

Letter From The Editor

by Philipp Steger

The current, somewhat slimmer – it's summer time, after all – edition of "Voices on U.S. Science & Technology (S&T) Policy" focuses on two issues: the increasingly confusing question of what the legal and political status quo of stem-cell based research in the U.S. is, and the role science & technology play in U.S. efforts to face bioterrorism.

In his contribution about the debate over embryonic stem-cell research and therapeutical cloning, Stephan Neuhäuser tackles a daunting challenge: to sift through the overwhelming body of material regarding the legislative proposals both in Congress and at the state level, and to provide you with an explanation of this debate that is so essential for the future of the Life Sciences in the U.S. While the topic has not received a lot of media coverage in recent times, emotional appeals by celebrities are sure to heat up the debate in the months ahead. The latest example is Christopher Reeve's announcement that, as part of his campaign on stem cell research, he plans to travel to Israel to find out more about the relevant research programs there.

My own contribution on the role of science & technology in bioterrorism preparedness-efforts acknowledges that there is a wealth of information available on the Internet for anyone who cares to delve into the complex questions of whether the U.S. is ready to deal with the potential of a bioterrorist attack. The literature is abundant, for the most part rather technical and focuses nearly exclusively on a narrowly defined role of the sciences. Hence, the provocative title of the article claims that there is, in fact, an underutilization of the sciences in the "war on bioterrorism." The contributions of Peter Palese and Dorothea Strozyk, two accomplished Austrian scientists based in the U.S., counterbalance my approach by choosing themes that would be identified with the "traditional" role of science & technology in dealing with bioterrorism.

With Irene Eckart's review of the World Resources Institute's new report "World Resources 2002-2004 – Decisions for the Earth: Balance, Voice and Power," we revisit the area of environmental policy, a policy field that "Voices" tries to cover as often as possible.

We at the OST hope that you enjoy "Voices" and wish you a pleasant summer.

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Embryonic Stem Cell Research And Therapeutical Cloning in the U.S. – A Never-Ending Story

by Stephan Neuhäuser

“Voices on U.S. Science & Technology Policy” reported on the debate regarding embryonic stem cell research in February 2002 (Philipp Steger, Zur US-amerikanischen Stammzellendebatte). With new legislation pending in the U.S. Congress, in various state legislatures and around the world, it is once again time to review the ongoing debate in the U.S.

During a hearing of the Senate’s Subcommittee on Labor, Health and Human Services, Education, overseeing the budget of the National Institutes of Health (NIH) on May 22, 2003, two senators recently lambasted Elias Zerhouni, the NIH’s director. Subcommittee Chairman Arlen Specter (R-Pennsylvania) and Tom Harkin (D-Iowa), the panel’s ranking Democrat, accused Mr. Zerhouni of having misinformed the subcommittee about certain embryonic stem cell lines eligible for federally funded research, and also for not doing enough to make them available widely enough for research. “Their tone was at times testy and challenging, with Mr. Harkin voicing ‘extreme frustration’ about the NIH’s responses,” the Chronicle of Higher Education reported in June 2003 (Chronicle of Higher Education, Volume 49, Issue 36, Page B13, June 6, 2003). Dr. Zerhouni admitted to discrepancies in NIH spending priorities. In 2002, only \$ 11 million was earmarked as funding for research on embryonic stem cells compared to a hefty \$148 million spent by the NIH for studies on stem cells derived from adult human tissue in the same timeframe. In contrast to Harold Varmus, former NIH Director, it should be mentioned that Dr. Zerhouni takes a rather critical approach to embryonic stem cell research and therapeutical cloning. President Bush supported Dr. Zerhouni when he said: “Dr. Zerhouni shares my view that human life is precious, and should not be exploited or destroyed for the benefits of others. And he shares my view that the promise of ethically conducted medical research is limitless.”

However, most researchers feel that embryonic stem cells hold much more potential than their adult counterparts. It is believed that new treatments designed to halt the effects of aging, incapacitating, degenerative and sometimes fatal illnesses like Alzheimer or Parkinson’s Disease can be garnered from research on embryonic stem cells. Stem cells are capable of continuously reproducing themselves and renewing tissue throughout an organism’s life. Embryonic stem cells are the most adaptable of all since they are not yet differentiated like adult stem cells. Hence, they are not committed to any particular function. Embryonic stem cells are usually derived from blastocytes, umbilical cord blood or bone marrow, and are cultured in “stem cell lines.” As soon as enough cells have developed, batches of cells may be distributed to research laboratories. The ethical debate stems from the fact that embryonic stem cells can - for the time being - only be “harvested” from blastocytes. Blastocytes are defined as embryos, only a few days old, that are left over from in-vitro-fertilization procedures. “Harvesting” ultimately destroys them. For those who believe that an embryo has the moral status of a person from the moment of conception, research involving its destruction is considered unethical.

What further fuels the debate is the fact that embryonic stem cells can also be derived from embryos created through *somatic cell nuclear transfer*, better known as “cloning.” In fact, some scientists believe that deriving stem cells from therapeutic cloning might be the most promising avenue towards developing tailored to individuals treatments as this treatment would involve using the recipient’s own DNA.

- Hearing of the Subcommittee on Labor, Health and Human Services, Education on May 22, 2003 <http://appropriations.senate.gov/subcommittees/record.cfm?id=204165>
- National Institutes of Health <http://www.nih.gov>
- Senator Arlen Specter <http://www.senate.gov/~specter/>

- Senator Tom Harkin <http://harkin.senate.gov/>
- Remarks by the President in Announcement of the Director of the National Institutes of Health and the Surgeon General
<http://www.whitehouse.gov/news/releases/2002/03/20020326-3.html>

“I Believe Human Life Is A Sacred Gift From Our Creator” (President G. W. Bush) – Current Federal Rules

The ongoing debate in the U.S. Congress, of which the above mentioned hearing was a part, circles around the unclear situation created by President George W. Bush. Originally, President Bush was strictly opposed to research on embryonic stem cells based on religious grounds. However, he issued an Executive Order on August 9, 2001, for the first time in the U.S. history, legally allowing federal funding for this type of research, but limiting it to embryonic stem cell lines already in existence worldwide at that time. The Executive Order also stated that no federal money would be available for research on cell lines created after the deadline of August 9, 2001, 9 PM. In his “Radio Address to the Nation” on August 11, 2001, President Bush said that “embryonic stem cell research offers both great promise and great peril. So I have decided we must proceed with great care. As a result of private research, more than 60 genetically diverse stem cell lines already exist. They were created from embryos that have already been destroyed, and they have the ability to regenerate themselves indefinitely, creating ongoing opportunities for research. I have concluded that we should allow federal funds to be used for research on these existing stem cell lines where the life and death decision has already been made.” Secretary of Health and Human Services Tommy G. Thompson, an avid supporter of embryonic stem cell research, testified in a Senate Committee hearing on September 5, 2001, and interpreted the President’s decision from his point of view: “The principle that the federal government should not encourage or sanction the destruction of embryos was a cornerstone of the President’s decision.”

Since no federal legislation is in place, private and state supported research is not affected by President Bush’s policy. However, NIH, itself funded from federal R&D funds has issued eligibility criteria for federal funding of research on human embryonic stem cells based on the President’s Executive Order. Aside from the August 2001 deadline, the eligibility criteria stipulate that: 1.) the stem cells must have been derived from an embryo that was created for reproductive purposes only; 2.) the embryo is no longer needed for these purposes; 3.) consent was obtained for the donation of the embryo, and 4.) no financial incentives were provided to encourage donation of the embryo. In addition to publishing these criteria, the NIH also created a “Human Embryonic Stem Cell Registry.” It lists all cell lines that fulfil the eligibility criteria. Currently, 78 qualified cell lines should be available worldwide.

- August 11, 2001 Radio Address by the President to the Nation
<http://www.whitehouse.gov/news/releases/2001/08/20010811-1.html>
- Statement of Tommy G. Thompson, Secretary, U.S. Department Of Health And Human Services, before the Committee on Health, Education, Labor and Pensions, United States Senate, September 5, 2001
<http://www.hhs.gov/asl/testify/t010905a.html>
- Stem Cell Fact Sheet (White House)
<http://www.whitehouse.gov/news/releases/2001/08/print/20010809-1.html>
- NIH’s Role in Federal Policy <http://stemcells.nih.gov/fedPolicy/NIHFedPolicy.asp>
- NIH’s Human Embryonic Stem Cell Registry (<http://stemcells.nih.gov/registry/>)

Missing Funds and Mad Mouse Disease?

Providing sufficient quantities of cell lines for distribution can take up to one year or even longer for each cell line. As a result of this, only five of the 78 lines approved were available to researchers in the U.S. as of last September, the NIH’s director Elias Zerhouni said at the hearing on May 22nd. To make things even more complicated, most of these human cell lines were grown on mouse feeder cell layers. This means that they had been in direct contact with mouse cells. Therefore, the human cells may have been damaged or may even carry mouse

viruses. The Food and Drug Administration, fearing *xenotransplantation* (transplantation of animal tissue into human recipients), has asked scientists to conduct extensive testing of cells before using any of them in human clinical trials. In Singapore, a country at the forefront of embryonic stem cell research, the Straits Times even drew a “Mad Mouse Disease” scenario. The scenario pointed out the unpredictability of the consequences of stem-cell transplants that may carry mouse genes or viruses. Furthermore, intellectual property rights issues have to be resolved before government-funded researchers can work with the eligible cell lines which all happen to be privately owned.

