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INTERNATIONAL HEALTH: BEGINNING OF
A REVOLUTION

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The first three lectures in this series on high technology have scanned important but still distant horizons of prospective breakthroughs in science and technology, such as those relating to superconductivity and the space telescope. The potential for application of science and technology in international health, has also expanded dramatically in recent years and continues to do so. Important impacts have already been made and more can be foreseen. However, the need for the pace to accelerate is of the greatest urgency as I shall describe although the horizons are of a different character than those envisaged by our colleagues in astronomy and physics. Our concerns focus more heavily on simplicities in application, a universality in availability and solutions for the complex of sociocultural and managerial problems which stand as barriers between possible and existing realities. I don't see many symposia series which are advertised as breakthroughs in "low technology," if indeed this is the antithesis of "high technology." Today, however, you must bear with me as much which I wish to discuss with you has as much to do with the needs and opportunities for application of low technologies as it does with high technology itself.

It is important to note at the outset that until comparatively recently, international health and population issues and their research agendas were not high on anyone's list of international development priorities. I need only remind you that international support for family planning programs is a recent product - of the late 1960s and early 1970s - and is still seriously underfunded. Significant support for programs in health only began to emerge during the 1980s. In illustration, our budget for research in smallpox eradication was exactly \$40,000 per year and that was granted reluctantly. Moreover, during the first five years of the global smallpox eradication campaign, we in WHO received less than \$100,000 in cash contributions and this for a program from which all countries would materially benefit.

After decades of disinterest, however, there is a growing awareness that health and population issues are of more than casual concern. Indeed, they are critical to our collective survival as a species.

Note that the world's population crossed the five billion mark in 1986, doubling in just 36 years and more than doubling our capacity to produce more babies. Certain of the implications of this need to be highlighted:

1. As documented by Brown and his colleagues, the population of a number of countries is already beginning to exceed the calculated carrying capacity even assuming total utilization of available land. Among the more serious problems is Nigeria where the population, now 100 million persons, would be

expected to grow to 520 million by mid-century before stabilizing. This would be five times its present size. Bangladesh would expand to 330 million persons or three times its present size. Such projections, although representing straightforward mathematical extrapolations, are unquestionably surreal as social collapse would almost certainly occur long before these numbers materialized. The time frame, however, is very short.

2. Environmental changes, most notably, the "green house effect" and loss of the ozone layer portend catastrophic global change. Needless to say, these physical changes are driven primarily by population growth and these are occurring and can be expected to occur with a rapidity which defies correction. How rapidly is illustrated by the pace of forest damage in West Germany. In 1982, 8% of trees were damaged; by 1983, 34% of trees were yellowing and losing foliage; by the summer of 1984, the proportion reached 50%.
3. Urban areas, now accommodating 43% of the world's population, are becoming centers of pollution, tension and conflict as services deteriorate under the growing press of migrants and unchecked fertility. The most unbearable periods of Los Angeles smog now pale in severity to what is a regular occurrence in such as Mexico City, Sao Paulo and New Delhi.

Population size is the determinant and critical factor underlying a host of global problems ranging from biological diversity to climate change, but family planning programs alone cannot address the problem. As has been documented in numerous studies, population growth does not begin to stabilize at reasonable levels until after childhood mortality rates have begun to fall and economic and social gains reduce the desire for large families. In brief, health and population programs must proceed in tandem along with other development measures. But time is required and time is rapidly running out. Forty percent of the world's population is now under 15 years of age and even with the impossible goal of one-child families, substantial - in some countries, questionably sustainable - population growth is inevitable.

There is an urgency in bringing to bear the best of science and technology to these problems - if we don't other developments in high technology may well be of marginal relevance.

There is no question but that we already have a substantial capability and capacity to effect rapid and profound changes. The last century has witnessed dramatic improvements in the health of children in the United States and other industrialized countries. Today, we know that of 100 children who are born in this country, 99 will celebrate their fifth birthday. We believe that within the next decade, the mortality rate for those under five years will decrease again by half. Indeed, countries such as Finland and Sweden are already approaching such levels.

