology—developed to ensure that potentially unsafe warheads would not go off accidentally—could be used as an ingenious way of permanently disabling the warhead. The idea, in short: stuff the hole inside the plutonium "pit" of the weapon's primary atomic warhead with an explosion-neutralizing wire and do so in a way that defeats removal of the wire.

In a follow-up article, Richard L. Garwin, America's most talented and experienced assessor of nuclear weapons technology, pronounces "pit-stuffing" for disarmament a "good idea" that should be "discussed with urgency on a technical basis." And he makes a good start on this bilateral discussion project by sketching some of the issues that need to be addressed to give each side confidence in its verifiability and irreversibility.

Pit-stuffing, as seen from here, would be quick and easy (potentially as little as a few minutes per warhead) and would not require moving the warhead in question but could, instead, be done at its location—thus obviating such problems as finding new storage, or moving the warhead from the custody of one ministry or agency to another. In sum, it appears to be just what the doctor ordered for quick disarmament of large numbers of nuclear weapons—and it is not easy to see what could substitute for it.

Quick Dismantlement Improves Security

Does the world need a capability for large-scale quick dismantlement of nuclear weapons? We think it does. President Clinton and President Yeltsin should know that whatever they agree is excess to their respective security needs—either unilaterally or through bilateral treaties—can quickly be made inoperative. This will much advance the date of implementation of their declarations and orders, thus improving the security of both of their countries. It will make the proposals much more meaningful politically—because implementing action will follow right on the heels of purposeful declarations.

If, for example, the two presidents wanted to take a leaf from the book of President Bush and President Gorbachev in making parallel, reciprocal announcements concerning non-deployed warheads or tactical nuclear warheads, or both, they could—with pit-stuffing—be confident that the warheads of which they spoke could be disabled within weeks or months. If, to take another example, they wanted to speed up the effective implementation of START III, they could, with pit-stuffing, disable the warheads that

were excess long before these could be relocated, dismantled, and, finally, disarmed. Indeed, pit-stuffing could make in-place de-MIRVing possible—with wire stuffed into the pits of all but one warhead on a multiple-warheaded submarine-launched missile—and the disabled warheads could be removed much later when time permitted.

In sum, pit-stuffing makes large-scale "instant" disarmament a real and a live option. And this could change a lot in the calculations of decision-makers on whether to attempt fuller exploitation of the present window of opportunity for disarmament.

FAS Plans to Take Action

Accordingly, FAS intends to follow up this PIR by urging the Department of Energy and the Russian MINATOM to give priority to talks on pit-stuffing either between their nuclear weapon laboratories on the two sides or through non-proliferation offices.

But interested official entities may have either less motivation or less agility than one might wish. Accordingly, FAS is planning to give special attention to pit-stuffing in its up-coming U.S.-Russian workshops on warhead-dismantlement. Recently funded by the W. Alton Jones Foundation, these talks are being organized by FAS Fund Chairman Frank von Hippel as part of FAS's decade-long dialogue with Russian scientists on warhead dismantlement.

— J.J.S ❑

FAS Newsletter Delayed for Clearance

The March/April FAS PIR was delayed to confirm declassification of the lead article by Matthew Bunn on the application of pit-stuffing to arms control. But this requirement only confirms the importance of this article. And the two FAS-commissioned articles, by Bunn and Garwin, have already stirred Government thinking on the desirability of U.S.-Russian discussions of pit-stuffing.

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"Pit-Stuffing": How to Disable Thousands of Warheads And Easily Verify Their Dismantlement

Matthew Bunn

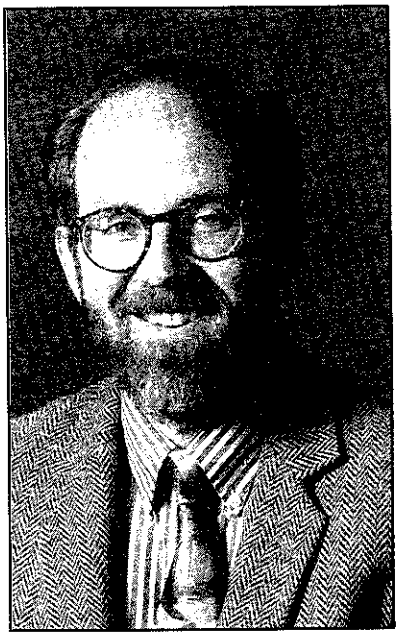
Technology exists which makes it possible to disable thousands of nuclear warheads, rapidly, permanently, and verifiably—and to verify their dismantlement with a minimum of cost and intrusion.

