

12 PROF. BENGT SUNDELIUS: I want to welcome you back to
13 our plenary. I hope you have had very fruitful
14 discussions, chewing on good pieces of puzzles and
15 problems in the breakouts. And we will now have the
16 privilege to spend an hour with some of the great
17 scholars, scientists in the infectious disease area.
18 After this session I have some household chores to
19 discuss with you. But first of all I want to introduce
20 Dr. Ragnar Norrby, who until recently was the Director
21 General of the Swedish Institute For Infectious Disease
22 Control, SME, and personally insured that also Sweden
23 will have a high quality IVI lab while few countries
24 invested in this and built up further research in Sweden
25 over many years in this area. Last year we had a

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1 bilateral when Undersecretary Cohen came to visit with
2 his staff, and Dr. Norrby was gracious enough to bring
3 the team to Solna to the Institute, to not only feed
4 U.S. a wonderful lunch but also show U.S. the lab,
5 present lectures on the activities, and there was a
6 great interest by Secretary Cohen and his staff to
7 listen to this and hopefully learn some things to bring
8 back home to DHS. So I give you Ragnar Norrby, who will
9 introduce our main speaker.

10 PROF. RAGNAR NORRBY: Thank you very much. The title of
11 this session is "Tales From the Hot Seat -- When Science
12 Matters." And being an infectious disease physician, I
13 think it's important to realize that science does
14 matter. Without good science, continuous science, we
15 will not be able to face the threats we have. We will
16 not be able to detect the cause of SARS, for example, in
17 three weeks' time with the full genetic mapping, which
18 was due to high level scientific efforts both in the
19 U.S. and in Europe. So I think it's very important to
20 point out that we need continuous support for scientific
21 development within this field which you are discussing
22 here during these two days. And I think we will
23 hopefully get that type of resources.

24 Now then to my main task, which is to introduce the
25 keynote speaker for this session, who is Dr. D.A.

1 Henderson from Baltimore, United States. You will now
2 have, I think for most of U.S., it's the first time we
3 meet a person who has saved millions of lives in the
4 world. He was director of the WHO's campaign for
5 eradicating smallpox. Against all odds he succeeded.
6 He made a major step in the development of medicine in
7 the world by taking away one of the worst diseases we
8 have ever had. So really he did save millions of lives.
9 It's my great pleasure to introduce Dr. Henderson to
10 you, who will talk about smallpox, the death of a
11 disease. Please.

12 DR. D.A. HENDERSON: I thank you very much, Professor
13 Norrby, and I thank you all for the opportunity to
14 participate in this conference on science and
15 technology. But, before beginning, I would like to pay
16 a special tribute to Professor Holger Lundbeck, who
17 preceded Professor Norrby in charge of the Institute.
18 During all the days of the smallpox eradication program,
19 Professor Lundbeck was a strong supporter, and it made a
20 very big difference in the whole program that we had.
21 He then participated finally in the international
22 commission to determine whether we could declare it
23 eradicated. I salute him and thank him for being here.
24 This conference is exceedingly timely. Societal
25 security has a new and different meaning than it did

1 20 years ago or ten years ago, and the new swine
2 influenza pandemic is an emphatic reminder that it has
3 transversed the world with blinding speed well before
4 the best of our vaccine producers could create needed
5 vaccines. Had the far more lethal H5N1 avian bird flu
6 acquired a comparable ability to spread, we would today
7 be dealing with a global crisis such as we have never
8 before witnessed. Societal security today is more
9 fragile than it has ever been. It is a shrinking world
10 and becoming smaller all the time. But security is
11 everyone's problem. And transnational cooperation in
12 the development of appropriate countermeasures is needed
13 as never before as well as efforts at diagnosis and
14 development of new drugs and vaccines. Now, for me,
15 September 16, 2001, began one of my most serious,
16 anxious days and weeks. It was a Sunday afternoon only
17 five days after the airplanes struck the World Trade
18 towers. I was then head of a Johns Hopkins center for
19 biosecurity that was struggling to persuade a complacent
20 country that biological weapons had to be taken
21 seriously. We were almost alone. The telephone rang,
22 and it was a call from the Secretary of Health and Human
23 Services. The Bush administration had been in office
24 less than a year. I'd never met the secretary. And he
25 said, I need you to attend a meeting at 7:00. And I

1 said naively, 7:00 tomorrow morning? 7:00 Monday
2 evening? And he said, tonight. So I met with the
3 secretary and a small staff until nearly midnight. The
4 concern was that intelligence intercepts had indicated
5 that there would be a second attack and that it would be
6 biological, probably smallpox or anthrax. The question
7 was what can we do. The following morning I called the
8 Center for Disease Control, which was a steward of such
9 vaccine as we had still in store produced in 1978, and
10 asked, suppose we do have an attack. How quickly could
11 they ship the vaccine? How much was there? And later
12 that day they informed me that there was only 90,000
13 doses that were suitable for use. And five weeks later
14 the first of the anthrax cases was reported, followed
15 shortly by 21 more cases, and our country was
16 ill-prepared to deal with this problem as well you can
17 imagine. Our laboratory competence was at a premium.
18 We had only two laboratories that could diagnose anthrax
19 or smallpox at that time. Our medical and health staffs
20 were still in the early stages of simply learning about
21 diseases such as smallpox and anthrax. The nation was
22 highly vulnerable. The secretary immediately took steps
23 to establish a new office called the Office of Public
24 Health Emergency Preparedness, and I was named to the
25 position, which was an assistant secretary's position.