The death of a child in this country is an uncommon event. This is in stark contrast to the situation in Third World countries where as many as 20 to 25% of those born do not celebrate their fifth birthday. Many attribute these differences to our increased prosperity and improvements in education. Undoubtedly, these factors have been important, but many fail to appreciate that at the turn of the century, standards of health in the United States were little better than the poorest of Third World countries today. In the U.S. in 1900, 18 of every 100 children did not live beyond 5 years; life expectancy was only 47 years; and 26 of our 96 largest cities had no sewerage system whatsoever. Yet, at the turn of the century, the United States was comparatively prosperous, with a per capita income equivalent to that of Portugal or Argentina today and the U.S. census of 1900 revealed that nearly 90% of all adults were literate. Interest in the application of science to health, however, had not matured. In illustration, I cite the behavior of the Superintendent of the New York Hospital and then President of the American Hospital Association. In 1900, he declared: "I am absolutely at a loss for an understanding of the value of a medical library in a hospital. Accordingly, he closed the library and gave away its books.

In the United States, the period extending from about 1900 through perhaps 1950 was an extraordinary period in the improvement of the health of Americans. In concrete terms, life expectancy increased, on average, about 15 minutes every hour. What accounted for this? As time has passed, we have largely forgotten that it was primarily community-based programs which, at the time, we called public health - provision of water and its chlorination, the implementation of food and

drug legislation, improved nutrition with vitamin fortification of milk and wheat, the addition of iodine to salt, the pasteurization of milk, immunization against diphtheria, tetanus and smallpox, provision of sewerage and the like. Legal barriers which prevented the provision of family planning services fell and fertility rates plummeted. The contributions of traditional curative medicine were marginal - not that practitioners weren't needed or that people didn't seek medical care, only that they contributed little to better health or to longevity. None seriously debate this.

After World War II, a biomedical revolution began and this has since accelerated steadily. Among other developments, we soon had an array of antibiotics, more sophisticated diagnostic procedures, organ transplantation, improved surgical techniques and parenteral feeding. For every illness, there were far more diagnostic and curative procedures which could be applied than ever before and more often - although not always - to the benefit of the patient. There was a demand for more hospital beds, more physicians to treat patients, broader and more generous insurance schemes to treat the ill. Legislators, benefactors and consumers alike responded by providing a cornucopia of coronary care units, ever more sophisticated machines for diagnostic radiology and who knows how many fat farms, as well as plastic surgery centers which could build a nose or drop a chin.

We build a magnificent curative care structure which we call a health care system - which, of course, it isn't. To serve this system, we churned out physicians in unprecedented numbers to the point where, as

Bruce Vladek expressed it: "What we are facing in the hospital industry, in health care in general, is a very serious shortage of patients." Medical schools, however, continue to graduate large numbers of additional physicians, trained as they have always been trained, primarily to treat those who seek care.

These more recent developments in the U.S. and other industrialized countries have been paralleled in the developing ones. Their concerns over the past four decades have also been for the development of curative medical services. Community-based public health programs have been largely ignored. Enormous investments have been made but the results have been profoundly disappointing. This cannot be attributed to a shortage of physicians as there are today distressingly large numbers of unemployed physicians in many developing countries, including such as India and Bangladesh as well as Mexico and Brazil.

Only during the past decade have we begun to develop strategies which might deal effectively and practically with health conditions in the developing countries. As was the case in the industrialized countries before World War II, these are primarily community-based programs. The most important of these activities are presently embraced within a program called the "Child Survival Revolution." It is a universal effort in which nations throughout the world are participating, joined by such disparate groups as the World Bank and regional development banks and by Rotary International, which has pledged to raise \$120 million for the effort. Although much remains to be done, dramatic progress has already been made and more can be foreseen over the decade

ahead. Surprisingly, however, the program and its achievements are, as yet, little appreciated among the professionals and the public in this country. Its genesis, rationale and progress are important to understand as they represent the foundation for future applications of science and technology.