Since the news spread in late 2001 of human embryonic stem-cells possibly containing mouse-genes, scientists began looking for ways and means to grow stem cells without using animal feeder cells. Finally, in the fall of 2002, researchers in Sweden, Singapore and at Johns Hopkins University/U.S. reported separately that they had succeeded in growing new lines of embryonic stem cells not mingled with animal cells. However, under President Bush’s policy, research using these cell lines is not eligible for federal funding. Although some pharmaceutical companies have supported studies on embryonic stem cells, U.S. scientists argue that the field will take off only once access to the larger stream of funds that the U.S. Federal Government is uniquely positioned to supply is provided.

- FDA Approach To The Regulation Of Xenotransplantation
<http://www.fda.gov/cber/xap/xap.htm>
- Save The World From Mad Mouse (Straits Times, September 9, 2001)
<http://straitstimes.asia1.com.sg/columnist/0,1886,56-69316,00.html>

Pending U.S. Legislation

Whilst the the U.S. Congress has not been able to reach a decision on whether to use federal funds for embryonic stem cell research or not since 1996, the U.S. Department of Health & Human Services announced in 1999 that it intended to provide financing for research on stem cells derived from embryos left over from in-vitro fertilization procedures. This decision was taken under Dr. Zerhouni’s predecessor as director of the NIH, based on the belief “that human embryonic stem cells are not a human embryo within the statutory definition” since “the cells do not have the capacity to develop into a human being even if transferred to the uterus, thus their destruction in the course of research would not constitute the destruction of an embryo” (Congressional Research Service Report for Congress – Stem Cell Research, September 19, 2000). Therapeutic cloning, i.e. transferring the nucleus of an adult cell into an unfertilized human egg, stimulating it to begin dividing and then harvesting the stem cells for therapeutic purposes, stayed out of the scope of federal funding. However, therapeutical cloning itself and the use of private funds for this type of research was not affected by the NIH’s decision.

There is currently a total of six bills touching upon embryonic stem cell research and therapeutical cloning that are in discussion in Congress, with four of them in the House of Representatives and two in the U.S. Senate. Senate Bill S.245 and House Bill H.R.534 as well as H.R. 938, would prohibit reproductive and therapeutic cloning altogether and impose criminal and civil penalties of up to 10 years in prison and six-figure fines. Whilst also banning reproductive cloning, i.e. cloning babies, Senate Bill S.303 and the House Bills H.R.801 and H.R. would allow the production of embryonic stem cells including therapeutical cloning.

- U.S. Department of Health & Human Services <http://www.hhs.gov/>
- Senate Bill S.245 http://thomas.loc.gov/cgi-bin/t2GPO/http://frwebgate.access.gpo.gov/cgi-bin/getdoc.cgi?dbname=108_cong_bills&docid=f:s245is.txt.pdf
- House Bill H.R.534 http://thomas.loc.gov/cgi-bin/t2GPO/http://frwebgate.access.gpo.gov/cgi-bin/getdoc.cgi?dbname=108_cong_bills&docid=f:h534pcs.txt.pdf
- House Bill H.R. 938 (http://thomas.loc.gov/cgi-bin/t2GPO/http://frwebgate.access.gpo.gov/cgi-bin/getdoc.cgi?dbname=108_cong_bills&docid=f:h938ih.txt.pdf)

- Senate Bill S.303 (http://thomas.loc.gov/cgi-bin/t2GPO/http://frwebgate.access.gpo.gov/cgi-bin/getdoc.cgi?dbname=108_cong_bills&docid=f:s303is.txt.pdf)
- Congressional Research Service Report for Congress – Stem Cell Research, September 19, 2000 (<http://www.senate.gov/~budget/democratic/crsbackground/stemcell.pdf>)
- House Bill H.R.801 (http://thomas.loc.gov/cgi-bin/t2GPO/http://frwebgate.access.gpo.gov/cgi-bin/getdoc.cgi?dbname=108_cong_bills&docid=f:h801ih.txt.pdf)
- House Bill H.R.916 (http://thomas.loc.gov/cgi-bin/t2GPO/http://frwebgate.access.gpo.gov/cgi-bin/getdoc.cgi?dbname=108_cong_bills&docid=f:h916ih.txt.pdf)

Deadlocked

President Bush made his point quite clear in a speech on April 10, 2002: "I believe all human cloning is wrong, and both forms of cloning ought to be banned for the following reasons. First, anything other than a total ban on human cloning would be unethical. Research cloning would contradict the most fundamental principle of medical ethics, that no human life should be exploited or extinguished for the benefit of another."

Nevertheless, cloning and stem cell research divide the Republican Party, as well as the Democratic Party. Whilst most Republicans support the President's policy, Democrats generally take a more liberal approach to the ethical issues underlying embryonic stem cell research and therapeutical cloning. Nonetheless, all related bills that are currently under discussion in Congress are sponsored by prominent Republicans, the restrictive bills including also those that would explicitly allow embryonic stem cell research and therapeutical cloning. Republican congressional representatives supportive of embryonic stem cell research include Senators Orrin Hatch (R-Utah), Jim Greenwood (R-Pennsylvania), Cliff Stearns (R-Florida) and Arlen Specter (R-Pennsylvania). These Republicans are supported by well-known Democrats such as Dianne Feinstein (D-California), Senator Edward Kennedy (D-Massachusetts) and Senator Tom Harkin (D-Iowa).

On the other hand, a few Democrats are opponents of embryonic stem cell research and therapeutical cloning. One of them is Senator Mary Landrieu (D) from Louisiana. She is co-sponsor of the Brownback-Landrieu bill (S.245) that would prohibit both reproductive and therapeutic cloning. In a press release on March 5, 2002 she claimed: "In the past several weeks there has been a movement to the Brownback-Landrieu bill by opinion leaders on the political right, the political left and from those of us in the center. Our reasons may all be slightly different, but the conclusion is the same – creating human life simply for the purpose of destroying it – is immoral, unethical and should be illegal." Other co-sponsors of S.245 include staunch social conservatives like Senators Chuck Grassley, Rick Santorum and George Voinovich. President Bush "wholeheartedly" endorsed S.245 in public.

In February 2003, the House of Representatives, historically more conservative than the Senate, voted in favor of a bill which would make illegal any form of human cloning (H.R.534, the Human Cloning Prohibition Act of 2003). However, it is likely that H.R.534 will die in the Senate, as many of the Senate's 49 Democrats oppose the bill, as does at least one prominent Republican, Orrin Hatch of Utah. Overall, approximately 50 senators are likely to vote against the proposal. Senate rules stipulate that 41 votes are needed to hinder any bill from passing into law. This means, no legislation is to be as long as the stand-off between the House of Representatives and the Senate continues.

- Remarks by the President on Human Cloning Legislation, April 10, 2002, <http://www.whitehouse.gov/news/releases/2002/04/20020410-4.html>
- Senator Orrin Hatch (R- Utah) <http://www.senate.gov/~hatch/>
- Senator Jim Greenwood (R-Pennsylvania) <http://www.house.gov/greenwood/>
- Senator Cliff Stearns (R-Florida) <http://www.house.gov/stearns/>
- Senator Arlen Specter (R-Pennsylvania) <http://www.senate.gov/~specter/>

- ❑ Senator Dianne Feinstein (D-California) <http://www.senate.gov/~feinstein/>
- ❑ Senator Edward Kennedy (D-Massachusetts) <http://www.senate.gov/~kennedy/>
- ❑ Senator Tom Harkin (D-Iowa) <http://harkin.senate.gov/>
- ❑ Senator Mary Landrieu (D-Louisiana)
<http://landrieu.senate.gov/newsite/biography.cfm>
- ❑ March 5, 2002, Landrieu Testifies: "Total Human Cloning Ban is Only Way to Go"
<http://www.senate.gov/~landrieu/releases/02/2002305B44.html>
- ❑ Senator Chuck Grassley (R-Iowa) <http://grassley.senate.gov/>
- ❑ Senator Rick Santorum (R-Pennsylvania) <http://santorum.senate.gov/>
- ❑ Senator George Voinovich (R-Ohio) <http://voinovich.senate.gov/>
- ❑ Remarks by the President on Human Cloning Legislation, April 10, 2002,
<http://www.whitehouse.gov/news/releases/2002/04/20020410-4.html>
- ❑ Alliance for Aging Research <http://www.agingresearch.org>

The Case of Orrin Hatch: A Pro-Life Advocate In Favor Of Cloning

Senator Orrin Hatch (R), a Mormon from Utah, is sponsoring a bill that would allow therapeutic cloning (S.303). Senator Hatch is an outspoken supporter of therapeutic cloning and embryonic stem cell research. What appears to be somewhat of a contradiction is that the conservative Republican is also a long-standing opponent of abortion and shares the same pro-life views as President Bush. "I also strongly believe that a critical part of being pro-life is to support measures that help the living. ... At the core of my support for regenerative medicine research is my belief that human life requires and begins in a mother's nurturing womb," Orrin Hatch said explaining the apparent contradiction. He supports the view that blastocytes resulting from cloning should not be considered human life. In the case of therapeutic cloning, genetic material is taken from adult human tissue and injected into a female egg cell whose own genetic material has been removed. In the next step, the cell is electrically stimulated to make it divide, thus making it possible to harvest stem cells. Since the egg is not fertilized with sperm, and will never be implanted in a woman's womb, there is no chance of birth which makes this procedure acceptable for some pro-life advocates like Orrin Hatch.