This technology, which might be called "pit-stuffing," was originally developed by the Los Alamos National Laboratory to ensure that warheads that had been determined to be unsafe would not go off accidentally—but it has never been applied to arms control. How does it work? Every modern "boosted" nuclear weapon has at its core a "pit"—a hollow sphere of plutonium or highly-enriched uranium, with a tiny tube through it that allows the tritium to be fed into the hollow inside the sphere. If a steel wire is fed in through this small tube until the inside of the pit is "stuffed" with tangled wire, the pit can no longer be compressed enough by the explosives surrounding it to sustain a nuclear chain reaction — the weapon is physically incapable of going off.

I believe this "safing" technology should be applied to permanently disable nuclear weapons. If the end of the wire is pushed inside the sphere, it cannot be pulled back out—the weapon is permanently disabled. The only way to get the weapon to work again is to dismantle it, remove the pit, cut the pit open and take the wire out, remanufacture the pit, and reassemble the weapon—a long and costly process. (While it might be possible to develop a means to pull the wire back out through the tube, it should also be possible to fray the end of the wire before pushing it in, making it impossible to pull it back out. Additional "red team" studies should be done to confirm this.)

Thousands of Warheads Disabled in Weeks

In the past, the rate at which the costly and time-consuming process of dismantling nuclear weapons could be accomplished posed a physical limit on how rapidly nuclear arms could be reduced. Pit-stuffing overcomes that problem; in principle, it would be possible to disable thousands of nuclear weapons in just a few weeks. The physical act of stuffing the pit takes only one or two minutes for one person, using a small device developed for the "safing" mission at Los Alamos—though disabling "live" warheads would take somewhat longer, because of the neces sary safety procedures involved in doing anything at all to a nuclear weapon.



Matthew Bunn

Once the pit has been stuffed with wire, this fact can be easily confirmed by a variety of means, such as a gamma-ray image of only, for example, one square inch of the pit. It should be possible to devise simple means to confirm the presence of the wire without revealing substantial design information.

Pit-Stuffing is Easily Verifiable

This approach would also make it possible to verify warhead dismantlement with minimal cost and intrusiveness. Inspectors could observe as technical experts from the inspected party inserted the wires into the pits of warheads that were to be dismantled in the future. Since the inspected party would do the actual insertion, very little design information would be revealed. Wires could be inserted into the pits of all weapons the parties had agreed to eliminate. Since this disablement can be accomplished very rapidly, each inspection visit could witness the disablement of hundreds of warheads, so only a few inspection trips would be required.

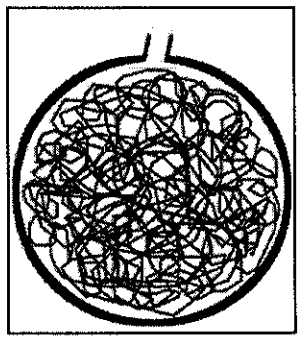
Then the inspectors would leave, and the inspected party would dismantle the warheads on whatever schedule was convenient, in complete

privacy. After the dismantlement was complete, the inspectors would return and be shown the canisters containing the "stuffed" pits. By taking gamma-ray images as described above, the inspectors could confirm that the containers contained hollow spheres of plutonium stuffed with tangled wire — a virtually sure sign that these were in fact the pits from the warheads observed before, which had been dismantled in the interim. (In the current post-Cold War environment, and with Russia's collapsing federal budget, it appears highly implausible that either side would go to the enormous trouble of manufacturing thousands of hollow plutonium spheres stuffed with wire just to fool the other side about its warhead dismantlement.)

Unobtrusive Inspections

In a certain sense, the wire can be thought of as a tag placed inside the pit, rather than on the surface of the warhead, so that it stays with the pit through the process of dismantlement, and can be checked after dismantlement is complete. If the two governments wanted even higher confidence, each wire could probably have a unique gamma-ray fluorescent tag, which would allow it to be uniquely identified from outside the pit canister, matching the "stuffed" pit with the specific warhead into which that particular wire was stuffed. The feasibility of such tags needs to be examined further, however, along with the long-term compatibility of the tag material and the plutonium of the pit. Another approach to such unique matching of pits to the warheads from which they came would be to take a somewhat more elaborate gamma-ray image of the tangled wire inside each warhead, from several different angles, after the wire was inserted; after dismantlement, similar images could be taken of a few of the pits, selected at random, making it possible to match the unique tangles of wire inside to the tangles inside the warheads from which the pits came.