Preparatory to doing so, let me offer some data which illustrate measurements of change which have occurred over the past quarter century. First, let us compare the traditional infant mortality rates in 1960 and 1986. In 1960, 45 of the 128 largest countries reported 150 or more deaths per 1,000 births. Today, only 8 report infant mortality rates of this magnitude. Note that as recently as 1900 in the United States, infant mortality rates were in the range of 160 per 1000 births. Today this rate would be among the highest recorded.

Life expectancy at birth, as you would expect, has increased dramatically. For more than half the countries, it was less than 50 years in 1960. Today, nearly two-thirds of 131 countries recorded life expectancies of more than 60 years.

Few recognize that the health experience of our parents (or at least those of my generation) were comparable to those of many of the poorest developing countries today. Decades were required to effect significant change. In the developing countries, this time is being compressed. It can be compressed further. The developing world is not an unchanging morass of poverty, disease and despair. Change is possible and it is occurring.

An important contributor to this change is the Child Survival Revolution, which recognizes and incorporates the potential of simple, inexpensive community-wide interventions to prevent disease and death and to promote the well-being of children. Of equal importance has been a growing appreciation by political leaders that improved health plays a vital role in national development.

The genesis of the Child Survival Revolution has its origin in not one but several developments. To identify the most important helps to characterize it. An important component and its foundation, is the planned objective of providing well-established vaccines against six of the major diseases to all of the world's children - the diseases being poliomyelitis, measles, tetanus, whooping cough, diphtheria and tuberculosis. This initiative followed inexorably from the experience gained in smallpox eradication.

The smallpox program, coordinated by WHO, succeeded in only a decade, and at a total cost of less than \$8 million per year in international support, in eliminating from the earth one of the most feared diseases known to man. Smallpox was a disease which, when the program began, annually resulted in more than two million deaths despite the fact that an effective vaccine had been known and available for more than a century and a half. However, an intensified program, endorsed by the World Health Assembly, eradicated the disease in only 10 years, 9 months and 26 days. What accounted for this rapid change? First, was the finding that in most countries, trained health personnel were in surprisingly plentiful supply and that even with moderately effective

supervision, they were capable of a remarkably high standard of performance and achievement. The numbers needed to effect change were really very small. In Africa, for example, most programs consisted of only 12 to 100 dedicated smallpox staff. Competent, motivated leadership, even though few in number, and a community-based strategy made the difference. Second was the discovery that villagers, when properly approached, were usually willing, in fact eager, to cooperate in the program and sometimes even could serve as volunteer vaccinators. Third was the finding that a system for the routine notification and investigation of cases and outbreaks could be reasonably easily established and that the findings were invaluable in guiding strategy and in monitoring progress.

It seemed only logical to us that other vaccines might similarly be applied with good effect and, in the course of doing so, might serve to strengthen national health systems. Thus, as the smallpox eradication program was concluding, an Expanded Program of Immunization was launched - in 1974. At that time, less than 5% of all children in developing countries were receiving any of the vaccines which were in common use in the industrialized countries.

In retrospect, it is curious that so little effort had been made to provide vaccination, the single most cost-effective, most innocuous procedure in our entire medical armamentarium - and the simplest to administer. Quite simply, the efficacy of preventive as compared to curative procedures was not appreciated. Existing so-called health-care systems were really sickness care systems, designed to treat persons who

asked for help. Gradually, the immunization program gained momentum and over recent years, progress has accelerated. Today, more than 50% of all children in the developing world are being vaccinated; vaccine demand has tripled in the past two years alone; poliomyelitis incidence in the Western Hemisphere has fallen to such low levels that an eradication program has begun with the objective of eliminating poliomyelitis from the hemisphere by the end of 1990. The global objective is a vaccination program which reaches 90% of the world's children by 1990. The task is not yet complete but the result, if successful, translates into the saving of more than 3 million lives annually.

