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"Eradication: Pitfalls and Promise"

THOMAS FRANCIS MEMORIAL LECTURE

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Introduction

I thank you for the honor of being asked to present the Thomas Francis Lecture for, truly, Tommy Francis was and is a giant in the field of epidemiology - a creative mind whose clarity of thought and persistence created and shaped institutions, concepts and students. I count myself among the fortunate who shared in his wisdom. As it so happens, one of his young proteges during the war was an epidemiologist named Alex Langmuir with whom I spent the first decade of my career at CDC. Alex held Francis in extremely high regard and characterized him a "great sparring partner," one of very few whom Alex ever so qualified. Both participated actively in shaping policies for polio and influenza, in deliberations of the American Epidemiological Society and in many other settings. When the participation of Francis and Langmuir was assured, attendance was always better. The meetings were inevitably interesting, provocative and sometimes turbulent - but all in good humor or, at least, pretty good humor. But they were never dull.

On May 8 of this year, we celebrated the 10th anniversary of the realization of a dream - the global eradication of a disease. It was a vision worthy of Tommy Francis himself and so the conjunction this year of the two events - this anniversary and the 90th of his birth - are a happy concordance. For myself and others

whose specialty and life was smallpox, the detection and containment of the last case marked an abrupt ending to a major phase of our own professional careers. Few of you can imagine the emotions associated with the conclusion of the program. For years, we had been at the forefront of public health in coping with a major problem, international experts in smallpox, at the center of excitement in achieving what many once believed impossible. Suddenly, the disease vanished. It was akin to the armistice at the end of the World War - immensely gratifying but suddenly creating a void in life and rendering all but obsolete one's professional credentials. I've wondered how many old generals became deans for want of better employment!

Let me not try to rehearse for you today the history and battles of smallpox eradication. Rather, let me endeavor to cast in perspective the concept of eradication itself - its beginnings, its failures and its future.

Attitudes toward Smallpox Eradication

It is difficult today to imagine how few, only 25 years ago, believed that the eradication of smallpox or any other human disease was a feasible, let alone a practicable objective. Skepticism and disbelief were widespread and these extended from politicians to knowledgeable scientists. One of the most widely read and respected scientists in the 1950's and 1960's was René Dubos - the Lewis Thomas of that era. In 1965, he published his eminently readable book, *Man Adapting*.⁽¹⁾ This appeared on the

market just as the World Health Assembly was deciding to embark on the 10-year Intensified Smallpox Eradication Program. I quote from his chapter dealing with eradication:

"At first sight, the decision to eradicate certain microbial diseases appears to constitute but one more step forward in the development of the control policies initiated by the great sanitarians of the 19th century ... In reality, however, eradication involves a new biological philosophy. It implies that it is necessary and desirable to eliminate completely the etiological agents, once and for all ...

"In all cases the problems posed by biological and epidemiological peculiarities of each type of infection are still further complicated by financial, administrative and political uncertainties. Even if genuine eradication of a pathogen or vector on a worldwide scale were theoretically and practically possible, the enormous effort required for reaching the goal would probably make the attempt economically and humanly unwise ..."

"Social considerations make it useless to discuss the theoretical flaws and technical difficulties of eradication programs, because more earthy factors will certainly bring them soon to a gentle and silent death. Certain unpleasant but universal human traits will put impassable stumbling blocks on the road to eradication. For example, it is easy to write laws for compulsory vaccination against smallpox, but in most parts of the world, people would much rather buy the vaccination certificate than take the vaccine ...

"Public health administrators, like social planners, have to compromise with the limitations of human nature. For this reason, and many others, eradication programs will eventually become a curiosity item on library shelves, just as have all social utopias."

This was not an auspicious time for a neophyte eradicator to assume direction of a global eradication campaign! But Dubos had cause to write as he did. The so-called global malaria eradication campaign was then in its tenth year. Enormous sums of money had been spent, but progress in Asia and Latin America was far behind schedule, and costs were far greater than any anticipated. Moreover, what few appreciate, there was neither a strategy nor a program for the vast area of sub-Saharan Africa - and none was ever developed.