Thus, a limited number of inspections that would reveal very little design information could potentially offer high confidence that particular observed nuclear weapons had in fact been dismantled, with that dismantlement resulting in particular observed stockpiles of pits. Moreover, the pits would now be unusable in weapons unless they were remanufactured. No presence within the confines of the dismantlement facility itself would be required, and no information concerning warhead production, or warhead dismantlement and remanufacturing for maintenance purposes, would be revealed. Most of the other approaches that have been considered for verifying the dismantlement of nuclear warheads — such as setting up perimeters around the dismantlement facility and counting the number of warheads coming in and the pits coming out—involve far higher costs and greater intrusiveness, or do not achieve as high confidence. And these other approaches do nothing to prevent the pits from being reassembled into new weapons, unlike pit-stuffing. In addition, pit-stuffing can be applied to the thousands of pits from warheads that have already been dismantled. This would ensure that these pits, too, could not be re-used without being cut open and remanufactured, and identical inspections, by showing that the item in the canister was a hollow sphere of plutonium stuffed with wire, would help to confirm that these were in fact pits from previously dismantled weapons, and not some other form of plutonium.



Plutonium pit stuffed with wire

Pit-Stuffing with What?

Of course, a steel wire is only one of many things that could be used to "stuff" the pits. Originally, for ensuring the safety of the unsafe weapons, aluminum powder was used—which could be removed by simply shaking the powder back out through the hole. Another approach was to fill the inside of the pit with epoxy—but putting anything organic in with the plutonium leads to chemical reactions that reduce long-term safety, and the bonding of the epoxy and the plutonium made the pit a "mixed waste" (both radioactive and toxic) under U.S. regulations. The idea of the steel wire was to make it possible to "stuff" the pits in a way that would have no impact at all on the safety of long-term storage, either of the weapons, or of the pits themselves after the weapons were dismantled. Another possibility would be to stuff the pit with hundreds of tiny "barbells" whose wide parts are just small enough to fit in through the tube—making it virtually impossible to shake or pull them back out.

U.S. and Russian experts should be directed to immediately begin working together to analyze the pros and cons of pit-stuffing. Studies should be undertaken to examine:

- means to ensure that the wires cannot be removed without cutting open the pit;
- the safety of the stuffed pits during long-term storage and pit disassembly;
- the best approaches to verifying the presence of the wire without compromising sensitive design information; and
- the best approaches to uniquely matching a stuffed "pit" to the warhead from which it came, should political leaders decide they want such a capability.

Within a few months, it should be possible to answer these questions and confirm the potential of pit-stuffing.

Ensures Transparency and Irreversibility

Pit-stuffing has the potential to be a remarkable new tool in the arms control toolbox, enabling fast dramatic reductions in nuclear arms—and verification that those arms have really been dismantled. This approach could make a huge contribution to the goal of ensuring the "transparency" and "irreversibility" of nuclear arms reductions, repeatedly agreed to by Presidents Clinton and Yeltsin. This technology can offer policy-makers new options—and deprive them of excuses for not pursuing deep, transparent, and irreversible reductions in nuclear arms.

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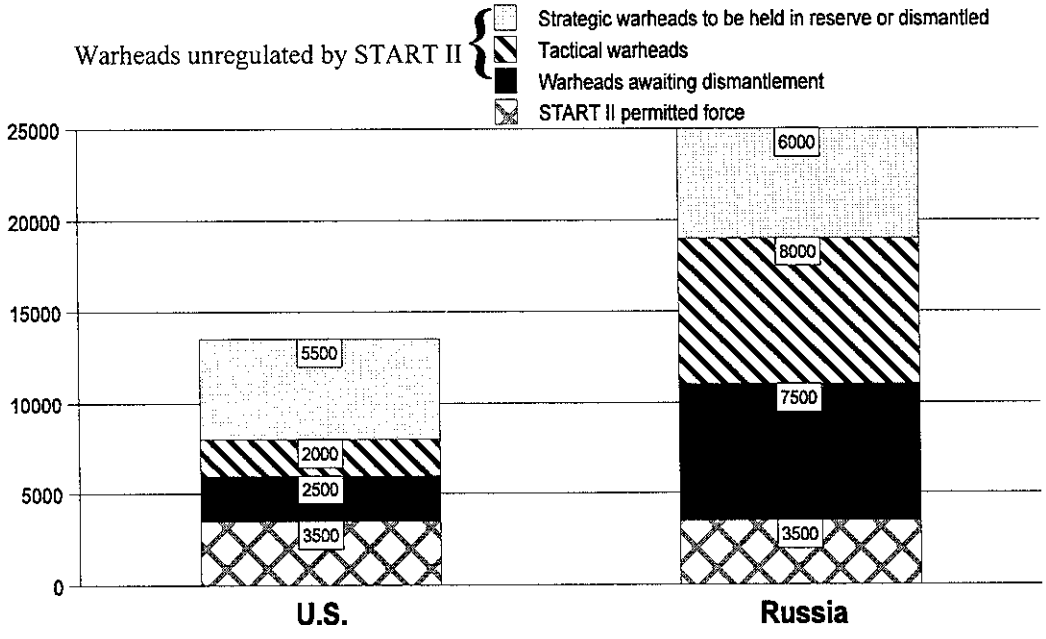
Potential Targets for Pit Stuffing:

The Size of the Nuclear Stockpiles



Graph adapted from NRDC data, 1996

The above graph shows estimates of U.S. and Russian nuclear stockpiles. The U.S. holds 10,000 and Russia 21,500 warheads in excess of the agreed upon START II levels of 3500. These additional warheads, unregulated by START II, represent potential pit-stuffing targets. Any further warheads reduced in START III and beyond could be immediately pit-stuffed as well.

Comment on Matt Bunn's "Pit-Stuffing" Proposal

Richard L. Garwin

It would indeed be valuable for the political leaders to have an option to safely, permanently, and quickly destroy the military utility of vast numbers of nuclear weapons that are agreed to be excess (and that would be slated for early dismantlement if that were feasible at reasonable cost). So I applaud the emphasis on this particular technique that can surely be applied to U.S. nuclear weapons, and I strongly support opening a technical dialogue among U.S. and Russian experts as to how this can be carried out and verified.

Tritium and deuterium gas are admitted to the hollow pit of a nuclear weapon primary shortly before the high-explosive implosion, in order to achieve the benefits of boosting.

The tritium "fill tube" is normally welded shut and can be explosively sheared to admit the tritium gas to the pit; since the plutonium shell would be corroded by reaction with the hydrogen isotopes, the weapon cannot be stored with boost gas in the pit. The fill tube is presumably accessible, because tritium reservoirs are substituted in the field, to replace tritium that has partially decayed with its half-life of 12 years.

As Matt Bunn indicates, it is possible to push a wire or cable through the fill tube into the pit, and I would suggest also that this could be done with wire that is pre-kinked, with the kink constrained by the wire storage device and then by the fill tube, so that it then snarls predictably as it enters the void of the pit.

Issues with Pit-Stuffing

• The first question is the effectiveness of pit-stuffing in eliminating the possibility of a nuclear yield. This has apparently already been established for U.S. weapons, but needs to be calculated by Russian experts for their own nuclear weapons.

• The work involved in pit-stuffing needs to be addressed. The actual operation may take minutes, but one needs to obtain access to the nuclear weapon, open some maintenance port, do the operation, and close up the weapon again. In the case of pits that have already been removed from nuclear weapons and are in their individual storage containers at Pantex or elsewhere in the United States (or in analogous locations in Russia), the storage container needs to be opened to have access to the pit, the pit-stuffing operation carried out, and the storage container resealed.

• Irreversibility needs to be addressed, as Matt Bunn indicates. In an era of laparoscopic surgery, one wants to make sure that instruments cannot readily be inserted through the intact fill tube to remove the wire. Naturally, one will need also to evaluate the possibility of chemical dissolution without harming the chemically reactive Pu, but it seems unlikely that would be a problem.

• Verification is important. If the host country pretends to feed in hundreds of grams, or kilograms of wire, how does the other side know that it was really inserted and that it is not of a type that is readily removable? The two sides could agree in principle on suitable characteristics of wire or cable, and the actual spool could be provided by the other side. Alternatively, as is common in such agreements, the U.S. (to be specific) could lay out several identical kits that it might use in stuffing a weapon, and the Russian side could select one to dismantle and one for actual use in disabling the particular U.S. weapon.

• Presumably one side would desire to verify that the pit is really full of wire. One convenient option would be the use of radiography, with a few-millicurie radioactive source. Although Pu (like uranium or lead) strongly absorbs x-rays, the absorption in the hollow shell is not excessive at high energies. For instance, if a pit contains 5 kg of Pu at a shell diameter of 25 cm, the area is 1900 sq cm and the thickness of the layer about 2.6 g/sq cm. So the radiation must penetrate two such layers, for a total of about 5.2 g/sq cm. At a gamma ray energy of 1 MeV from a cobalt-60 source, the absorption of gamma rays is only about 8% per g/sq cm of Pu or U, so one would have no difficulty of imaging a few square centimeters of path through the pit. The Pu shell is less than 2 mm thick, and (at 1 MeV) the absorption per mm is about

the same as that of tungsten and only twice that of steel, so that it should be possible readily to see steel or tungsten wire within the pit.