1 He insisted I direct the program. Two months later,
2 January 9, 2002, the office received an emergency
3 appropriation from Congress of three thousand million
4 dollars, three billion dollars of new money. In the
5 beginning, for me, it was seven-day weeks as we tried to
6 shape both our research and operational program with a
7 small staff of actually about five people as we began,
8 constantly struggling to formulate a response to deal
9 with the next attack, and we considered an event
10 probable. If a man could release a small amount of
11 anthrax like that, he undoubtedly had more, and we were
12 worried what to do. Much had to be done and done
13 quickly. We were deeply concerned about smallpox
14 because, with very little vaccine, the country was
15 about, we estimated, about 75 percent of the people were
16 susceptible. We had had discussions with laboratory
17 producers about how rapidly could we produce vaccine,
18 and they gave U.S. the figure of five years from the
19 time we let the contract till the first batches could
20 appear. In fact, we turned on all manner of activities
21 and actually in 18 months we had 200,000,000 doses of
22 vaccine still to be tested. We hoped it would work.
23 Now, it's notable that this year marks the 30th
24 anniversary since the declaration that eradication had
25 been achieved. The challenge began in 1967 to eliminate

1 smallpox worldwide in ten years. It's a disease which
2 over three millennia had been the most serious
3 pestilence known to man. To succeed, it required the
4 participation of every country, and this was achieved
5 even during some of the darkest days of the cold war.
6 It required many new and untried approaches in order to
7 succeed. In all, we had health staff from 73 different
8 countries who served at one time or another during the
9 course of the program. Now, it's not a program as some
10 have speculated whose execution was a simple matter of
11 buying enough vaccine, sending vaccinators out into the
12 field and take it from there. Indeed, strategy, tactics
13 and tools for implementation changed steadily every year
14 as science and technology continually brought new
15 insights and new looks. This June I published a book
16 which portrays the challenges and the realities in
17 candid detail, in hopes that lessons might be drawn from
18 it for the many challenges we face ahead. I notice some
19 of you, I suspect smallpox is regarded as really a
20 forgotten disease. Perhaps it invaded the tropics,
21 maybe it was around at some point that it had something
22 to do with developing countries. It was far, far more
23 than that, and I hope to illustrate this briefly during
24 the talk.

25 To put this into perspective, David Oshinsky --

1 Professor David Oshinsky, who was winner of the 2006
2 Pulitzer Prize in history, wrote, as he finished the
3 book, there has been no greater medical or humanitarian
4 miracle in modern times than the eradication of
5 smallpox. This book is more than a riveting account of
6 the day-to-day struggle for international cooperation in
7 a divided world; it offers a winning blue print for the
8 great medical challenges to come. Indeed it is a story
9 of a great many people who participated and worked
10 together on this.

11 Just to remind you that smallpox is caused by a virus.
12 It spreads from person to person by face-to-face
13 contact, and the individual cannot spread it beyond the
14 time that he has a rash. So there's no long-term
15 carriers, but only humans can be infected. So that this
16 has to go -- the virus had to go from human to human to
17 human to survive in a continuing chain of infection, as
18 one thinks about it, which we know goes back at least
19 3,500 years because of pharoahs who died of smallpox and
20 whose mummies are preserved. The death rate of the
21 variola major, the serious form of the disease, was
22 30 percent. There was no treatment then; there is no
23 treatment now. It is a disease which was represented by
24 gods and goddesses in a great many countries. China,
25 Japan, west Africa, and this is from India, Sitala Mata,

1 whom as you see here in this form has the marks of
2 smallpox. And throughout the Hindu areas of Asia the
3 Sitala Mata temples are very common.
4 Now, the disease began with usually very high fever.
5 The individual would take to bed and really not want to
6 roam around at all. And then a rash would begin after a
7 couple of days. The rash looks like this. And as
8 you -- we do have it? Yes. It begins as little
9 papules, little raised areas of the skin, and if a child
10 like this came to a clinic there would be no way of
11 defining this or diagnosing this as smallpox. However,
12 pus begins to form in these small papules, and this is a
13 child after the fifth day. He's absolutely miserable.
14 He has lesions on the inside of his mouth, on his
15 tongue. He has trouble eating, has trouble drinking,
16 feels terrible. And it goes on. As you can see, by day
17 nine, very distinctive disease, extremely well-known to
18 natives wherever the disease was prevalent. And then by
19 day 13 scabs form over the pustules. Eventually they
20 drop off, and it leaves pitting scars over the skin
21 which will last for a lifetime. The famous milk maid's
22 complexion back in the 18th century, which they referred
23 to, is simply that the milk maids did not get smallpox
24 because they had another disease called cow pox, and it
25 was from this origin that the vaccine was derived with

1 Edward Jenner experimenting this, our first vaccine, in
2 1796.

3 We come to the 20th century. Conservatively we estimate
4 there were 300,000,000 deaths in the 20th century up
5 until the time of eradication. The New York Times
6 provides a comparison on this when they pointed out that
7 120,000,000 people died, either directly or indirectly,
8 as a result of armed conflict during the 20th century.