Recently, Senator Hatch was joined by a group of 38 House Republicans in his uphill battle for federal funding of embryonic stem cell research. In a Senate Hearing on therapeutic cloning, he even presented a supportive letter by Nancy Reagan whose husband, former U.S. President Ronald Reagan, at age 92 suffers from Alzheimer's disease. Ms. Reagan concluded her letter with an emotional plea: "I believe that embryonic stem cell research, under appropriate guidelines, may provide our scientists with many answers that are now beyond our grasp. Orrin, there are so many diseases that can be cured, or at least helped, that we can't turn our back on this. We've lost so much time already. I can't bear to lose any more."

- ❑ American Association for the Advancement of Science
(<http://www.aaas.org/spp/cstc/stc/stc02/02-05/cloning.htm>)
- ❑ Hatch Holds Hearing On Cloning, Stem Cell Research Bill
- ❑ http://www.senate.gov/~hatch/index.cfm?FuseAction=Statements.Detail&PressRelease_id=191528&Month=3&Year=2003
- ❑ The Pro-Life Case For Cloning (Editorial, New York Times On The Web, May 2, 2002
http://www.nownj.org/News_Clippings/ClippingArchive/The%20Pro-Life%20Case%20for%20Cloning.htm)
- ❑ The Bottom Line (CNN's fact sheet on embryonic stem cell research)
<http://edition.cnn.com/2001/HEALTH/07/11/stem.cell.fact>

Shifting Ground

It is quite obvious that advocacy groups for research on aging support therapeutic cloning in hope for life-prolonging treatments and cures for diseases that usually afflict older people (Alzheimer's, Parkinson's disease, etc...). Though groups like the Washington-based Alliance for Aging Research might have some influence on Congress, they have not succeeded in convincing lawmakers to go ahead with an explicit *placet* for embryonic stem cell research

and therapeutical cloning. Also, the deadlock in Congress seems to prove that there is an even split between the advocates and opponents of the disputed research.

Two recent polls suggest that there is wide-spread support in the U.S. for research in these controversial fields. The polling institute Opinion Research Corporation International surveyed more than 1,000 Americans and found that 67 percent said they favored Congress allowing research in therapeutic cloning to continue. This poll produced results very similar to one the Council for the Advancement of Medical Research (CAMR) conducted last year, United Press International (UPI) reported in March 2003. People with a college education were more likely to favor therapeutic cloning. About 75 percent of those who had a college degree were in favor of continuing research, compared with 63 percent of those with a high school degree.

Even the Bioethics Council, whose members were chosen by the Bush Administration and which is led by Leon Kass who opposes all forms of cloning and embryonic stem cell research, seems to be moving towards a more favorable view on embryonic stem cell research and therapeutical cloning. In fact, in a vote on whether to recommend a moratorium on therapeutical cloning to the President, seven out of 17 members opposed a moratorium.

There is even mounting support from religious leaders: Whilst most Christian Organizations in the U.S. oppose therapeutical cloning, the Union of Orthodox Jewish Congregations of America – the U.S.' largest Orthodox Jewish umbrella organization representing nearly 1,000 synagogues – and the Rabbinical Council of America have both endorsed the research in a joint statement and in a letter to President Bush.

- ❑ Coalition for the Advancement of Medical Research <http://www.stemcellfunding.org/fastaction/>
- ❑ Opinion Research Corporation International <http://www.opinionresearch.com/>
- ❑ United Press International (UPI) <http://www.upi.com>
- ❑ The President's Council on Bioethics <http://www.bioethics.gov/>
- ❑ Human Cloning and Human Dignity: The Report of the President's Council on Bioethics, Tuesday, October 29, 2002 (http://www.aei.org/events/filter_.eventID.69/transcript.asp), Presentation at the American Enterprise Institute (including a statement by Leon Kass)
- ❑ Cloning Research, Jewish Tradition & Public Policy; A Joint Statement By The Union Of Orthodox Jewish Congregations Of America And The Rabbinical Council Of America <http://www.ou.org/public/publib/cloninglet.htm>
- ❑ The Union Of Orthodox Jewish Congregations Of America's and The Rabbinical Council Of America's letter to President Bush regarding stem cell research <http://www.ou.org/public/statements/2001/nate34.htm>

State Legislation

Faced with the *impasse* in Congress, a growing number of state legislatures have begun drafting their own rules on embryonic stem cell research and therapeutic cloning. Approximately half of the states are currently considering new legislation on cloning. Ten of them have bills pending that would explicitly prohibit all types of cloning (Alabama, Arkansas, California, Connecticut, Florida, Nebraska, North Dakota, Oklahoma, Oregon, West Virginia and Wisconsin). Nine states have draft bills pending that would either allow or ban therapeutical cloning (Illinois, Indiana, Kentucky, Massachusetts, New Jersey, New York, Tennessee, Texas and Washington). The only state proposing to allow therapeutical cloning is Vermont, renowned for its open-minded legislature when it comes to scientific and technological issues. Similar to the deadlocked bills in Congress, some of the bills put forward on the state level involve penalties of up to 10 years in prison and astronomically high fines.

However, for the time being, cloning for research purposes remains legal in most states. Only Iowa and South Dakota have explicitly banned it. California explicitly allowed therapeutical cloning in 2002. This could change, though, if a proposed ban on cloning is turned into state law. Research that includes the destruction of human embryos, i.e. embryonic stem cell re-

search and all forms of human cloning is currently illegal in Florida, Louisiana, Maine, Michigan, Minnesota, North Dakota, Pennsylvania and Rhode Island.

A Case In Fact: Embryonic Stem Cell Research In Wisconsin, “The Birthplace Of Human Embryonic Stem Cell Research” (Gov. Jim Doyle of Wisconsin)

The University of Wisconsin at Madison pioneered embryonic stem cell research in 1998 when its biologist James Thomson was the first scientist to isolate and grow such cells from leftover embryos from in-vitro fertilization treatments. Currently, Madison – home to more than a dozen Nobel laureates – is one of the few sources of NIH approved embryonic-stem-cell lines world-wide.

In 2002, Wisconsin’s Republican-controlled State Assembly voted to ban all forms of human cloning. As in Congress, the bill stalled in the state’s Senate. However, during elections, three Senators who support therapeutical cloning were defeated and replaced by Republicans leaning towards a total ban.

Wisconsin’s Governor Jim Doyle (D), however, supports the newly founded “Wisconsin Coalition to Support Stem Cell Research” and has vowed to veto any legislation that would put an end to embryonic stem cell research at Madison. At a press conference on April 23, 2003, he clearly voiced his support: “Legislation that would restrict or criminalize stem cell research would send a message not only to stem cell researchers, but to all biotechnology research companies that Wisconsin is not friendly to their businesses. It would be devastating to our efforts to build a high technology economy and attract and retain researchers, investors and entrepreneurs.... As Governor, I will do everything in my power to promote Wisconsin’s leadership in this promising field, foster the growth of this important industry, protect our great universities and help us maximize their usefulness as economic growth engines. Other states around the country – states that do not have the scientists or the infrastructure – are attempting to market themselves as stem cell centers. California, New Jersey, Pennsylvania, Massachusetts have all passed or are considering resolutions inviting companies to come to their states.” For example, Wisconsin’s neighbor, Michigan, is about to devote \$ 50 million a year for the next 20 years into a \$ 1 billion project called “Life Sciences Corridor.”

- University of Wisconsin at Madison <http://www.wisc.edu/>
- James Thomson
http://www.news.wisc.edu/packages/stemcells/index.msql?get=thomson_bio
- Governor Jim Doyle Prepared Remarks, News Conference on Stem Cell Research, Wednesday, April 23, 2003
http://www.winfoundation.org/winfoundation/upload/doyle_stemcell_press.pdf
- Wisconsin’s Assembly Bill AB104 <http://www.legis.state.wi.us/2003/data/AB-104.pdf>
(banning embryonic stem cell research and therapeutical cloning)
- Wisconsin’s Senate Bill SB 45 <http://www.legis.state.wi.us/2003/data/SB-45.pdf>
(banning embryonic stem cell research and therapeutical cloning)
- University of Wisconsin Testimony at the Wisconsin Legislative Hearing on AB104 & SB45 on May 20, 2003
<http://www.wicell.org/uploads/media/CharlesHosletTestimonyClon.pdf>
- States vie for biotech dollars – Delegations try to stand out at convention (National Association of Seed and Venture Funds)
<http://www.nasvf.org/web/allpress.nsf/pages/4767>

“If I Will Walk Will Depend On Politics” (Christopher Reeve)

The current situation – with Congress at a stalemate, while some state legislators rush ahead and others maintain a wait-and-see attitude – could become politically uncomfortable for George W. Bush with the 2004 Presidential elections approaching. Even now, new stem cell lines, obviously superior to those eligible for federal funding, have been developed in universities, private companies in the U.S. and overseas. They remain out of reach for U.S. researchers relying on federal funding. “I think the United States is not leading the world in the area of stem cell research, and it could be, and in my opinion it should be,” the famous actor

Christopher Reeve said on a TV show in July (CNN's Larry King Live, July 30, 2003). Christopher Reeve, who has been paralyzed from the neck down since an accident in 1995, is currently in Israel – a country that has no restrictions on therapeutical cloning – to study the country's treatment of spinal injuries. Mr. Reeve is Chairman of the Board of Directors of the Christopher Reeve Paralysis Foundation, an organisation that strongly supports stem cell research as well as therapeutical cloning.

With such star-studded support in mind, the pharmaceutical industry, advocacy groups and bioscience companies may pressure the President to reconsider his position on embryonic stem cell research and therapeutical cloning. These groups might even end up spending millions of dollars in political donations so that they get the right results in 2004.