A Few Answers

To ensure that the wire is actually within the pit and not elsewhere in the line of sight, two pictures can be taken at a slightly different angle to provide the equivalent of a stereo view.

If the owner of the weapon is reluctant to allow information to be gathered on the thickness of the Pu shell, provision can be made for inserting in the path a uniform plate which can add the equivalent of a millimeter or two of U or Pu; this would simply mimic additional thickness of the shell, without adding any features that could be mistaken for wire within the pit.

Alternatively, incorporating some microcuries of cobalt-60 in the stuffing wire itself would allow the use of simple counters to provide assurance that the wire is in the pit, without the use of film or imaging systems.

Pit-stuffing does not resolve all problems of nuclear weaponry. For instance, a weapon detonated with a pit stuffed full of wire would still disseminate plutonium, which would be a health hazard. Furthermore, others might have their own favorite approaches to achieving these same ends.

In fact, one must be wary of the common response

- It won't work.
- It's not new.
- I thought of it first.

I do think that this is a good idea and that it should be discussed with urgency on a technical basis so that it could be available as a valuable tool for quick reduction in the nuclear threat.

In an era in which the United States and Russia have agreed in principle to demilitarize missiles slated for destruction in the START process, it seems long overdue to do the same for the nuclear warheads themselves.

Richard L. Garwin is the Senior Fellow for Science and Technology at the Council on Foreign Relations. ❑

Verifying Arms Control Through the Scientific Community

Not long ago, a *Washington Post* article showed pictures of two Iraqi scientists deeply involved in its current crisis. One, a man trained in Mississippi, had stimulated the Iraqi Government to build biological weapons (Abdul Nassir Hindawi). The other, a woman trained in Britain (Rihab Taha), wife of the oil minister, was running the covert Iraqi program.

Mobilizing Scientists

All this raises a question of increasing importance in today's world. How best can scientists be mobilized not to cooperate in developing weapons of mass destruction?

Increasingly, in the future, scientists will be living in states that have undertaken not to develop chemical or biological agents—under the Biological Weapons Convention (BWC) of 1972 and under the Chemical Weapons Convention (CWC) of 1993. For example, even Iran has ratified both of these Conventions. And both of these Conventions provide for States making violations of these international treaties a domestic crime which puts a special personal responsibility on the scientists involved.

Iraq is under sanctions from the U.N. Security Council that require it to "unconditionally accept" the destruction of chemical and biological weapons and even ballistic missiles with a range over 150 kilometers and to cease efforts to develop these and nuclear weapons. Accordingly, Iraqi scientists who help develop such weapons are acting in violation of the United Nations Security Council. Therefore, Iraqi scientists should not work on such projects and, if coerced to do so, should drag their feet In particular, the U.N. Special Commission might, as part of its detective work, seek to interview Iraqi scientists and distribute material concerning scientific responsibilities.

Using Peer Pressure to Achieve Compliance

Now that it is becoming so clear, in almost all

states, just what behavior is, and is not, "lawful", the international scientific community, normally cautious about "political issues" could do more than it has. In particular, it could, at its meetings and in its publications, press scientists everywhere to comply with these sanctions and international treaties using peer pressure and the serious threat of ostracizing non-complying scientists—cutting them off from meetings and publishing in scientific publications.

Scientific Network is Pervasive

So pervasive is the scientific network into formerly secret areas that violators do risk becoming known just as the secret work of Abdul Nassir Hindawi and Rihab Taha has become known. Scientists from the key atomic laboratories of Russia, China and the U.S. frequently meet together and except for unusual situations, such as that of North Korea, scientists of all kinds are closely linked through the internet and their many professional meetings.

But if the international scientific community is to press Iraqi, Iranian and other third- world scientists to forswear development work on weapons of mass destruction, the United States, Russia, Britain, France, and China ought to encourage verification by scientists of their own related international legal responsibilities.