9 Smallpox was far worse. In the United States we had
10 compulsory vaccination at school entry until 1972. This
11 was 23 years after the last case in the United States.

12 Sweden had its last case in 1963, as a result of an
13 importation from Asia. And as you may recall,
14 international travelers up until 1980 and a bit beyond
15 had to carry a little yellow booklet indicating with the
16 proper official stamp successful vaccination within the
17 preceding three years. Now, many times I think the
18 vaccination booklet was vaccinated rather than the
19 individual, but still it was a valid yellow booklet that
20 you had to have. The WHO program had grown, and there's
21 a longer history on this, but the Soviet Union had been
22 very anxious to have the program, primarily because they
23 had a lot of importations from south Asia. And they
24 thought, as they pointed out to me, that in the 1930's
25 they could get rid of smallpox with a very poor health

1 system with not very good vaccine; why can't we do it
2 worldwide? Eventually the director general of WHO was
3 asked to submit a plan to the World Health Assembly, and
4 he did so in May of 1966. And it was a ten-year program
5 laid out with the expectation that WHO could provide in
6 its budget of 2.4 million dollars per year for the
7 program. This is far short of what the estimates were
8 of need, which was more like \$20 million a year, but
9 that was the maximum that he could see putting into it.

10 The subject was debated for three days at the assembly,
11 when normally at the assembly there is little debate and
12 things are decided mainly by consensus. But in this
13 case it was a very hostile debate. Many delegates said
14 it was simply not feasible. We should not get into it.
15 And many of the delegates demanded that the WHO budget
16 not be further increased, that it was already too large.
17 Finally a vote was called for. It needed 58 votes to
18 pass, and 60 voted for it so it was a very tenuous
19 beginning. The director general, Marcelino Candau, a
20 very able man who came from Brazil, who knew the field
21 very well, he believed that the program would fail, and
22 he was very much opposed to it. At that time malaria
23 eradication was doing very badly. It looked like it was
24 failing after 11 years and a great deal of money. And
25 he saw the World Health Organization and public health

1 credibility generally being threatened. One more
2 eradication program he felt was not needed. He was
3 angry with the United States, who he felt was, by
4 joining with the Soviet Union and a number of other
5 countries in supporting this, had played an important
6 role in getting this through, so he wanted an American
7 to be head of the program so that when it went down the
8 tube that the Americans would be seen to be holding the
9 bag. I was called to Washington, and it was suggested
10 that I might like to go to Geneva to be head of the
11 smallpox program. I was in the Public Health Service at
12 that time, and I was so assigned. So I left in
13 November 1966 to go to Geneva. Our challenge at that
14 time, as we were able to put it together, we had more
15 than 10 million cases of smallpox. There were at least
16 2 million deaths. It was in 43 countries that reported
17 cases that year. And the budget and plan called for at
18 that time a headquarters staff which consisted of six
19 medical and administrative staff and three secretaries.
20 This was what you call low overhead indeed. And we
21 would have in each of four WHO regions where there was
22 smallpox we would have one advisor.

23 As we went into this during the years we had as many as
24 150 international staff at any one time, never more than
25 that however, and that includes Japanese Peace Corps,

1 U.S. Peace Corps, Austrian Peace Corps, volunteers from
2 OXFAM, others who turned up at certain of the country
3 programs and who volunteered. So it was a small staff.
4 And I think this is important because the program was
5 really done by those in the country and those who ran
6 the health services. It was really quite an
7 achievement. The first crisis we ran into was of
8 vaccine supply. We figured we needed probably 200- to
9 250 million doses a year. The Soviet Union had promised
10 to provide 25 million doses a year. The United States
11 had come through with a program to support the
12 activities in west Africa, and that accounted for
13 another 35 million doses a year. And we knew that
14 vaccine was produced in 42 countries, so we assumed that
15 vaccine was not a problem. Well, Canada and the
16 Netherlands offered to test the vaccine, and this set a
17 new precedent for WHO, who had never been involved in
18 certifying the vaccine from any country. So this was a
19 breakthrough which came about, which was very helpful.
20 We soon found that less than ten percent of the vaccine
21 was fully potent and stable. In fact, some of the
22 vaccine as far as we could tell contained no virus at
23 all. We immediately called an emergency meeting of five
24 different laboratories which were producing vaccine in
25 the United States, United Kingdom, Soviet Union, Canada

1 and the Netherlands to come together and develop a
2 straightforward step-by-step manual that could be
3 brought back to each of the producing countries and try
4 to see what we could do about not only the production
5 but the testing and so forth. And indeed scientists
6 from each of those countries played an important role in
7 going to different countries, working with those for a
8 week to two weeks and going back again. And that they
9 did. Meanwhile began a series of work on research on
10 production. How do we get more vaccine? What methods
11 do we use for testing it? So that it was a continuing
12 research process that went on, and as we went along, by
13 1972, believe it or not, 80 percent of the vaccine was
14 produced in the developing world, and every dose passed
15 the test of stability and potency and so was fully
16 adequate vaccine.