In 1959, WHO had also reluctantly launched a smallpox eradication program⁽²⁾ in response to a proposal by the Soviet Union,⁽³⁾ but seven years later there was little progress to report.⁽⁴⁾ Senior staff at WHO openly opposed the program, in part because its Director General believed that the eradication of smallpox could only be achieved through universal vaccination. Knowing well his native Brazil, he knew this to be impossible throughout the vast regions of the Amazon if not elsewhere. WHO's support for smallpox eradication reflected these beliefs. In 1965, WHO spent \$63,000,000 for malaria eradication and \$233,000 for smallpox eradication - a difference of 300 fold.

Belief in the concept of eradication was at a low ebb when, in 1966, the United States and the Soviet Union took the lead in proposing that the smallpox eradication program be given a chance of success by earmarking a larger sum in WHO's budget for its implementation.

In planning for global smallpox eradication, WHO foresaw a need for international support amounting to \$7 million annually.⁽⁵⁾ Voluntary contributions were expected to cover most of this. How much should be provided for in the WHO budget was heatedly debated but eventually \$2.4 million was decided upon - overall, about \$50,000 for each country where a program was thought to be required. Many countries were not enthusiastic, and the WHO budget for 1967 was accepted by the margin of only 2 votes with 12 nations abstaining.⁽⁶⁾ No WHO budget, before or since, proved so divisive as this one. The lack of international support, thereafter, bore out the reservations which so many had. CDC provided crucial support to the program in Western and Central Africa and the Soviet Union contributed hundreds of millions of doses of vaccine. However, during the first seven years of the intensified program, the combined cash contributions of all other donors amounted to less than \$200,000 per year.⁽⁷⁾ Indeed, throughout its course, the smallpox eradication campaign was a precariously funded uphill battle whose achievement was anything but certain less than a year before the last case occurred.

It is important that we understand why there was such skepticism and so little support for the campaign, for it has a

bearing on the lessons which the campaign offers for future health initiatives. The reasons, as we shall see, rest primarily in the history of eradication as a public health policy, a policy which led to strategies which dominated our international health agenda until little more than a decade ago.

Origins of the Concept of Eradication

Interestingly, the first planned program whose stated objective was "eradication" was one intended to eliminate a disease of cows - bovine contagious pleuropneumonia.⁽⁸⁾ This highly fatal disease had been imported into New York in 1843, and gradually spread to the Midwest. Eventually, a number of countries began to embargo imports of livestock from the United States. To deal with the problem, the Congress in 1884 created the Bureau of Animal Industries. Its stated objective was to eradicate the disease over a five-year period, the term "eradication" actually being used in its charge. And, indeed, it was successful. Soon, other animal disease eradication programs began to be conducted which likewise proved successful.⁽⁹⁾ Different approaches were used for each but most of these involved the isolation and/or slaughter of infected herds. (This approach was obviously not well-suited for dealing with human disease.) Moreover, they all dealt with recently imported organisms or vectors which were localized geographically and had not become enzootic. Another important characteristic of these programs was that they invested heavily in surveillance in order to identify the prevalence and distribution

of the disease or vector. Regrettably, this was a principle which was not well-heeded when human disease eradication programs began.

From these experiences, the belief grew that there might be a number of microorganisms or vectors which clung so tenuously to an ecological niche that simple measures could be found to upset the balance of nature. By the turn of the century, planned programs for disease eradication were a familiar concept to many veterinarians but were largely unknown to those concerned with human medicine. For diseases such as plague, smallpox and yellow fever, quarantine regulations were adopted but until the present century, the term eradication was not applied to a planned program for the elimination of a human disease.

Eradication of Human Diseases

Surprisingly, the first human disease to be considered for eradication was hookworm - in 1907. This was soon followed by one for yellow fever.⁽¹⁰⁾ From what is now known of their ecology, neither disease was a reasonable candidate. When the programs began, however, a visionary belief, albeit a limited scientific understanding, caused them to be selected. The magnitude of the efforts was extraordinary even by contemporary standards and the patterns of program operation, especially for yellow fever, largely defined the nature of public health strategies and agendas for the next 50 years. Both were the products of the philanthropy of John D. Rockefeller.

With support from Rockefeller, hookworm eradication campaigns began throughout the southern United States in 1909. Why hookworm? In its more severe forms, it caused anemia and lassitude and, this, it was reasoned, was the underlying cause for what was perceived to be a less vigorous and productive population. Some, in fact, called hookworm infection the disease of laziness. In the belief that the eradication of hookworm would effect a fundamental economic transformation of the region, an eradication program was launched. The program strategy called for mobile teams to identify infected persons by stool examination and to treat them. At the same time, other teams worked to construct sanitary privies. It was anticipated that this would interrupt the cycle of transmission between infection in man and persistence of the worm in the soil. During the first five years of the program more than 2 million persons were treated and 250,000 rural houses were inspected and sanitary privies provided. Over the succeeding years, programs were extended to 52 countries on 6 continents. It was an unprecedented global effort.