- New Stem Cell Issue (New York Times, September 3, 2001)
<http://www.nytimes.com/2001/09/03/health/03CELL.html>
- Christopher Reeve Paralysis Foundation
<http://www.apacure.com/>

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Review: World Resources 2002–2004 Decisions for the Earth: Balance, Voice and Power

by Irene Eckart

Environmental failures are all too often the result of development-related decisions made without sufficient information on localities and proper consultation and support of the local population. This is the key message of the recently published report, "World Resources 2002–2004 – Decisions for the Earth: Balance, Voice and Power." The Report is the result of a joint project between the *United Nations Development Program* (<http://www.undp.org/>), the *United Nations Environment Program* (<http://www.unep.org/>), the *World Bank* (<http://www.worldbank.org/>) and the *World Resources Institute* (<http://www.wri.org/>). It examines the process of "environmental governance" and thus addresses the question of how and by whom environmental decisions are made. At the official launch date of the Report, the presentation held at the *World Resources Institute*, focused on two key elements of environmental governance: participation of all stakeholder groups and accountability of the decision-makers.

The Report includes an assessment of those two functions in nine countries, chosen for their varied economic status: Chile, Hungary, India, Indonesia, Mexico, South Africa, Thailand, Uganda and the U.S. The study shows that some progress has already been made in adopting the basic principles of good environmental decision-making that have been established and endorsed by the 178 nations that attended the *Rio Earth Summit* in 1992 and signed the "Rio Declaration on Environment and Development". These principles, which ensure open and inclusive decision-making, include:

- *making decisions at the appropriate level by assigning authority to match the scale of the natural system affected ("Subsidiarity Principle") and*
- *providing access to information, participation and redress to stakeholders.*

Although these principles are not new, they profoundly challenge our traditional government institutions and economic practices. Indeed, one of the most apparent failures over the decade since *Rio* has been the inability to mainstream environmental thinking into economic and development decision-making, which once again became apparent at the *Johannesburg Earth Summit* in 2002 (<http://www.earthsummit2002.org/Es2002.PDF>). At this conference, even after intense negotiations, the results were far away from any kind of breakthrough. The disappointing outcome is inconsistent with a growing awareness of the urgent need for change to arrest the accelerating deterioration of the world's environment. This gives reason to take a broader look at the challenges inherent in environmental governance.

First and foremost, conflicting interests between governments, private sector groups and international organizations make it difficult to work towards common goals that go beyond narrow national interests to pursue global benefits. However, it is evident that a basic consensus is critical in order to proceed with international negotiations and to encourage the various governments to take action. The second major obstacle is one that is shared by virtually all issues requiring international collaboration: a lack of enforcement mechanisms in the international arena. Enforcement and compliance will always be problematic in an international system still based on the dominance of national sovereignty.

Although the Report aims at assessing and evaluating stakeholder access and participation as a first step to a sustainable development, there is some lack of direction on how to tackle these challenges. The Report neither gives an indication of the role science can play to reach tangible results nor does it raise the question whether the environment is adequately represented by international organizations.

Science, due to its objective and reliable approach, is one of the most crucial factors in producing more effective environmental agreements. Developing scientific data and analysis to identify problems, their likely consequences and possible solutions is often argued as a way

that might offer a less tricky road to a common agreement on environmental issues than politics. Once negotiations result in multi-lateral agreements, the need for an enforcement mechanism becomes apparent and is even more obvious as far as environmental questions are concerned, than it is in other areas. Very few international environmental agreements actually contain provisions for compliance such as trade sanctions against violators. Those who do have such provisions virtually never invoke them or are challenged by the *World Trade Organization* (WTO www.wto.org). Whereas there are specialized UN agencies for health, labor, culture and education and food, the environmental issues are only endowed with a subsidiary program of coordination called the *United Nations Environment Program* (UNEP <http://www.unep.org/>). This program hardly has sufficient power and national support of its Member States.

A possible suggestion to address this problem is the upgrading of UNEP from a UN program to a fully-fledged specialized agency. But no matter whether such a transformation takes place, unless the Member States demonstrate a greater political commitment to supporting its mission, mandate and operations, UNEP will continue to be treated as a marginal player in the UN system. As far as the frequent claim for the establishment of a *World Environment Organization* (WEO) is concerned, the underlying rationale holds out considerable merit. By the majority of stakeholder groups, this option is considered the only possibility to ensure that the policy balance is shifted in favor of sustainable development, and that the WTO would therefore be counterbalanced by a sufficiently robust international environmental regime.

These questions are not raised by the World Resources Report. However, the initiative of the four major organizations concerned with environmental issues is encouraging, since joint projects are the best way to fill a gap resulting from the absence of one global environmental organization. The report also urges acknowledgment of the increasing importance of stakeholder information and involvement in the decision-making process. Especially considering the latest developments, such as globalization, democratization, the rapid growth of non-governmental organizations (NGOs), new information and communication technologies and decentralization, participation and empowerment of the civilian world are inevitable.

In this respect, the Report represents a good starting point by providing general guidelines on how to realize access and participation of stakeholders, valuable insights in the form of case studies and country evaluations giving an overview of the present situation. Nevertheless, the practical implementation of the principles for fair environmental governance in every decision-making process, ranging from large-scale decisions such as environment legislation to questions concerning our daily lives, remains a challenge and requires major changes on a global level.

The World Resources Institute is an independent environmental research and policy organization that works closely with governments, the private sector and other stakeholder groups in more than 100 countries around the world to find and implement solutions to protect the Earth's living systems and to ensure sustainable development. For more information, please visit the following website: http://pubs.wri.org/pubs_description.cfm?PubID=3764

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The Underutilization Of The Sciences In The U.S. War On Terrorism

by Philipp Steger

"In the war against terrorism, America's vast science and technology base provides us with a key advantage." (George W. Bush as quoted in an official document of the Office of Science & Technology Policy/OSTP entitled "Combating Terrorism. Research and Development Funding in the President's 2004 Budget" [http://www.ostp.gov/html/budget/2004/OSTP%20CT%201-pager%20\(OMB\).pdf](http://www.ostp.gov/html/budget/2004/OSTP%20CT%201-pager%20(OMB).pdf))

"We'll continue to support science and technology because innovation makes America stronger. Innovation helps Americans to live longer, healthier and happier lives. Innovation helps our economy grow, and helps people find work. Innovation strengthens our national defense and our homeland security, and we need a strong national defense and homeland security as we fight people who hate America because we're free." (George W. Bush during a speech at the Presentation of the National Medals of Science and the National Medals of Technology, June 12, 2003
<http://www.whitehouse.gov/news/releases/2002/06/20020612-7.html>)

One could arguably claim that U.S. Science & Technology (S&T) Policy has become dominated by the exigencies of the "War on Terrorism", a term coined soon after the September 11 attacks and encompassing the myriad efforts undertaken by the U.S. government to respond to the vulnerability of the U.S. to terrorism.

This is clearly evidenced by the President's Research & Development (R&D) Budget for FY2004 with its focus on R&D areas that are pertinent to "national security" and the "war on terrorism". The White House budget proposal would allocate 55 % of federal R&D funds to defense research, which is an increase of 7.2 % over FY 2003. That means that a substantial part of the overall increase in the R&D budget (as compared to FY2003) of 4.4 % actually goes toward defense related R&D. The beneficiary of the majority of the remaining overall increase for non-defense R&D are the National Institutes of Health (NIH) which play a crucial role in bioterrorism-preparedness efforts.

The S&T policy community has picked up the signals and, for the most part, seems to follow the money. There is hardly any gathering of the S&T policy crowd in Washington DC these days that does not feature the various aspects of the "war on terrorism" and its repercussions on the fate of the sciences in this country. The annual AAAS colloquium on S&T policy held in Washington DC this past April served as another reminder of the preponderance of this particular aspect of S&T policy. Its program <http://www.aaas.org/spp/rd/colloqu.htm> emphasized "homeland security" and related issues.

The Role Of The Sciences Is Limited In Scope

At meetings like the AAAS colloquium and others of that sort, one gets the impression that there is a general consensus that S&T assumes a strong role within the efforts broadly summed up in the "war on terrorism", and that there are no doubts as to the nature of that role. A closer look at the role of S&T in the anti-terrorism efforts will show, however, that not only is the clarity about the nature of this role restricted to a fraction of the whole spectrum of S&T, but also that this often quoted essential role of S&T in fighting terrorism is less pervasive than its ubiquitous proclamation would let one believe.

Much of the buzz concerning the sciences' pivotal role in protecting the nation against terrorist attacks centers around so-called "bioterrorism preparedness". The U.S. Department of Justice defines bioterrorism as "the deliberate use of microorganisms or toxins derived from living organisms to induce death or disease in humans, animals or plants". In this understanding Bioterrorism preparedness describes the extent to which the U.S. would be able to deal with a bioterrorist attack and its aftermath. The Anthrax scare that had threatened to paralyze the U.S. postal system after several people had died in the late fall of 2001 provided a glimpse of the potential havoc that bioterrorism could wreak on the country. Ever since, a substantial part of the scientific anti-terrorism efforts has been focused on improving bioterrorism preparedness.

In trying to assess the actual state of bioterrorism preparedness in the U.S. and the role of the sciences in this particular arena of the science-led war against terrorism, one comes across one, seemingly insurmountable, problem: all the preparations and all the science that is being carried out is based on fictitious scenarios whose likelihood, or lack thereof, is not substantiated by any impressive array of scientific studies.

SARS – Nature As The “Bioterrorist”

The single most important role of science in the immediate aftermath of a bioterrorist attack is to come up with the appropriate remedies and antidotes as quickly as possible. But presumably there are challenges going well beyond those imposed by the immediacy and urgency of a medical response. These challenges are, in essence, the same regardless of whether the perpetrators of a biological attack are terrorists or nature itself.