17 We did special studies to standardize strains. The
18 laboratories pursued an inactivated vaccine. They tried
19 an oral vaccine that didn't work very well, but
20 nevertheless research continued constantly to try to see
21 what we could do. In fact, a tissue cell culture
22 vaccine was eventually developed. Before that it was
23 done by streaking the side of a calf with the Vaccinia
24 virus and after 8 or 9 days sacrificing the animal and
25 scraping it off. And that was the standard way of

1 making vaccine even as recently as 1978. We managed to
2 get an endo tissue cell culture, and the first tests
3 were being done on that just as eradication occurred.
4 But the point was, as we saw it, we'd keep on with the
5 research right to the end.
6 We felt that we needed a better technique for
7 vaccination. The technique here in Europe was to take
8 with a drop of vaccine was put on the arm and then
9 scratches were made through the vaccine to implant the
10 virus just in the skin. In the United States something
11 similar was done to use the point of a stylet to press
12 in the vaccine virus into the skin. And the teaching
13 was that if it bled the virus would be washed out and it
14 wouldn't take. On the other hand, if you didn't press
15 hard enough, it wouldn't get implanted in the skin, and
16 therefore there were a lot of failures of vaccination at
17 that time. We felt something better might be possible
18 here. It was a fortuitous circumstance that I was
19 visiting the Wyeth Laboratories, and they had developed
20 this instrument which is called a bifurcated needle.
21 Actually, it's only two inches long, but this needle was
22 just as you see it. It had a very small point, and you
23 could dip this into the vaccine and withdraw it, and
24 just enough vaccine would be held between the two points
25 to permit vaccination to be carried out. And the idea

1 as intended by the inventor at Wyeth was to then use the
2 two points to press it into the skin. Well, we decided
3 to try a different approach, and that is to just make 15
4 direct punctures -- we called it the multiple puncture
5 method -- and see how that would work. Suppose we do
6 get bleeding. What would happen? Well, we did get
7 bleeding. We did a whole series of children in
8 different countries, and every one of them was
9 successful. In other words the bleeding was key to
10 getting a successful vaccination. And so we changed the
11 technique altogether. We found that we could get four
12 times as much vaccine out of the single vial of vaccine,
13 which multiplied our supply, our very tight supply, very
14 quickly. We could train people in the villages. Within
15 15 minutes you could train them to be vaccinators. The
16 vaccine needles were easily sterilized. Simply drop
17 them in a bucket and boil them for 15, 20 minutes, pull
18 them out, and away you went for the next day. They
19 could be reused many times, and for our budget it was
20 critical. They cost just \$5 per thousand. It was the
21 ultimate, if you will, in terms of remarkable
22 inventions, and just as an aside I would say the
23 inventor of this received the John Scott medal of the
24 City of Philadelphia, which had been given since
25 something like 1750 for the outstanding invention of the

1 year. And he received it, and as he said to me, I have
2 never been so embarrassed in my life. He said, I am
3 receiving a medal like this, which Thomas Edison
4 received and Marconi and so forth and so on. He said,
5 this is the least important thing I ever invented. But
6 it was also the most appropriate.

7 Our strategy was to vaccinate 80 percent of the
8 population to diminish the likelihood of spread because
9 what was said at the time, smallpox spread like
10 wildfire, rapidly. So we set out to do this in working
11 with the villagers in set patterns and sort of
12 organizing this so that there was good consultation with
13 the village head and the religious leader and so forth.
14 And then we set in motion a plan for the teams to move
15 through and a team to follow to do a sample check ten
16 days later. Well, we found out that vaccinators in
17 Africa could readily vaccinate 500 people a day. And as
18 you can imagine, with a team of only four people or five
19 people, you were then doing 2,500 vaccinations, a good
20 size village with no trouble at all in a single day. We
21 also found that the success rate in vaccination was
22 high, and this really laid the foundations for
23 subsequent developments which I won't talk about, which
24 was called the expanded program of immunization. As we
25 looked at it, we said, look, if we can vaccinate this

1 many people this well, this successfully and with this
2 much acceptance, why aren't we giving polio vaccine,
3 measles vaccine, diphtheria, pertussis and tetanus
4 vaccine, and that program did emerge. We finally got
5 that going, which reached 80 percent of the world's
6 children by 1990.

7 We then sought to get a report, surveillance from every
8 health center every week. This was at a time before we
9 had email and before we had faxes, so a lot of this was
10 done by telephone, by messenger, by what have you. And
11 we found that within 18 months even some of the most
12 poor of the countries could provide U.S. information
13 about cases. And then we had firefighting teams,
14 usually two people, who would go out for every reported
15 case. They would then investigate, see if there were
16 other cases, and initially it was to vaccinate 30 huts
17 around whatever the outbreak was. The idea of this was
18 that because smallpox had to go in a continuing chain,
19 if you could vaccinate around and you got within days to
20 a week you had protection of everybody around. What you
21 were doing was stopping its spread and thereby breaking
22 the chain of infection. And this turned out to be
23 dramatically successful, and we gradually moved from
24 saying, we don't want to vaccinate everybody. What
25 we're really concerned about is stopping the spread of