In particular, these states ought to embed in domestic legislation, in due course, the nuclear test prohibitions present in the already-signed but not yet ratified Comprehensive Test Ban Treaty (CTBT) just as is being done with the chemical and biological conventions. This will strengthen the hand of scientists who want to ensure that the Treaty is obeyed punctiliously. If these scientists are armed with the precise treaty rules (e.g., on what exactly constitutes a nuclear test—something now secret), it will be harder for rogue laboratories or agencies to bully or mislead them into participating in any violation of this international treaty. In turn, this will assuage the fears of cheating in the parliaments of those considering ratification of the CTBT.

This trend toward applying scientific responsibility to the verification of treaties is inevitable since the world wants, increasingly, to ban work that can be done or initiated by small numbers of scientists in small laboratories and may sometimes be verifiable only through them. Under these circumstances, the scientific community must learn to police itself and Governments must learn to work with, and through, the scientific community. —*J.J.S.* □

On Both Sides, Disarmament is Big Bucks

Jeremy J. Stone and Carl Kaysen

Reports of the Russian Duma's unwillingness to raise the issue of ratifying the START II Treaty this spring were discouraging to those Americans who want economic relief from high defense budgets. According to the Congressional Budget Office (CBO), a Russian failure to ratify START II could cost the U.S. about a billion dollars a year to maintain strategic forces that otherwise would be retired.

How Low Will They Go?

Russian ratification of START II—already unsettled by western plans for NATO expansion—may turn on similar Russian economic concerns. START II permits each side 3,500 deployed strategic warheads, but this formal equality masks the fact that Russia cannot easily maintain such a large force. It wants lower limits in the next agreement.

Last March, at Helsinki, Presidents Clinton and Yeltsin agreed to a projected START III limit of 2,000 to 2,500. Three months later, in a Washington speech, Alexei Arbatov, Deputy Chairman of the Duma's Committee on Defense, said even 1500 strategic warheads was too high a level and would require 50% increases in yearly costs for Russian strategic forces for "better maintenance, overhaul and service life-extension programs."

Three months later, on September 17, President Yeltsin emerged from a meeting with his defense minister and, referring to START III, announced that Russian security could be ensured with "even 1,000 strategic nuclear warheads."

For the United States, a START III limit using this 1,000 figure, rather than 2,000, would probably

mean 10 Trident submarines (rather than 14) and 250 Minuteman III land-based missiles (rather than 500), along with 20 B-2 bombers and fewer nuclear charges on fewer B-52 bombers.

1,000 Warhead Level Could Save Billions

At this level, both sides would be forced to single-warheaded missiles, and concerns about first-strike threats would finally disappear—something of real interest to the Duma. But it would still leave the United States with 160 warheads invulnerably based at sea at all times—far more than enough for any conceivable future purpose or enemy.

Cutting back to 1,000, rather than 2,000, strategic warheads would save, according to CBO, $16 billion for the Defense Department and about $6 billion for the Department of Energy by the year 2010. If one factors in the $12 billion of maintaining START I force levels in the event the Russians do *not* ratify START II, the financial stakes involved in disarmament total $34 billion over the next dozen years. Thus it represents a significant fraction of President Clinton's recently announced new spending of $30 billion per year for education, child care, and expanded health care. Put another way, it is $500 for every family of four. Nuclear weapons no longer mean "more bang for the buck;" now there are big bucks in less bang.

Stone is President of FAS and Kaysen is Chairman of FAS. □

AHEAD in Africa

Dorothy Preslar

The Animal Health/Emerging Animal Diseases (AHEAD) project went to Africa in late February and early March to get a first-hand look at areas targeted for the first phase of our Sub-Saharan program. This initiative, described in an earlier PIR, is intended to monitor diseases shared by livestock and wildlife, some of which also affect humans.

Accepting the invitation of the renowned Onderstepoort Veterinary Institute (OVI) to visit and discuss issues, AHEAD's first stop was South Africa. Met by Dr. Leon Prozesky, director of the OVI diagnostics program, we were whisked away to Pretoria, about 40 miles northeast of Johannesburg, and settled into a thatched-roof lodge near the Institute. Over the next five days, meetings with provincial veterinary service officers took the project through mountain passes illuminated by the ever present African sun, through lowland corn greened by the El Nino rains (possibly the only positive effect in Africa of the weather event that has wreaked havoc in Somalia, Kenya and Tanzania) and through the bush to the cow sheds and cotton fields of small and mid-sized farms.

At Onderstepoort Veterinary Institute: Dr. Leon Prozesky, Diagnostics Program Manager and Dr. Mary Lou Penrith, Veterinary Pathologist

Having been informed by day-long trips to Mbotho in the Northern Province, Nelspruit in Mpumalanga and Rust de Winter in the southern Gauteng, and by briefings from OVI scientists and epidemiologists (all of whom follow the AHEAD disease reports on our electronic mail network), the work of settling on an approach for the first phase of a pilot program began.