For that reason, a look at some of the challenges posed by SARS, in particular the efforts to keep it from turning into a large-scale, global pandemic, provides the opportunity to shift from a "what-if" scenario to a specific case. By looking at how the "minimal" challenges have been dealt with by the U.S. one should be able to make some general conclusions as to the breadth and depth of the role of S&T in fighting the "War on Terrorism".

SARS, actually a disease in the minor league when it comes to the death toll, has already shown a horrific ability to attack the crucial vulnerabilities of an open, interdependent and highly globalized society. As Prof. Palese points out in his guest commentary (LINK), a relatively small amount of a deadly pathogen is enough to cause major disruption. Therefore, the way the U.S. addresses the challenges arising from this threat of an endemic is indicative of how S&T is applied in general in the context of U.S. bioterrorism-preparedness.

- ❑ One of the most comprehensive studies on the nature of the challenges of bioterrorism and contagious diseases was done by the Institute of Medicine: Microbial Threats to Health: Emergence, Detection, and Response (2003)
<http://www.nap.edu/books/030908864X/html/>

SARS – The Story So Far

WHO's declaration on June 5 that the SARS epidemic had passed its peak was preceded both by an extraordinary degree of international scientific collaboration over several months, but also by a staggering display of the effects of panic and hysteria caused by the uncertainty surrounding the mysterious new disease. The disease has not only caused the death of 813 people worldwide, but has also been a sobering lesson on the multifarious challenges associated with a highly contagious disease. And it is more likely than not that SARS will reappear next winter.

Until the beginning of March, even after the first reports on the mysterious lung infection by the name of "Severe Acute Respiratory Syndrome" (SARS) had surfaced in newspapers around the world, SARS remained relegated to the status of a curiosity in the news. The initial disinterest turned into a fixation soon after WHO had declared the disease a "worldwide health threat" and the U.S. and Canada had their first SARS cases.

SARS, an airborne disease, supposedly first appeared in November 2002 in China's Guangdong Province. Since then there has been strong evidence that SARS constitutes the emergence of a natural disease, given the proclivity of the corona virus' RNA for a very flexible recombination after absorbing bits of stray genetic material. While there had initially been speculation that SARS might be caused, at least in part, by a virus belonging to the paramyxoviridae family, there is now scientific consensus that it is caused by a novel form of a corona virus that might possibly have developed after the virus jumped species from animals to humans. By April 14, the corona virus had been sequenced by both the U.S. Centers for Disease Control and Prevention (CDC) and Canada's National Microbiology Laboratory. The comparatively low lethality of the disease – according to a WHO report it is just below 10% – is another indicator supporting the hypothesis of a newly emerging disease with natural origin.

Within the U.S. the brunt of the work of addressing the SARS epidemic has been carried by three agencies: the Centers for Disease Control and Prevention (CDC), the National Institute of Allergy and Infectious Diseases (NIAID), which is a part of the National Institutes of Health (NIH), and the Food and Drug Administration (FDA). The CDC has played a central role in terms of coordination measures including keeping the public informed and overseeing the implementation of response actions. To carry out these activities the CDC received a supplemental appropriation of \$ 16 million from Congress.

- Information regarding the SARS death rate - WHO Cumulative Number of Reported Probable Cases of SARS
http://www.who.int/csr/sars/country/2003_07_11/en/

7 Challenges Posed By SARS (And Bioterrorism)

Bioterrorism, just like contagious diseases, usually arrives without prior announcement, thus leaving little to no time to prepare if countermeasures have not already been planned. Nonetheless, -neither bioterrorism nor pandemics are unavoidable phenomena – there is always the chance of preventing bioterrorist attacks and keeping the emergence of a new contagious disease from turning into a pandemic. By taking a broad look at the challenges inherent in dealing with an emerging contagious disease, it becomes evident that successfully addressing the most apparent challenge, the medical challenge, largely depends on whether other interrelated challenges have been adequately dealt with. If, for instance, the adequacy of public health system were to be neglected, the best medical science would be of little use in combating bioterrorism.

A brief analysis of how the U.S. addresses each of the seven main challenges will show a disproportionate focus on supplying good medical science, while most of the other challenges remain solely under-addressed.

Challenge Number 1 – Rapid Availability Of Good Medical Science

“The Department of Homeland Security will be charged with four primary tasks. This new agency will control our borders and prevent terrorists and explosives from entering our country. It will work with state and local authorities to respond quickly and effectively to emergencies. It will bring together our best scientists to develop technologies that detect biological, chemical, and nuclear weapons, and to discover the drugs and treatments to best protect our citizens.” (George W. Bush, Address to the Nation, June 6th 2002)

The foremost challenge, and the one posing the keenest sense of urgency, is the need to quickly identify the agents (pathogens, viruses, bacteria) causing the pathological symptoms, to provide the public health system with epidemiological studies, to develop tools for reliable diagnosis and to come up with some sort of antidote. All of these needs can be summed up as the need for the rapid availability of good medical science.

It is fair to say that there is generally a high level of awareness and preparedness in the U.S. to deal with the immediate research exigencies. Considerable amounts of money have already gone into the research that focuses on contagious diseases. The recently completed

doubling of the NIH budget has provided the biomedical sciences with hitherto unheard of capacities. The National Institute of Allergy and Infectious Diseases (NIAID) is at the forefront of that research. As Anthony S. Fauci, a prominent scientist and director of NIAID, declared during a Senate hearing in April, this means in particular, *“rapidly addressing the issues of vaccine development, drug screening, and clinical research.”*

There have been complaints, however, that it has not been possible to sufficiently involve the private sector in the general research effort to find ways to combat SARS. One of the main reasons cited by the government is the uncertainty in regards to the potential long-term market for any drugs that might be developed as a result of such research. This concern has also surfaced in government-coordinated research aimed at being prepared for the eventuality of a bioterrorist attack. In this instance, however, fears that private companies might not be lured into joining the effort appear to have been allayed. In the context of bioterrorism preparedness activities, the government has to some extent “created” the necessary market with its “Strategic National Stockpile” (SNS) program that, in essence, stockpiles vaccines and other antidotes to biological pathogens and chemical agents for rapid distribution in case of attack. A specific program linked to the SNS is “Project BioShield” which also provides additional funds for the development of vaccines. According to an article in “Nature,” “Project BioShield” seems to exude an irresistible charm to quite a few companies in the beleaguered biotech sector.

Within the scope of supplying good science there are some deficits, for instance in providing adequate epidemiological studies. A recent article in the magazine “Science” highlighted the complexity of the challenges facing those who set out to develop models to reliably predict the potential of a disease. (See Dorothea Strozkyk’s explanation of the basic challenges involved in epidemiological studies at the end of this article).

- ❑ <http://www.nap.edu/catalog/2008.html> Emerging Infections: Microbial Threats to Health in the United States (1992)
- ❑ "Infection risk puts the brakes on Canada's biomedical research", Nature, 04/17/03.
- ❑ "SARS Outbreak. Modelers Struggle to Grasp Epidemic's Potential Scope", 04/25/03
- ❑ Testimony of Anthony S. Fauci, Director of NIAID, at a Senate hearing on April 7, 2003
http://www.senate.gov/~labor/testimony/030_tes.html Fauci's testimony gives a good overview of what NIAID does in particular in regards to SARS, but also overall in maintaining a high level of preparedness to address newly emerging contagious diseases.
- ❑ White House Press Release on Project Bioshield:
<http://www.whitehouse.gov/news/releases/2003/02/20030203.html>
- ❑ Information on the Strategic National Stockpile on the DHS Website:
<http://www.dhs.gov/dhspublic/display?theme=15&content=327>
- ❑ The CDC National Pharmaceutical Stockpile:
<http://www.bt.cdc.gov/stockpile/index.asp>
- ❑ "Biotech firms pin hopes on defense", Article in "Nature" (04/24/03)

Challenge Number 2 – Smooth International Cooperation

“SARS highlights (...) that fulfilling (...) CDC's domestic mission – to protect the health of the U.S. population – requires global awareness and collaboration with domestic and international partners to prevent the emergence and spread of infectious diseases. (...SARS) also serves as an excellent illustration of the intense spirit of collaboration among the global scientific community to combat a global epidemic. It is not possible to adequately protect the health of our nation without addressing infectious disease problems that are occurring elsewhere in the world.” (Dr. Julie Gerberding, CDC Director, in a Congressional testimony on April 29, 2003)

International cooperation, a hallmark of successful research and an essential component of fast and reliable scientific advances and insights, is particularly important in dealing with an emerging contagious disease, especially when little is known about the agents causing the disease and its pattern of spreading. Early findings of one lab need to quickly be ascertained by other research institutions, and common hypotheses formulated and tested. The response to the SARS outbreak, in large part managed and coordinated by WHO, has been blessed by unusually smooth and nearly frictionless international cooperation. Apart from the occasional victim of international politics – Taiwan, lacking recognition by the UN, was for months dependent on second-hand information received from mainland China – the collaboration between the 13 laboratories in 11 different countries that make up a network of WHO-coordinated labs was, at least to the public's eye, flawless and produced considerable and reliable results.