1 smallpox. And this strategy was the real key, but
2 where, as we started on this from the beginning we
3 thought it was a good idea, we had no idea that it would
4 be as successful as it was, and so we used this very
5 rapidly. We also did research in the field, and what we
6 were surprised to find, that transmission did not occur
7 long distances and spread by the air as old textbooks
8 said. It was face-to-face. Most all of it was
9 face-to-face. It spread slowly and primarily only to
10 these close contacts, and fomites, like letters or
11 various other things, except for bedding, never played a
12 role. So it was much easier to contain than we thought
13 it would be. We also found that the duration of
14 protection was longer than the three years or five years
15 which most countries talked about. In fact, it was at
16 least 10 years. So it wasn't a matter of going back to
17 revaccinate an area. You go through, you go through
18 once, and that was it. Big difference in the
19 capabilities there. This is the situation in 1967. The
20 red countries are where smallpox was continually
21 spreading. The blue countries reported cases as well
22 that year. You'll note, in South America, Brazil was
23 the only remaining country with smallpox. They had been
24 using some very good freeze-dried vaccine in other
25 countries in South America. Africa, virtually all

1 countries south of the Sahara were with smallpox, and we
2 had India, Pakistan, Bangladesh, Nepal, that group up in
3 Asia, and Indonesia. There were more than a billion
4 people in the area, above 1.2 billion, that were
5 infected countries, and we had to work in countries
6 adjacent to those infected to prevent spread. So we
7 were really trying to do a program in 50 countries.
8 Three years later you don't see much change except west
9 Africa which now has only one red spot, Nigeria, but a
10 program supported by the Centers for Disease Control and
11 U.S. Government had run a very effective program in some
12 of the poorest countries and some of those most
13 infected, and so that was great encouragement for the
14 other countries.
15 And by 1973 we're only six years into this, and South
16 America is free, Indonesia is free. We have two spots
17 in Africa. The southern one was Botswana, but those
18 were its last cases. Ethiopia was the other, and all we
19 had left was India, Bangladesh, Pakistan and Nepal.
20 Well, "only" was not quite the way to put it. I think
21 we're dealing with 700,000,000 people, and it wasn't
22 going very well. We were not succeeding. There was
23 talk that maybe this is the home of smallpox, like some
24 refer to it as the home of cholera, and there's no way
25 in the world that you're going to stop it in these

1 densely populated areas, particularly in the Ganges
2 River. But one of the reasons was, as we saw it, that
3 we weren't getting the outbreaks soon enough. And in
4 India and Bangladesh, Pakistan, all of them, there's
5 quite a bit of travel by whole families. And it's not
6 uncommon for a family to move into a city, one of the
7 members get ill, and they all went back to the village.
8 And so the smallpox was moving faster than we were in
9 stopping it. And you can see here there's a jitney bus.
10 That's the upper deck is well populated. They're very
11 inexpensive, and this was one of the modes of travel.
12 This was the train. You can see the air-conditioned car
13 on the top there, the top tier. And in fact very few
14 paid admission on this. I was told of one train they
15 had actually collected only one ticket. And as I later
16 learned, it was our WHO advisor who was paying his
17 ticket. So things were moving very rapidly. So we
18 decided on a new strategy, and this is June of '73. We
19 met with the government of India, talked about it.
20 Could we employ health workers, a portion of the health
21 worker staff, of which there are very many, and try to
22 visit every village in India in ten days' time. And we
23 mobilized 120,000 health staff, organized that. And the
24 idea was that containment teams would go out after every
25 outbreak and try to stop it. The numbers of cases that

1 we turned up were huge, far beyond anything we could
2 ever have imagined. It was disastrous. But we were
3 doing this every two months, and by the third round they
4 had managed to organize it well enough so that they were
5 not visiting every village, but they were visiting every
6 house in India. And how do we know that? Because again
7 we had quality control teams who followed along, took a
8 ten percent sample, and they had to go back and do a
9 second search if they didn't reach 90 percent of the
10 houses. I often thought, as I'm flying back to America,
11 and we've got maybe 220 million people, I thought to
12 myself, could I organize something in the United States
13 at this point to visit every house in the United States
14 in a month or even a year? It would be very difficult.
15 Here we were doing it every two months and reaching
16 every house in India.

17 We then ran into catastrophic problems. The gasoline
18 crisis hit. We couldn't get gasoline. Railroads went
19 on strike and the airlines went on strike and then
20 health workers began to go on strike. And if that
21 wasn't bad enough, the worst floods in something like 20
22 or 30 years struck across all of northern India and
23 Bangladesh -- in Uttar Pradesh and Bihar states -- and
24 at the same time we had the event of India detonating an
25 atomic bomb in May of 1974. Well, two things happened

1 that were of tremendous help. One was due to Sweden.
2 SIDA, the Swedish International Development Agency, the
3 representative there, we talked with him about the
4 problem, and within a few weeks there was something like
5 3 to \$4 million had been allocated for this purpose for
6 India. Eventually more than \$20 million was to flow
7 from SIDA into this, really the critical difference that
8 was made in being able to complete this task. The
9 atomic bomb was covered by press from all over the
10 world, and headlines were there for everywhere, here is
11 this country with sophisticated physics, able to
12 detonate an atomic weapon, but cannot conquer this
13 primitive disease which even countries in Africa had
14 managed to conquer. This quite clearly bothered the
15 prime minister greatly. And we did get substantially
16 more help because of this from the Indian government.
17 And less than a year later on August 15, 1975, the prime
18 minister annually makes a speech from the Red Fort in
19 New Delhi and saluted India on its 28th anniversary of
20 freedom and announced that India was free of smallpox
21 for the first time in recorded history. It was for all
22 of U.S. a very telling moment. It left U.S. only
23 Ethiopia. But Ethiopia is 25 million people, the size
24 equivalent to that of Sweden, France and Germany
25 combined. There were few roads. We had to travel on