A second and more recent development contributing to the Child Survival Revolution was the discovery that deaths from diarrhea could be sharply reduced if victims received by mouth ample fluids of the proper type. A simple oral rehydration solution comprised of salt and sugar was developed, a discovery in which Johns Hopkins played a major role. The first 1,000,000 packets of such a mixture were purchased by UNICEF in 1975 and the supply lasted 18 months. Today, more than 1,000,000 packets are used daily. National programs have begun in more than 100 countries and in countries as diverse as Egypt, the Philippines and Honduras, diarrheal disease mortality has decreased by 50%. Indeed, pediatricians, even in this country, are finding that effective oral rehydration, provided early, diminishes the need for hospitalization and intravenous therapy.

A third and more recent development, an intervention which has only begun to be exploited, is based on the discovery by Sommer and his colleagues at Johns Hopkins that the administration of vitamin A once every six months resulted in a dramatic decrease in childhood deaths in Indonesia, deaths due primarily to respiratory disease and diarrhea. Sommer's team administered vitamin A in standard UNICEF capsules to one to six-year-old children in one group of villages; a second group of villages served as a control. The capsules were given once every six months. The capsules cost less than ten cents each. Death rates among children in the treated villages were 34% less than those serving as controls. Laboratory studies showed that vitamin A was vital for the maintenance of the integrity of intestinal and respiratory epithelium and to the immune process, effects which are compromised even among those who are marginally deficient. Vitamin A, previously given for the prevention of blindness, has now been accepted by WHO and UNICEF for widespread use throughout all developing countries.

Meanwhile, another community-based program, one for family planning, has made surprising progress. I say "surprising: because most of the publicity is given to what yet needs to be done. It is important to recognize that much has already happened. Specifically, little more than 20 years ago, only a few countries had government-supported family planning programs. Today, more than 93% have such programs. Total fertility rates have fallen by 33% during the last 25 years and world population growth has declined from 2.0% to 1.5%. However, we need to bear in mind that the female population in the developing countries will grow by 35% over the next 20 years and even if each of them has only two

children, the population would continue to grow for 50 years, before stabilizing.

The development of these community-based programs represents a truly revolutionary conceptual change in the provision of health care. The potential of this change has only begun to be realized. Basically, it involves social mobilization. To realize the potential, we need to fully exploit science and technology in three important areas:

(1) Biomedical science; (2) communications and computer technology and, (3) behavioral and management sciences. We have begun this task but we are only at the threshold.

Let me be specific. Vaccines which can confer protection for long periods with only one or two inoculations represent, by far, the most effective and inexpensive tools available to us in modern medicine. With the new techniques available to contemporary biomedical science and a rapidly improving knowledge of immune mechanisms, the potential for new vaccines has expanded by light years and the time required for vaccine development has been compressed several fold. Many antigens can now be combined into a single preparation, and some have been made sufficiently stable so as to be able to be kept for long periods at ambient temperatures under tropical conditions such as was the case with smallpox vaccine. At a recent seminar, it was estimated that more than 50 new vaccines are at different stages of development, at least 6 to 10 of which could be in routine use within the decade. Included among them are vaccines, now actually under field study, which are effective in preventing pregnancy.

Diagnostic reagents, such as monoclonal probes, provide powerful new tools for determining the foci and extent infection. Although sophisticated in concept, they can be simple indeed to use - an important characteristic for the developing countries. These are already proving to be of inestimable value in polio eradication in the Americas and offer new vistas for epidemiological research. A major barrier is the conventional method for inoculating vaccines. The needle and syringe is an antique instrument. However, there is now a simplified jet injector, now moving toward the prototype stage, which could replace the cumbersome needle and syringe. The injector expresses vaccine in a jet under high pressure which passes through the skin. The model now under development would cost perhaps \$25 and would be capable of providing thousands of vaccinations per day. I could describe other developments but the key words are simple, inexpensive and more fool-proof under field conditions than is required in the industrialized world.