WHO, a United Nations agency, has very few formal means of wielding power, since it lacks regulatory or policy implementation competence. But the management of the emergency response to SARS has shown that the international body can still be very influential. The one exception was WHO's decision to withdraw its travel advisory regarding Toronto, only a week after it had imposed the restrictive, three-week travel advisory. The original decision that put Toronto on the list of affected areas to which non-essential travel was strongly discouraged constituted a move that was certain to increase Toronto's by then already enormous economic fallout. By giving in to the ensuing political pressure exerted on WHO and its director general, Gro Harlem Brundtland, the agency undermined the perception that its expertise is undisputed and its public health decisions politics-free, and thus cut short its emergence as a powerful player. WHO's quick reversal of its decision certainly allayed any fears the current U.S. administration, somewhat weary of powerful international organizations, might have had over early signs of WHO successfully transforming itself into a powerful international player through its SARS crisis management.

In addition, past and more recent experiences show that WHO's potential strength as an international public health advisor and crisis manager above the fray of national and international politics is severely hampered by an onslaught of interventions aimed to either influence or prevent public health recommendations that run counter to the interests of powerful political interest groups. Take, for instance, the U.S. Sugar Association as an example (<http://www.sugar.org>). The lobbying group that represents the sugar industry spared no effort in a recent, not-so-subtle attempt at undermining WHO's role as a neutral scientific advisor. After WHO had published its new guidelines on nutrition and exercise recommending a lower sugar intake, the association heavily lobbied both Congress and the Administration to threaten WHO to cut its US funding, if WHO continued to refuse to substantially revise the guidelines.

- ❑ Testimony of Dr. Julie L. Gerberding, Director, Centers for Disease Control and Prevention (CDC) during Senate Hearing from April 29, 2003
http://www.senate.gov/~labor/testimony/033_tes.html
- ❑ "Taiwan left isolated in fight against SARS", Article in Nature, 04/17/03
- ❑ WHO Report "Diet, Nutrition and the Prevention of Chronic Diseases", 2003
http://www.who.int/hpr/NPH/docs/who_fao_expert_report.pdf
- ❑ "Health News 24/04/2003 U.S. and the U.N. at war over sugar guidelines" – Report by the Australian Broadcasting Cooperation (ABC) on the UN-U.S. controversy regarding the above mentioned report
http://www.abc.net.au/science/news/health/HealthRepublish_839642.htm
- ❑ Sugar industry threatens to scupper WHO, 04/21/03, The Guardian <http://www.guardian.co.uk/usa/story/0,12271,940479,00.html>
- ❑ Various News releases of the Sugar Association regarding the "misguided" WHO report on health & nutrition guidelines.
<http://www.sugar.org/newsroom/releases.html>

Challenge Number 3 – Adequacy Of The Public Health System

“A strong and flexible public health infrastructure is the best defense against any disease outbreak.” (Dr. Julie Gerberding, CDC Director, in a Congressional testimony on April 29, 2003)

“People are now back in dumb-and-happy mode” (Tara O'Toole, director of the Center for Civilian Biodefense Strategies at Johns Hopkins University lamenting the virtual stand-still of the National Smallpox Vaccination Campaign. Quote taken from “Focus on Smallpox Threat Revived” in the Washington Post, July 17, 2003)

Hardly any of the challenges highlight the far-reaching repercussions of bioterrorism-preparedness as much as does the challenge of preparing the public health system for the eventuality of widespread infection of people with a pathogen, regardless of whether the source is terrorism or nature.

SARS and, more recently, an outbreak of monkey pox in the Midwest, have served as a wake-up call to all those involved in the public health enterprise. Some argue that the response to the sudden outbreak of monkey pox had been too slow. According to the CDC, by June 14th, 81 people in several Midwestern states were suspected of having contracted monkey pox, a rare viral disease imported from Africa and first detected in humans in 1970. Although there are several reasons to believe that the infected persons contracted the disease via animals, the CDC has not excluded human-to-human transmission. The biggest deficit in responding to this particular threat was that it took considerable time for public health officials to realize that there was a problem and to identify the source of the problem. Clearly, a majority of doctors and other health care workers are simply not prepared or trained to look for and detect the signs of any unusual disease.

There is, however, a strong argument that hospitals are in general already aware and prepared to address these issues due to the alertness created by the threat of bioterrorism. The increased awareness will likely not suffice to address those shortcomings that are a reflection of systemic weaknesses brought about, at least in part, by the increased shifting of the burden of providing adequate health care to privately managed Health Care Organizations (HMOs). This shift and the cost-cutting following in its wake has, for instance, caused many hospitals to decrease the number of beds significantly in order to reduce the costs associated with empty beds. It is hardly surprising then, that many hospitals would be completely overwhelmed in the case of a specific crisis requiring the hospitalization of large numbers of patients. SARS is a perfect example for this, since suspected victims require both intense treatment and isolation.

The lack of general health insurance makes the specter of highly expensive and – for the individuals involved – potentially ruinous prolonged hospital stays a particularly daunting problem. To give an idea of the dimensions of the problem: in 2001, 40 million Americans were without any sort of health insurance, and many millions more were underinsured. These data are particularly worrisome in view of studies that show a strong correlation between a disease's death rate and the general public's access to health care.

A timely GAO report concludes that significant improvements to the U.S. Public Health System need to be made in order to meet the needs of bioterrorism or an emerging infectious disease. Among the shortcomings, the report cites gaps in the various disease surveillance systems and laboratory facilities, an absence of regional planning and coordination between individual states, strongly varying levels of public health preparedness and the inability of most hospitals to handle a large influx of patients due to lack of adequate equipment, isolation facilities and staff. One remedy recommended by the General Accounting Office is that the federal government foot the bill of eliminating the shortcomings on the state level.

These observations allow a simple conclusion: even a pathogen with a low lethality rate, but very high infection rates, could eventually result in a disproportionate number of casualties

due to the inability of the Public Health System to respond to an overwhelming wave of victims.

The recent campaign to vaccinate health care workers and first-responders to smallpox is a perfect example for both the intricacies of the challenge and the mundane details that can cause even plans based on the best of intentions to go awry. The experiences of the U.S. smallpox vaccination campaign are a sobering lesson in the intricacies and pitfalls of administering preventive immunizations on a large scale.

As part of the overall campaign to increase U.S. preparedness for a potential bioterrorist attack, the Bush administration decided it would have the so-called “first responders”, mostly health care workers such as doctors and nurses, inoculated against smallpox, a pathogenic agent considered the likely choice by terrorists. The president took the symbolic lead in this campaign by receiving the controversial immunization himself.

The outcome of the campaign has so far not been promising: of the envisioned 439,000 people receiving smallpox vaccination only about 25,000 had actually been inoculated by the end of March, the time by which the whole campaign was scheduled to be completed.

The emergency responders’ reluctance to get the vaccination stems mostly from the potentially harmful side effects of the vaccination. The death of 2 people who had received the vaccination didn’t help the matter either, although in both cases the negative side effects had been exacerbated by previous illnesses. The worries about potential side-effects were made worse by a long period of uncertainty of whether affected persons could expect any compensation for damages incurred by the negative side effects. Legislation to address that crucial aspect of the whole campaign made very slow progress in Congress, where Democrats and Republicans disagreed strongly over the amounts of the compensation, with Democrats favoring more generous compensation for emergency responders that take ill after receiving the vaccination. The outcome, a compromise reached in April, was met with heavy criticism from those that would be entitled for compensation under the new legislation.

The approach underlying the current vaccination campaign has its critics – amongst them the Institute of Medicine. The Institute, part of the National Academies of Science, published a report highly critical of the approach, which neglects looking at the actual level of preparedness among health care providing institutions. A more outspoken critic is Senator Kennedy (D-Mass.) who called the vaccination campaign an “absolute disaster”. The General Accounting Office (GAO) came down particularly hard on the CDC and the civilian part of the “National Smallpox Vaccination Program” in a very recent report criticizing the agency for having missed the target of inoculating close to 500,000 health care workers within 30 days by a huge margin.

The factors quoted by GAO as being responsible for the “disastrous” results are particularly troublesome to anyone involved in bioterrorism preparedness: the program schedule itself and the targeted participant’s hesitation to fully engage in the program. The CDC’s reaction to this disappointing outcome has raised some eyebrows: without any scientific explanation, the vaccination of 50,000 health workers in the U.S. is now deemed to provide sufficient response capacity by the CDC. This stands in obvious contrast to the early plans calling for much higher numbers.

- ❑ CDC information regarding monkey pox
<http://www.cdc.gov/ncidod/monkeypox/qa.htm>
- ❑ Report on the repercussions of Monkey pox appearance in the Midwest on “All things considered”, National Public Radio, 1 7 . 6 . 2 0 0 3 -
<http://www.npr.org/dmg/dmg.php?prgCode=ATC&showDate=17-Jun-2003&segNum=6&NPRMediaPref=RM>
- ❑ WHO fact sheet on monkey pox
<http://www.who.int/inf-fs/en/fact161.html>
- ❑ Collection of data on healthcare expenditure by the Agency for healthcare research and quality <http://www.ahrq.gov/data/>

- ❑ Report by the Center on Budget and Policy Priorities on the number of Americans without Health Insurance <http://www.cbpp.org/9-30-02health.pdf>
- ❑ “Sars Outbreak: Improvements to Public Health Capacity are Needed for Responding to Bioterrorism and Emerging Infectious Diseases” <http://www.gao.gov/cgi-bin/getrpt?GAO-03-769T>
- ❑ The highlights of the above mentioned report <http://www.gao.gov/highlights/d03769thigh.pdf>
- ❑ <http://www.bt.cdc.gov/agent/smallpox/index.asp> extensive information on smallpox provided by the CDC (<http://www.cdc.gov/>)
- ❑ CDC information regarding patterns of reaction to the smallpox vaccination <http://www.bt.cdc.gov/training/smallpoxvaccine/reactions/default.htm>
- ❑ CDC Smallpox Fact sheet <http://www.bt.cdc.gov/agent/smallpox/overview/disease-facts.asp>
- ❑ Review of the CDC’s smallpox vaccination program by the Institute of Medicine <http://www.nap.edu/books/NI000498/html/>
- ❑ Smallpox Vaccination: Implementation of National Program Faces Challenges. GAO-03-578, GAO Report from April 30, 2003 <http://www.gao.gov/cgi-bin/getrpt?GAO-03-578>
- ❑ National Public Radio, Radio discussion about the Smallpox Vaccination campaign, 4.4.2003 <http://www.npr.org/dmg/dmg.php?prgCode=TOTN&showDate=04-Apr-2003&segNum=6&mediaPref=RM>

Challenge Number 4 – Germs Vs. Globalization

“Still, some scientists fear that the nation may soon become less able to prevent outbreaks such as that of West Nile virus – whether accidental or intentional. They said the U.S. system for screening incoming animal, plant and microbial life – a patchwork of more than 20 agencies – has long been undervalued and under funded.” (Rick Weiss in: “West Nile’s widening Toll”, Washington Post, Dec. 28th, 2002.)