1 foot and with donkeys a good part of the time, which was
2 very difficult, as large as it was and hilly and
3 mountainous as it was. There was the emperor was
4 assassinated, Emperor Haile Selassie, and a Marxist
5 revolution took over, and two other civil wars broke out
6 in the north and down in the southwest. We had our
7 teams on nine occasions were kidnapped with the advisors
8 and taken to Mogadishu, and then there was a great UN
9 palaver with the rebels about getting them free. They
10 captured a program helicopter. We had two -- and held
11 it for ransom. The Canadian pilot was very diligent.
12 He had managed to get all the rebels vaccinated before
13 he was ransomed, so he was part of the team. And then
14 for a while the foreigners, many of the embassies,
15 withdrew from Ethiopia altogether. None were allowed
16 outside of Addis Ababa except the program staff. And
17 with great courage they kept going, often under armed
18 guard, and fought the last battles. It looked like it
19 was all over. We were about to celebrate the last case,
20 and then Somalia we found had smallpox. Another
21 thousand cases occurred. The government had been hiding
22 cases, trying to -- they were embarrassed they were the
23 last country with smallpox. And finally things opened
24 up, and we finally got the last case of smallpox, who
25 was this man Ali Moallin, 26th of October 1977. The

1 last in this chain of infection which we knew went back
2 3,500 years. Two years were spent in trying to find
3 cases, a thousand dollars reward was posted. This led
4 to some good deal of trouble in some areas because
5 tourists found themselves with pimples and what have you
6 being brought in as possible suspects, and it created a
7 bit of a stir in some of the countries. And finally
8 1980 the World Health Assembly declared solemnly that
9 the world and all its people had won freedom from
10 smallpox and it should be discontinued from every
11 country, and so it was. This was the Magazine of the
12 World Health Organization in May 1980. But the saga was
13 not finished. We learned of a biological weapons threat
14 that occurred. It was in the Soviet Union. This was
15 not recognized by intelligence agencies until the 1990s,
16 but subsequent to a 1972 biological and toxin weapons
17 treaty, all countries had stopped all use of or stopped
18 research on biological weapons and had destroyed what
19 they had. This was by agreement. No method was put in
20 place for inspection. The Soviet Union after 1972 went
21 and developed very rapidly an extensive program on
22 bioterrorism. Small was a priority. We met at one time
23 at the National Academy of Sciences for the principal
24 Soviet bioweaponeers, and they listed for U.S. each of
25 the different agents, the different characteristics.

1 The top of the list of this was smallpox. Second was
2 anthrax and third was plague. They had a major research
3 program. They had a manufacturing capability in a place
4 called Sergiev Posad with the capacity to produce
5 between 20 and 100 tons of smallpox virus in a year. I
6 believe this because I talked with the man who was
7 responsible for developing this and the problems they
8 ran into. It's all very consonant with that having been
9 the case. And then the Soviet Union dissolved, as you
10 know. There were financial troubles, and staff
11 dispersed to many different areas. And so after 2001
12 our concern was very high about smallpox, and we knew
13 that, with the amount of vaccine we had, we were not
14 going to stop an outbreak, and the problem was that
15 there was no vaccine laboratory in the world at this
16 point in time. We had no production capacity in the
17 world, and we had to then get vaccine. We had plans for
18 detection and containment, and we started a research
19 program to get an improved vaccine and antiviral drugs.
20 So we were successful, and we now have more than
21 300,000,000 doses of vaccine and the World Health
22 Organization also has and is building a larger reserve
23 in case of something happening. The vaccine is very
24 stable and can be kept for a long time.
25 But I think, to go back, to say whatever these threats,

1 nature reminds U.S. that the biologic agents could prove
2 even more catastrophic than some of those that might be
3 delivered by man. And I remind you that pandemic
4 influenza, we never had isolated that virus until
5 April of this year. That was the first isolation of
6 that virus. We now have a global pandemic, based on
7 previous experience, we would expect 25 to 35 percent of
8 the population to experience infection. And as we had
9 expected no vaccine would be available until at least
10 October, which is becoming fact, and some will be later.
11 And in fact by the time you give the vaccine and wait
12 for an antibody response of 10 to 14 days, it will
13 really be November before there will be any substantial
14 protection, and based on past experience the major part
15 of the epidemic will be ending. But then we asked the
16 question, what if this had been the avian strain flu?
17 The present death rate -- we're still seeing occasional
18 cases of this avian flu, and the death rate is more than
19 50 percent. Could it spread as we've asked like other
20 influenza, like the swine flu? The feeling is probably
21 not, but you can't rule it out, and so the worry that
22 has persisted. And then the question, are there other
23 possible agents that we really ought to be aware of that
24 we could think of? We've got Ebola virus, which is a
25 problem, but I would remind you that as of 1982 we did

1 not know of an AIDS virus. And the AIDS virus now
2 accounts for -- is the fourth leading cause of death in
3 the world, a virus we had not diagnosed until 1982. Are
4 there other agents out there? Can others occur? The
5 answer is certainly. So I think the point is that for
6 international security, and actually perhaps survival,
7 the cooperative efforts in science and technology are
8 more vital than they have ever been. Thank you.