The program strategy had been based on faith, without confirmation by a pilot project, that the measures employed would actually be effective in practice. Progress was measured in terms of numbers of treatments and numbers of privies constructed. Neither surveillance for infection nor research were deemed important. More than a decade after the program began, the first studies were conducted to assess whether transmission was being interrupted. They showed that even where programs were well

executed, infection rates were not diminished, albeit those infected had fewer worms, on average, and so, less illness.⁽¹¹⁾ Clearly, eradication was beyond reach. Soon thereafter, the program began to be phased out.

Yellow Fever Eradication - A Vector Control Strategy

In 1915, the Rockefeller Foundation embarked on yet a second global eradication program - against yellow fever. Here, the scientific foundation was better laid although understanding of the epidemiology of the disease was still deficient, as later became apparent. Prospects for yellow fever eradication originated in the dramatic interruption of yellow fever transmission in Cuba in 1901. The year before, a U.S. government commission, headed by Walter Reed, demonstrated conclusively that the disease was caused by a virus and transmitted by the *Aedes aegypti* mosquito after an extrinsic incubation period of 9-16 days.⁽¹²⁾ The mosquito was shown to breed almost exclusively in and around houses. Immediately thereafter, the Chief Sanitary Officer, William Gorgas, set in motion a massive control program.⁽¹³⁾ Patients were isolated in screened quarters; breeding sites were eliminated by the removal of bottles and cans and kerosene was applied to water surfaces. The program was a military-style operation in which teams of three inspectors were each assigned responsibility for 1,000 homes to be inspected at the rate of 30 houses per day. Only eight months later, Havana and indeed Cuba became free of yellow fever for the first time in memory. In 1902, Gorgas wrote to General

Leonard Wood "I look forward in the future to a time when yellow fever will have entirely disappeared ... I believe that when the yellow fever parasite has become extinct, it can no more return than the dodo."⁽¹⁴⁾

Subsequently, during construction of the Panama Canal, Gorgas confirmed the efficacy of his strategy⁽¹⁵⁾ and Oswaldo Cruz did likewise in Rio de Janeiro. Gorgas concluded that yellow fever transmission could be sustained only in population centers of 50,000 or more and that by intensive, short-term campaigns to reduce, not eliminate, *Aedes aegypti* populations, yellow fever could be eradicated.⁽¹⁶⁾

In 1915, the opportunity arose to test this hypothesis. Wickliffe Rose, the director of the new Rockefeller Foundation, was casting about for a major undertaking befitting the new foundation. In a visit to Asia, he discovered everywhere - or so he reported - that health officials were profoundly concerned about the possible importation of yellow fever in consequence of the opening of the Panama Canal.⁽¹⁷⁾ Given that the necessary mosquito vectors were widely prevalent in Asia, they feared the occurrence of massive epidemics should yellow fever be imported. Rose, a philosopher by training, consulted then Surgeon-General Gorgas who assured him that eradication could be achieved in a reasonable time and at a reasonable cost.

Thus, in May 1915, the Rockefeller announced its intention to provide assistance wherever infection with yellow fever was endemic with the objective of global eradication. Eradication in the

Americas was foreseen within five years; a timetable for Africa awaited further study. The campaign began in 1918 with Gorgas as its Director.

Using the same meticulously planned, quasi-military approach as had been used in Cuba, rapid progress was made - at least as measured by reports of yellow fever epidemics in the larger urban areas. Indeed, by the late 1920's, almost a year passed during which no cases were reported from anywhere in the Americas. In March 1928, however, the first cases of yellow fever in 20 years occurred in Rio de Janeiro and outbreaks rapidly spread across the country. At the same time, outbreaks whose sources were unclear occurred in Venezuela and Colombia. Doubts about the feasibility of yellow fever eradication began to be expressed and, with a failing anti-hookworm campaign, the Rockefeller Foundation came under severe criticism for its support of disease eradication programs. (18)

What had gone wrong? The Foundation turned to one of its promising young staff, Dr. Fred Soper, then 35 years old. He was subsequently to prove to be one of public health's most skillful administrators and a determined, articulate advocate of disease eradication as a public policy. Through his efforts, he dictated an international public health agenda and strategy which extended over the succeeding three decades.