The rapid spread of SARS, facilitated by the ease and ubiquitousness of international air travel, the outbreak of Monkey pox in the American Midwest, and the increasing threat of the West Nile Virus, supposedly originating in the Middle East, all show that the dangers of an epidemic rapidly spreading throughout the world once it has successfully overcome the primary barriers in one place are exacerbated by the high degree of global interdependence and permeability.

While SARS in particular has raised this issue – the grounding of airplanes and cancellation of flights to SARS “infested” destinations bears witness to this – little has been done so far to address the question on how to deal with the “demons” of globalization without unduly curtailing its benefits.

In scientific terms, one very important area of research in this regard focuses on invasive species. The U.S. has long been the victim of its own success in global trade. It is hard to underestimate the damage caused by invasive species. One of the more visible examples, which left a lasting legacy in the structure of forests along the East Coast is the nearly complete eradication of the American chestnut caused by a pathogen originating in China. Yet, in spite of the very limited knowledge about invasive species, a comparatively small amount of R&D funds are directed towards research aimed at better understanding the arrival and the spread of invasive species. For instance, although invasive aquatic species have turned out to be a major problem exacerbated by the growing number of consumer goods arriving in the US on cargo ships, the funding level for the specific programs dealing with this challenge have remained surprisingly stagnant (see the figures in a table prepared by the Northeast-Midwest Institute, quoted below).

Going beyond the specific unwanted side-effects, one has to address some very basic ques-

tions about how a trading nation like the U.S. would deal with the negative repercussions of a large scale outbreak of a contagious disease. Guangdong province, where SARS is thought to have originated, is not only a global hub for the manufacturing of information technology but also a hotbed for all sorts of new diseases, apparently due to an uncontrolled migration to this economically prosperous area and an unprecedented explosion in population growth as a consequence thereof. Addressing some of these social, regulatory and human rights issues will be unavoidable in the future and might, as an attractive byproduct of dealing with the undesirable side effects of globalization, lead to equally high regulatory and health standards across the globe.

The fact that globalization also has its clear advantages in this issues highlights once more how intricately linked all the challenges are. While there has been a reluctance of countries to report outbreaks due to fear of the negative impact this news would have on travel, trade and tourism, the global access to news from all over the world, provided by the media and in particular the Internet, has created enormous pressure for quick and complete disclosure. Countries are increasingly aware of the advantages of prompt outbreak reporting and official country notifications accompanied by prompt international help when needed.

- ❑ CDC Information regarding the West Nile Virus
<http://www.cdc.gov/ncidod/dvbid/westnile/>
- ❑ Information on the chestnut blight
http://www.forestpathology.org/dis_chestnut.html
- ❑ “West Nile’s widening toll”, Article on the ecological impact of the West Nile Virus in the Washington Post of December 28th, 2002
<http://www.washingtonpost.com/wp-dyn/articles/A45800-2002Dec27.html>
- ❑ A table prepared by the Northeast-Midwest Institute
<http://www.nemw.org>, an independent research organization, shows at the example of funding for the Aquatic Nuisance Species Programs that the funding level for most of these programs have hardly increased in the time frame 1992–2001.
<http://www.nemw.org/ANSfundhistory.pdf>

Challenge Number 5 – Harnessing All Of Science For The Sake Of Prevention

It’s obvious that the actual act of bioterrorism is the last step on a tortured path cluttered with myriad possibilities for intervention and prevention of the attack or of the potentially serious consequences of the attack. Recognizing these possibilities and seeing where the potential points of positive leverage lie requires substantial observation and analytical thought, an area in which the behavioral and social sciences have substantial contributions to make. Yet, most of the anti-bioterrorism efforts aimed at harnessing science neglect the insights potentially offered by the “other sciences”, thus leaving the playing field to a small group of scientific disciplines at the near exclusion of most other disciplines and renouncing the strength of interdisciplinary approaches.

This was made evident during the aforementioned AAAS colloquium on S&T Policy. During the discussion following a thorough description of the role of S&T at the newly created Department of Homeland Security (DHS) by the agency’s new undersecretary for S&T Charles McQeary, a participant inquired about the role the social & behavioral sciences would get to play in DHS efforts. The question, a justified one since both the social & behavioral sciences have been conspicuously absent in all the glorious talk about a Manhattan-Project-like surge in funding for the sciences, turned out to be more informative than the answer.

This is not to say that there aren’t scholars addressing these questions, but their insights seldom make it into the arena of public considerations regarding the role of S&T in dealing with the threat of bioterrorism. If one were to, for instance, go to the superbly informative website of the National Academies and type “bioterrorism” into their search engine, one would marvel at the amount and the quality of the material gathered there. Most of it, however, focuses on a very narrow aspect of bioterrorism, the immediate health effects of an attack, while little is to

be found regarding the causes, the ways of addressing these causes and the likelihood of how the various worst-case scenarios would play out in real life.

By pursuing an interdisciplinary approach one might also counteract the current trend of S&T merely reacting to external threats and new developments.

- Text of DHS Under Secretary for S&T Charles McQueary's Talk on Homeland Security <http://www.aaas.org/spp/rd/mcqueary.pdf>

Challenge Number 6 – The Economic Fallout

"[...] macroeconomic recovery may fall victim to microbe economics. Serious people know that germs pose a far greater threat to mankind than terrorism, and readers of books like William McNeill's "Plagues and Peoples" and Jared Diamond's "Guns, Germs and Steel" know microbes have been the downfall of many a civilization." (Paul Krugman in: "Guns, Germs and Stall?", New York Times, April 4th 2003)

Cruel as it may sound, in terms of mortality rate SARS has been anything but spectacular. Rather the indirect economic damage caused by fear and widespread hysteria is what really got heads shaking. If one compares the 42,000 traffic accident related deaths in the U.S. in 2002 and the economic disruption this high number of casualties has caused with the number of SARS related deaths and the resultant economic fallout a city like Toronto had to suffer, the disproportion becomes readily apparent.

At the point when WHO issued a travel advisory for Toronto, economic losses were estimated at \$ 30 million a day. After all, the cancellation of a big medical conference in Toronto during the early phase of the SARS scare was estimated to cause \$ 6 million in lost revenues. During the height of the crisis, the Bank of Canada pronounced a downward revision of its prognosis for economic growth, citing SARS as one of the main culprits. The considerable and eventually successful pressure that the Canadians exerted on WHO was to a large extent due to the unbearable prospect of even worse economic losses. Toronto's losses pale in comparison to the impact SARS had on Hong Kong, the most important trade hub between Asia and the West with the busiest airport in Asia and one of the most important seaports in the world.

Even in places relatively unscathed by the disease, i.e. the U.S., which reported no deaths, panic and hysteria abounded. The internet was alive with those predicting immediate doom and those who used people's credulity to sell a most impressive array of alleged antidotes. People in New York and San Francisco avoided the normally popular "Chinatowns" and left restaurants and shops in these areas deserted.

The sheer enormity of economic losses induced by the pandemic that never really came to the fore highlights a very serious problem: how to balance the need for early warning with the imperative of avoiding panic? This is a question that ought to be addressed by science and the social sciences in particular. As of now, there are hardly any signs that U.S. S&T Policy makes a concerted effort to support that sort of research as part of its bioterrorism preparedness activities.

- Paul Krugman: Gun, Germs and Stall?, in: The New York Times, April 4th 2003
- Press release from the Bank of Canada regarding its Monetary Policy Report: <http://www.bankofcanada.ca/en/press/2003/pr03-8.htm>
- Monetary Policy Report - Bank of Canada (04/23/2003) <http://www.bankofcanada.ca/en/mpr/pdf/mprapril03.pdf>

Challenge Number 7 – Containment Vs. Civil Liberties

"The United States remains lucky to have had no superspreaders and only 41 probable cases, with no deaths. Yet vigilance remains important. New York

City's health officials were appropriately cautious when they forced a foreign tourist to stay in hospital isolation for 10 days because he was a suspected SARS case. Their aggressive response ruined the tourist's vacation, but that kind of attitude can save the city from potential infections" (From an editorial in the New York Times from April 29, entitled "Finally, good news about SARS")

While no one was particularly surprised or up in arms at the draconian quarantine measures undertaken by Singapore, known for its one-party authoritarian political system, there was considerable surprise among international observers at the willingness and perceived eagerness of Hong Kong's denizens to have the government impose severe quarantine measures against all possibly infected fellow citizens.