9 PROF. BENGT SUNDELIUS: Let's see if they have some
10 questions while we have Dr. Henderson up here.

11 Questions or comments from all of you. I think it's a
12 fascinating story, and you have a microphone?

13 AUDIENCE QUESTION: I was wondering if perhaps you could
14 give some comments on the polio eradication, what
15 problems we're facing here, and perhaps they are the
16 same as during the final period of the smallpox program.
17 Thanks.

18 DR. D.A. HENDERSON: The polio eradication began in
19 1988, so it's now in its 21st year. And there are hopes
20 that it would be ended by the year 2000, but there are
21 problems. And one of the major problems is the vaccine
22 itself. It is not a stable product. It has to be
23 carried into the field in refrigerated containers;
24 otherwise it is inactivated. Whereas the smallpox
25 vaccine was very stable. We could keep it for a month

1 at 37 degrees, and it was perfectly good. Second thing
2 is that you have to give many different doses -- seven,
3 eight, nine different doses. It does not perform the
4 same way in developing countries as it does in our own
5 country. I won't go into why that is, but it does. The
6 industrialized countries can get away with many fewer
7 doses. So you've got a vaccine that is not stable, is
8 not as antigenic, cannot produce protection. So there's
9 really a much more difficult task trying to get rid of
10 polio. The other problem is that it's very hard to tell
11 where polio is. With smallpox we could tell whether
12 smallpox was in an area because we had no subclinical
13 cases. Everybody who had small pox virus infection had
14 a rash. Polio, there are 200 infections with a polio
15 virus for one case of paralysis so that, if one has an
16 introduction of a case into a country, you have to
17 assume that it's already spread well beyond a particular
18 area. And in many instances where there's been an
19 introduction of a case in polio, they've just had to do
20 the whole country. I think in Bangladesh they did 17
21 million children on three occasions because of
22 importation of one case. So that it's been extremely
23 difficult to do, and the question that is facing the
24 countries of the world now is the question can we
25 eradicate the disease? There's a heroic effort going

1 on, but there's an alternative, and that would be to
2 incorporate polio vaccination into this expanded program
3 on immunization and use a polio control as we do with
4 measles or diphtheria, whooping cough, for the long
5 term, and just plan to go that route. That's the debate
6 right now.

7 PROF. BENGT SUNDELIUS: One thing I get out of the story
8 is that not only that science can matter but the results
9 of science, they don't just float around there. It
10 requires so much more than results of science to get to
11 the end users. And I think in this case the meaning of
12 end user takes on a completely different meaning. Small
13 children, they're the end users here. And I think it
14 seems it takes stamina. It takes a whole process from
15 the results to the end user, and it takes courage, great
16 courage, to work with this. You have experience with
17 bringing the science to the practical use. I think
18 that's the key here.

19 DR. D.A. HENDERSON: I think this is the key, and I
20 think as I illustrated we were changing the strategy in
21 smallpox because we got the needles, we got a better
22 vaccine, we looked at the epidemiology, we found we
23 could do some things differently. And the idea of
24 continuing regularly the research right up till the end
25 was critical.

1 Polio staff took a different view. In 1988 I argued the
2 case they needed a better vaccine, and they said that
3 would be silly because we're going to eradicate it in
4 the year 2000 and it will take ten years to develop the
5 vaccine. So why go ahead and do it? We will eradicate
6 it by the year 2000. And so no research was done on a
7 better vaccine for a long time. It's now started two,
8 three years ago, for an intensive program, but now it's
9 been going on for so long that a lot of time has been
10 lost. There's also this idea of surveillance. We
11 wanted to know where the case is so we could focus our
12 energies on that and so the surveillance and
13 containment. We also needed that to know were we making
14 progress or not. And it took time to develop that
15 network, but it was critical because that was the name
16 of the game was really to get rid of smallpox. And
17 polio, most of the countries had no surveillance program
18 for at least 10 to 12 years. Before right around 2000
19 they really began to intensify it and really began to
20 move with it. So I think my own feeling is that there's
21 one -- we had a very diverse and very good group of
22 people from all the countries. The Russian-U.S.
23 relationships were excellent. People worked well
24 together. We had support and help from a lot of
25 different sources. It was possible with the group we

1 had, they're a very dedicated group and quite young. We
2 had quite a younger group who were -- I think we said
3 they didn't know what couldn't be done, and so they went
4 and did it. So it was a story of a great many different
5 people working cross-nationally in a major effort, and
6 really learning as we went. If we had not learned what
7 we did during the program, we would never have
8 eradicated it. So that these new findings as they came
9 up were applied, it was to the end user, just as fast as
10 we were finding new answers.