The second generic area for development lies in the field of communication science. There is an urgent need to convey health messages to large, scattered populations speaking many different languages and dialects. Until recently, this has been a major stumbling block. Such communication is essential to gain the cooperation of the populace, indeed, to gain their understanding so that they demand appropriate health services. Coupled with the problem of communication has been the deterrent of the stuffy, preachy, fuddy-duddy approaches so common among a past generation of health educators. This, too, has begun to change. Radios now are all but universal; television is

amazingly widespread; and the use of cassettes and satellite transmission offers bright new vistas which have only begun to be exploited. Contemporary communications scientists are taking to heart the lessons of the commercial world and are beginning to use soap operas and popular songs. The potential has scarcely begun to be tapped, especially with respect to the education of women. I note women in particular because a number of recent studies have documented that the level of education of women is an independent positive variable both as it applies to the health of children and to contraceptive use.

Measurement of progress in the community-based health programs demands enumeration of such as vaccination coverage as well as the creation of a network of reporting centers to measure numbers of cases of disease. For the traditional sickness care systems, such were unnecessary - the meaningful outcome was, quite simply, how the individual patient responded to treatment. Microcomputer applications are beginning to be exploited in surveillance but the operative word is "beginning."

Last but not least, there is a need, as never before, for those skilled in the behavioral sciences, cultural anthropology, operations research, economics and management to assess how best to interact with communities, how best to operate and manage programs and how to do this at a cost which is affordable.

The success of the community-based programs of which I speak have yet received little public attention although they are now attracting previously unheard of resources from donor agencies. Major investments

are now being made by the World Bank as well as the regional banks. Foundations and national agencies are increasing their support and, remarkably Rotary International has pledged to raise \$120 million for polio eradication.

As I noted earlier, the Pan-American Health Organization has established as a goal, the eradication of polio from the Western Hemisphere by the end of 1990 - only two years hence. How far have they come? To date this year, only 2% of all countries have reported a case. The total number of cases is just over 300 and recent studies indicate that money, perhaps the majority, are not polio, in fact. So far this year, only 9 wild polio viruses have been isolated in the whole of the Americas. Undoubtedly more will be isolated but the point has been reached where a substantial reward will now begin to be offered to those reporting and investigating cases of disease from which a wild polio virus is isolated. The World Health Organization this year set the year 2000 as the goal for global polio eradication and the Caribbean countries have embarked upon a program to interrupt measles transmission by 1995.

If there is a dark cloud which casts a shadow - and there is - it is the serious lack of support for needed research. In this country, the growth of product liability suits has driven many vaccine and contraceptive manufacturers out of the market and with this, an incalculable loss in research capacity. A further problem is that many of the donors to the Child Survival Program want to see immediate results in the field and regard the plea for added research funds as the irrelevant cry of academics concerned more about their own careers than

"getting on with the task." I would note, however, that politicians argued similarly when the global smallpox eradication program began. As they saw it, a good vaccine was available. The only problem was an administrative one - to apply it in the field. We resisted this view and promoted research throughout the program. By the time it concluded, little was the same as it had been. Vaccine production methods had improved, new vaccinating devices were in universal use, our understanding of the epidemiology of smallpox had greatly changed and the strategy and tactics of the program were substantially altered. Indeed, without research, smallpox would still be with us.

Let me conclude by noting again that the potential for new diagnostic and therapeutic technologies is growing exponentially, nurtured by a magnificent base of biomedical research. New fields have emerged - organ transplantation, fiber optics and nuclear imaging. To the press, indeed to many of our colleagues, these developments appear to be the real challenges, the true frontiers of medicine. Indeed they are but there are other frontiers, other challenges, sometimes less newsworthy but far more dramatic and urgent if we, as a species are to achieve equilibrium with planet earth. The cutting edge to that problem is wanted children who are given the opportunity to grow in health to adulthood.