Proposed Pilot Program Gets a New Look

Prior to the trip we were proposing a system of mobile lab/clinics that would begin in South Africa and expand over years to cover wildlife/livestock intersects throughout the region. Once we were in South Africa, the proposal took on a new look, at least for areas where provincial veterinary services are well established.

During one meeting with OVI Director, Dr. D.W. Verwoerd, and Deputy Director, Dr. J.D.

Bezuidenhout, and AHEAD's core group of OVI experts—Leon Prozesky, Mary Lou Penrith and Johan Vorster—a more imaginative system emerged. Instead of the originally proposed mobile vans (with their attendant insurance and operating costs and security problems) rolling from village to village, small permanent units would be placed at 100 km intervals (approximate), and coverage between these points would be effected through the use of motorbikes by veterinary technicians staffing the units. When the meeting ended, we congratulated each other on reaching consensus on a South African program that fits the country's existing capabilities and infrastructure.

At this point in history, South Africa is significantly more developed than some of the other sub-Saharan countries. Highways and tarmac roads lead out of Johannesburg and Cape Town, Nelspruit and Durban. Where these motorways end, one-lane dirt roads begin. Though rutted and dusty, these roads spread like tentacles and provide access to even the most remote rural communities, a necessity for the pilot program.

South African Veterinary Staffs Well Trained

Personnel of the government's veterinary services are well trained, and in some locations, the provincial offices are staffed even more fully than necessary. This latter phenomenon is a result of the need of the new government to make jobs available to as many qualified individuals as possible, even at the peril of having more employees and less operating funds to do the work.

Before leaving Pretoria, AHEAD had an opportunity to meet with Dr. Gavin Thomson, Director of the Onderstepoort Institute of Exotic Diseases. Dr. Thomson, recognized expert on diseases shared by wildlife and livestock, is currently involved with a proposed surveillance plan in Tanzania, which was AHEAD's next stop by way of Nairobi.

This second part of the trip was to establish contact with veterinary units of the Kenya Wildlife Services and Serengeti National Park, two important nodes in AHEAD's electronic reporting network.

In South Africa, the poverty level lay beyond the acacias, mostly out of sight. In Nairobi, the state of the economy is inescapable. Kenya-style strip shopping malls—an almost uninterrupted line of shacks

Dr. Morris Kilewo (left), Dorothy Preslar, and Dr. Titus Mlengeya, Chief Veterinary Officer of Serengeti National Park check out new computer provided by AHEAD under a grant from The Norcross Wildlife Foundation.

selling soft drinks, butchered meats, and cornmeal by the gram—border streets leading into the city center, where there are more casinos "than anywhere else in the world," according to a taxi driver, and "more being built." When I asked if the tax revenues went to benefit the people, he said "They are not taxed as heavily as they should be. And even if they were, the people would never see a shilling."

The Nairobi air was heavy with insecticide, as would be true a week later in Arusha, Tanzania, as health authorities attempted to deal with outbreaks of bluetongue and highland malaria and a "beefed up" strain of Rift Valley fever. First order of business at the hotel was rigging a mosquito net across the screenless window.

AHEAD Brings Computers to the Serengeti

After a day's stopover, in Nairobi, it was "up at dawn" and "no breakfast" before meeting up with Dr. Markus Borner of the Frankfort Zoological Society who was flying me and his visiting daughter to the Serengeti in a single-engine plane. We flew over the mountains west of Nairobi and, on a clear day, viewed the Mount Kilimanjaro crater trimmed with snow. Then the Rift Valley lay below, many of its streams still muddy from the floods that had complicated land travel for over two months. Here and there were the circular patterns of the Maasai compounds, from a height of two thousand feet looking more like stained cells under a microscope than human habitation.

Our business in the Serengeti was not only to discuss disease surveillance with as many officials as

possible, but also to deliver a computer to the park's veterinary unit under AHEAD's program of providing e-mail capability to remote locations.

Landing at Seronera, the plane roused a group of old bull buffalos who left their mark on the craft's exterior. We climbed out, carefully avoiding the fresh dung clinging to the doors and undersides of the wings, and we headed for the offices of Dr. Titus Mlengeya, Chief Veterinary Officer of the Serengeti. We dropped off the computer with much relief after lugging it through ten airport checkpoints and in and out of hotels in a constant state of alert to the possibility of a quick grab, and went with staff to the Seronera Lodge for tea and toast.