11 AUDIENCE QUESTION: I would like to add one thing to
12 what Dr. D.A. Henderson said, and that's that two thirds
13 of the costs were carried by the developing countries.
14 Because we were doing a thing that mattered to the
15 populations, and this might have had influence also on
16 aid work as a whole from some developed to developing
17 countries. I've heard it said a number of times. I
18 would just add a little experience from the work.
19 There's one thing more, and that's that we were all the
20 time working in the -- at the end of quite a chain of
21 efforts. And there is a little passage in a book by
22 Solzhenitsyn which I would like to refer to, and that's
23 how difficult the work is in the realm of the final
24 inch. And we were all the time working at the end of
25 the effort, which made the task more difficult. You are

1 tired, you want to leave the field before you have
2 reached complete victory, and a number of other causes
3 that might be coming up at such a time. May I give a
4 little experience of this kind of difficulty? Just a
5 very small but personal experience. In 1980 when the
6 commission was assembled in Nairobi, I stayed in the
7 Sirena Hotel, and as soon as I came to the hotel a man
8 rang the phone and said, I know who you are. I want to
9 meet you. And I said, for what purpose? And he said,
10 for sex. And I said that was kind of you, but I really
11 have no time. And then in the afternoon late he called
12 again and said, now I'm here, I'm coming whether you
13 want or not. And I called down to reception, and they
14 were very much alarmed and said, we will put a person at
15 your door all the time, and if he comes they will knock
16 him down. And afterwards we had hung up on the phone I
17 thought, oh, gosh, if my colleague came, some of them
18 might come there, and perhaps they'll knock him down.
19 But nothing, nothing really happened. And during the
20 practical work here there were situations which were
21 really dangerous. I can't give more -- I don't give
22 more example when pressed upon. Thank you very much.

23 DR. D.A. HENDERSON: I do thank Professor Lundbeck for
24 his comments. As you can tell, this was a man who
25 worked with U.S. and worked in the field as hard as

1 anybody and really was a tremendous support to U.S..
2 but I would like to add that he was the one responsible
3 for what we called "the realm of the final inch" or
4 having used this in our final years. He was translating
5 Solzhenitsyn The First Circle from Russian to English,
6 and this was a paragraph that he had called the realm of
7 the final inch. And it was as he said emphasis on doing
8 the work properly and doing it to the end. And at least
9 for the staff all we had to do as we came to
10 particularly difficult times was simply to use the words
11 "realm of the final inch," and all of them, it was a
12 message we really have to do this right; we have to
13 complete it. And we're thankful to Dr. Lundbeck, who
14 was the one who brought it to U.S., and we certainly
15 dispersed that and used it widely. I thank you again
16 for all you contributed. Thank you.

17 PROF. BENGT SUNDELIUS: We have questions from our
18 global viewing audience as well. I'd like to add those
19 if we have time. You see in front of you the screen.
20 First question: How serious is the threat of a
21 synthetic virus created in the lab by terrorists?
22 Second question: What can be done to anticipate the
23 emergence of dangerous viruses? If you can answer those
24 two questions from our global audience.

25 DR. D.A. HENDERSON: Let me take the first one about how

1 serious is the threat of a synthetic virus being
2 created. And I think the consensus is that based on
3 what we now know that a smallpox virus could be created
4 in a laboratory, but it would be extremely difficult to
5 do so. Once one thought one had created that virus or a
6 variant, one is faced then with the problem how do you
7 know you have it? And here one gets into difficulty,
8 because it doesn't grow on animals. You can't really
9 work on it with animals, so it becomes human testing,
10 and it becomes difficult to get human volunteers for
11 this sort of an experiment. I think the consensus of my
12 colleagues who are molecular biologists is that while
13 this may be possible to do this, it's very, very
14 unlikely that anyone would endeavor to do it. It's a
15 very large virus, a very complex virus, and there's a
16 lot that's not known about it.

17 The second question, what can be done to anticipate the
18 emergence of dangerous viruses. This is a subject which
19 at this point in time we at our center and a number of
20 others are deeply concerned about, because we really
21 need to know a great deal more about what is going on
22 with viruses in the third world. Many places, let's
23 say, the tropical rain forests and other areas where you
24 have man and nature in very close proximity, very rich
25 diversity of biomass, and the possibility of viruses

1 emerging from that circumstance or others are very high.
2 At the same time we recognize that we don't quite know
3 where the swine flu emerged, although it would appear
4 that maybe it arose in Mexico so that maybe we were
5 maybe a little presumptuous on this. However, the
6 answer to this is surveillance, and we really need to
7 develop a very good working relationship, partnership
8 with scientists and laboratories around the world,
9 working with them in controlling diseases of greatest
10 importance wherever they are. And in the course of this
11 one does turn up then a number of other viruses that
12 some of these may be of importance. So we have seen a
13 couple of variants of HIV viruses that come along, and
14 there are others that are out there that may indeed
15 cause problems. The best we can do, let's detect them
16 early. Then let U.S. have a good working relationship
17 between research laboratories, development laboratories
18 and production laboratories. And this is something that
19 we're talking about in the U.S., how do we develop
20 something so that we would be able to find a new virus,
21 do the research on it, translates in a vaccine antiviral
22 agent and go with it. And we think there are other
23 approaches that need to be taken that are not being
24 taken at the present time.

25 PROF. BENGT SUNDELIUS: Thank you very much,

1 Dr. Henderson, a scientist with endurance and courage.