Hong Kong's experience highlights what in the U.S. has become one of the most controversial issues in the discussion about the war on terrorism: the encroachment of government controls on civil liberties. The containment of pandemics, with the undeniable necessity of imposing quarantine measures in order to prevent the spread of a contagious disease, always runs the risk of interfering with civil rights. Toronto and the province of Ontario, Canada, have been able to count on a very civic-minded public, but the few cases in which potentially infected people were court-ordered to stay in isolation have become notorious, because there is something deeply troublesome about the notion of de facto imprisonment of people because they are infected with a disease.

The U.S. has been lucky so far; not a single death from SARS has been reported. But recent experiences, such as the Anthrax scare in 2001 or the sniper shootings in the Washington area last fall, offer a glimpse of the population's susceptibility to panic and behavioral changes that are out of proportion to the actual risk posed by these incidents to individuals. The average American watches an average of 4 hours of TV per day, and a majority of Americans gets their news from the TV, not just from news shows, but from all sorts of shows. Statistics and reasonable risk assessment intended to show the extent of danger for the individual and thus avoid panic don't make a difference to a nation hooked on TV.

A recent article in the New York Times mentioned a study carried out in China that showed the psychological toll that widespread discrimination against suspected or recovered SARS victims has taken on a large number of people. That study highlighted another problem stemming from discrimination against infected persons: the stigma associated with the disease will make it less likely that people will seek out a health professional at the earliest appearance of symptoms and will thus make containment even harder.

Civil libertarians and other like-minded groups in the United States will have a tough time arguing against severe quarantine and isolation measures in case of a potentially stronger outbreak, given the lack of scientifically valid alternatives.

While the greater good at stake may seem to justify locking someone up for 10 days and thereby spoiling their vacation – as happened in the case of a tourist in New York who was suspected of having SARS –, there are some troubling aspects to the general approach: in spite of all the science at our hands and the scholarly insights of decades of psychological and sociological research, we are still essentially using the same approach that was applied during the plagues of medieval times.

The experience of SARS shows that – independent of whether a bioterrorist attack is likely or not – these issues need to be addressed and better, more humane solutions found.

Conclusion

Looking at the seven challenges of bioterrorism as evidenced by SARS, one cannot fail to notice a lack of balance in how these challenges are being addressed in terms of political rhetoric, the appropriation and distribution of R&D funds and in terms of public perception. There is a disproportionate focus on the immediate medical preparedness and response to an eventual bioterrorist attack, while the other challenges, although essential in minimizing the damage of such an attack, are being more haphazardly addressed by the current administra-

tion. The highly complex interdependency of the challenges posed is largely ignored. The disproportionate effort going into the biomedical solutions to the problem reflects a poorly developed understanding in the general public about what it is that science can actually accomplish, especially in regards to the multifarious aspects of bioterrorism.

While there is certainly no shortage of clever and insightful research addressing the other six challenges, one gets the feeling that although there are many different and interesting approaches out there, hardly anyone bothers to listen or even promote such research. In addition, truly harnessing all of science would require the promotion of an intellectual atmosphere that encourages the sort of scientific and scholarly discussion that dares to question even some of our most basic assumptions and thus contributes to the development – and hopefully application – of innovative solutions.

Bioterrorism, like newly emerging contagious diseases, is a large problem and as such requires a similarly “large” solution. The current approach does not appear to attempt such a “large” solution and has thus far failed to entice and arouse the sort of all-out, nationwide research effort that characterized the Manhattan Project, a historical effort of legendary dimensions which these days is often implored as the great role model for this endeavor.

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Epidemiologic Investigation Of An Outbreak

Commentary by Dorothea Strozyk, MD

Epidemiology is the study of the distribution and determinants of health-related states in specified populations and the application of this study to control health problems. In the past few months, the World Health Organization (WHO) has coordinated an international investigation that has produced epidemiologic discoveries in regards to the worldwide outbreak of severe acute respiratory syndrome (SARS).

Many outbreaks are first recognized and reported by concerned health care providers or citizens. Field epidemiologists, together with laboratory and other logistic capacities, start an investigation by looking for the "population at risk" – the people who might be considered sick cases or who are most at-risk to become sick cases.

By comparing the current number of sick people to the number of similarly sick people from the previous few weeks, months, or even from a comparable period during the previous few years, the epidemiologist determines whether an outbreak exists (i.e., whether the observed number of cases exceeds the expected number in a given time frame). Hospital discharge records, telephone surveys of local physicians, health department surveillance records and death registries are often useful sources of data for determining any trends that might indicate an outbreak is present.

After verifying the existence of an outbreak, the specific nature of the disease has to be identified as accurately as possible. The goal is to ensure that the problem has been properly diagnosed, and that it really is what it has been reported to be. Verifying the diagnosis requires reviewing the clinical findings, including the symptoms and features of illness, and laboratory results for the people who are affected. While epidemiology can guide appropriate public health action, laboratory evidence is crucial in confirming the nature of the disease and in securing the findings. In addition, conversations with patients are very helpful in generating hypotheses about the cause, source and spread of disease. Critical information in an epidemiologic investigation is often gathered by asking questions, such as: What were you exposed to before becoming ill? What do you think caused your illness? Do you know anyone else with the disease or similar symptoms? Do you have anything in common with others who have the disease? Furthermore, it is important to note the characteristics of the affected population. Age, gender, occupation, information about their general location and the chronological order of events leading up to the patient's symptoms are all significant factors in determining previously unrecognized relationships of the disease and its population and a further course of action.

Taken all together, the goal of epidemiologic field investigations is to provide a comprehensive description of an outbreak by showing its trend over time, its geographic extent (place) and the populations (people) affected by the disease. Such a descriptive analysis leads to the development of causal hypotheses. Causal hypotheses address the source of the agent (i.e. virus), the mode of transmission (i.e. airborne, person-to-person, etc...) and the exposures that caused the disease.

To evaluate the credibility of a causal hypothesis, epidemiologists quantify the relationship between various hypotheses and the disease. For example, in the recent SARS investigation, a strong relationship between the new coronavirus and the disease outbreak was observed. This link indicated the virus may very well be the causative agent. Finally, it is crucial to the field of epidemiology to implement control and prevention measures in an investigation. Control measures can be implemented as soon as the source of an outbreak is known. These measures can be aimed at specific links in the chain of infection such as the agent (i.e. virus), the source (where the agent originates) or the reservoir. These control measures are usually

directed at interrupting transmission or exposure. For example, to limit the airborne spread of an infectious agent among residents, infected people may be moved to a separate area to prevent exposure to others.

Other control measures are aimed at reducing the susceptibility of at-risk people by developing an effective vaccine against a new infectious agent. Likewise, novel antiviral agents, antiviral drugs in development or existing licensed drugs are tested to provide effective prophylaxis or treatment. It is a challenge to make these products available fast enough to prevent an extensive global outbreak.

The final task in an investigation is to communicate the findings. In many outbreaks, public health officials decide to alert the public directly through the media. In the recent SARS outbreak, announcements in the media have alerted the public to avoid traveling in affected regions and to see a physician if they had symptoms of the disease.

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Biological Agents From Nature And Elsewhere

Commentary by Peter Palese, Mount Sinai School of Medicine

It is estimated that the total amount of anthrax spores sent in four letters during the fall of 2001 was equal to less than one-tenth of a teaspoon. This amount corresponds to about one gram of material, and yet it caused loss of life as well as enormous fear and disruption. The Clark Building, where Senator Tom Daschle had his office, has just been reopened almost a year-and-a-half after its anthrax incident. If one gram of "letterized" anthrax can cause this much of an uproar, consider the dangerous potential of the following: At the peak of its biological weapons program in the 1980s, the Soviet Union was producing 4,500 tons of weaponized anthrax annually!

A less well-known release of a bacterial agent, *Salmonella typhimurium*, occurred in 1984 when members of the Rajneeshes, a cult in Oregon, sought to sway a local election by causing food poisoning in the population. Almost one thousand people fell seriously ill, including a pregnant woman who gave birth prematurely to a poisoned baby. These and other incidents make it quite reasonable to be concerned about future attacks, particularly in light of information that more than 100 tons of smallpox and 250 tons of the Marburg virus were produced in the former Soviet Union and possibly in several countries of the mid-East. It may be more wise to ask *when*, rather than if, we might experience a biological weapons attack.

While we must try to prepare ourselves against a deliberate release of biological agents, we must not lose sight of the fact that Nature herself remains the most imaginative bioterrorist of all. In the last twenty-five years, more than a dozen agents novel to humans have emerged, including multidrug-resistant bacteria, HIV, West Nile fever virus and, most recently, the *severe acute respiratory syndrome* (SARS) virus. In most instances, these agents already had a niche in the animal kingdom and, as a result of sexual, social and economic changes, they found a foothold in the human population with devastating consequences. Thus, there is no need to conjure up images of Frankenstein concocting an HIV virus containing new genes which allow it to be transmitted through the air like an influenza virus and to kill as rapidly as an Ebola virus. Mother Nature does well enough on her own.

Despite the trauma caused by our fears about bioterrorism, there is at least one positive aspect of the situation. Funds made available to counter bioterrorism may be a boon for public health sectors in the U.S. and worldwide. Even more beneficial in the long run may be the accelerated efforts to develop improved antibiotics, novel antivirals and drugs against other infectious diseases, including malaria. Bioterrorism-related efforts by many scientists should also lead to the development of vaccines for infectious diseases against which we are presently helpless, as well as against other human diseases (the "spin-off" effect). By trying to fight terrorism and emerging pathogens, we may make great strides in developing stockpiles of novel treatments against a variety of diseases, including vaccines against Alzheimer's disease, multiple sclerosis and cancers.

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