The lodge is legendary—built dramatically amongst huge boulders of an outcropping on the Serengeti plain, its state of repair a bit iffy since its shift in operation by the Tanzanian Parks Board to a French company a few years ago. Nevertheless, a fascinating facility constantly surprised by the visits of gazelle and giraffe up to the edge of the clearing, and baboons within the premises. The next three days were a mixture of meetings with and briefings by park officials, wildlife sightings and one rather incredible experience of witnessing the de-tusking of a dead elephant (the full story of which will be published on the FAS AHEAD website at http://www.fas.org/ahead /wildlife/elephant.html).

Preslar is ProMED/AHEAD Project Director □

New Staff at FAS

FAS is pleased to welcome three new staff members to our office. All three have a strong scientific background, and share FAS's commitment to peace and global security.

Charles Ferguson

Charles Ferguson is working with Jeremy Stone on the START disarmament talks and de-MIRVing and with Frank von Hippel on nuclear warhead dismantlement verification and transparency. In addition to these issues, Ferguson also acts as the Federation's point-person on the Comprehensive Test Ban Treaty and other nuclear weapons policy issues.

Charles Ferguson

A 1987 United States Naval Academy graduate, earning a B.S. degree in physics with distinction, he attended the Naval Nuclear Power School and the Submarine Officers School and served on a fleet ballistic missile submarine as a sonar and reactor controls officer. After three-and-a-half years in the navy, he resigned when he became uncomfortable with nuclear war planning and received an honorable discharge.

Ferguson then earned an M.A. in 1994 and a Ph.D. in 1996, studying theoretical and computational physics at Boston University. His dissertation examined the phase transitions arising from and the statistics associated with long-range earthquake fault models. Before arriving at the Federation, he investigated chaos theory as a postdoctoral research associate at the Institute for Physical Science and Technology at the University of Maryland. Ferguson has also worked at the Los Alamos National Laboratory, the Space Telescope Science Institute, and the Harvard-Smithsonian Center for Astrophysics.

Antonia Herzog

Antonia Herzog, will be developing a new FAS newsletter on global issues in energy efficiency technology. Through a double degree program she received a B.A. in physics from Vassar College and a B.E. in Engineering from the Thayer School of Engineering at Dartmouth. She then proceeded to

Antonia Herzog

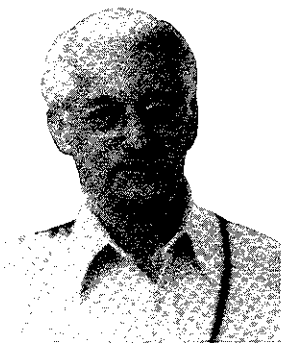
Columbia University where she obtained a M.S. in applied physics, followed by a Ph.D. in experimental con-densed matter physics at the University of California, San Diego. Her dissertation research used nano- fabrication techniques to create ultra-small super-conducting and metallic wires to study their unusual quantum properties. After completing her degree, she obtained a Sloan post-doctoral Fellowship in neurobiology at The Salk Institute in La Jolla, CA, where she studied the organization of neuronal circuits used in visual information processing.

Harrison Wein

Global Issues in Agricultural Research, a new FAS newsletter, will be written and edited by Harrison Wein. Wein received his Ph.D. in cell biology from the University of California at Berkeley for his studies on cell division in diatoms, a marine algae. In addition to his academic papers, Dr. Wein has written about science for *The Richmond Times-Dispatch*, *Science-Now*, and *Insight*, and is also co-author of the entry on mitosis in The *Encyclopedia of Human Biology*. He was awarded an American Association for the Advancement of Science Mass Media Science and Engineering Fellowship in the summer of 1996.

Harrison Wein

In hiring the above staff, FAS benefitted from the thoughtfulness of two long-time FAS members, now deceased, who had the forethought and generosity to remember FAS in their wills. One gift came from the estate of Dr. Letitia Shelby Kimsey Taylor in memory of her husband (and FAS member) Armor Hugh Platt Taylor. The second gift was from the Marvin S. and Gerda B. Irving Freedman Estate. Dr. Melvin Freedman was a senior scientist at Argonne National Laboratory who worked on the Manhattan Project. In addition, he was a founding member of the Atomic Scientists of Chicago which was one of the groups that later became the Federation of American Scientists. We note, with regret, the passing of both of these members. They will be remembered fondly for their kindness and generosity. We hope that other members will think of FAS's long-term needs when the time comes to prepare their own wills.



Dr. Melvin Freedman

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