Soper diagnosed the problem as being primarily one of failures in administration. Accordingly, Brazil's program was radically restructured. All personnel in the country working on yellow fever

were brought under a single National Yellow Fever Service which Soper himself directed. Detailed manuals were prepared and rigid discipline was imposed to insure that all premises in urban areas were meticulously searched and vector control measures applied. The meticulousness of the procedures is conveyed by the story of the health worker whose schedule called for him to visit an armory on a day when it exploded and burned. When the health worker appeared for work the following day, Soper expressed his pleasure that he was alive, but he promptly fired him for not having followed his prescribed schedule.

It was discovered that there were a number of rural areas in which yellow fever was endemic and that this was not a new phenomenon.⁽¹⁹⁾ As with the hookworm campaign, few efforts had been made in the program to measure with accuracy the effect of the massive field programs on the occurrence of the disease itself. Not until 12 years after the yellow fever eradication program began were efforts made to establish a disease surveillance program.⁽²⁰⁾ It was a omission but one which has continued to plague most of our efforts to control human disease.

It was found that there was a jungle reservoir of the yellow fever virus and that interruption of virus transmission was impossible. Soper's highly disciplined, all but autonomous Army, however, was recording extraordinary successes. In some areas, it was able not only to reduce *Aedes aegypti* breeding to low levels, it succeeded in eliminating the vector itself. The eradication of yellow fever was impossible but Soper proposed a bold new

initiative, the eradication of the species, *Aedes aegypti*.⁽²¹⁾ The scientific basis for so doing was even weaker than for yellow fever eradication. Moreover, the Brazilian government did not immediately agree, and the Rockefeller Foundation objected although it continued to provide reluctant support. Soper, however, pressed on.

Eradication of a Second Insect Vector - *Anopheles gambiae*

There the whole matter might have rested had not the African mosquito *Anopheles gambiae* been introduced into northeast Brazil.⁽²²⁾ This occurred in the 1930's soon after a rapid mail service had been established between the north eastern port of Natal and Dakar in Senegal. This African mosquito is an efficient vector of malaria and major epidemics soon gradually spread across two of the northeastern states of Brazil.

Soper correctly foresaw the problems that this vector could pose for the Americas and so proposed that an *Anopheles gambiae* eradication effort be launched. Many saw this as yet one more excuse to prolong the life of Soper's vector control army. Reluctantly, the Foundation provided yet more funds and an anti-malaria service was constituted by Presidential decree with Soper, of course, at its head. Four thousand workers were employed.

The *Anopheles* vector was a greater challenge as it bred more widely, especially in the rainy season. Soper's strategy was to determine the boundaries of the infected area and to cordon it off. All boats and vehicles leaving the area were fumigated. During the

dry season, when the number of breeding sites diminished in number, Paris green was applied to the breeding sites and pyrethrum sprayed in the houses. Amazingly, the last focus of the mosquito was discovered in November 1940, less than two years after the campaign had begun.

It was a brilliant achievement from which Soper drew a number of far-reaching conclusions.⁽²³⁾ Most important was his belief that the eradication of selected vector species was entirely feasible, as was the eradication of certain infectious disease agents. Success, as he saw it, lay in "vigorous and effective action rather than refined measurement of the problem." He had no malariologists on his staff and saw no need for them. The major constraints of disease eradication, as he saw it, lay primarily in the lack of vision of health administrators rather than in the lack of appropriate technology. With a meticulously executed field program, directed by dedicated and imaginative staff, the inconceivable could become possible.

Following the war, Soper, still the enthusiastic eradicationist, became director of what is now called the Pan American Health Organization. One of the first acts of its Directing Council was to agree that PAHO should undertake the eradication of *Aedes aegypti* throughout the Americas.⁽²⁴⁾ Three years later, the Council was persuaded to approve eradication programs against yaws, smallpox and malaria. PAHO's resources, however, were so limited that even one eradication program was beyond its reach. Soper's interest and expertise lay in vector

control and so neither yaws nor smallpox eradication was vigorously pursued. The stage was set, however, for the next great adventure in eradication - a program to eradicate malaria.

Malaria Eradication

DDT was discovered in the early 1940's and where widely applied, it had had a profound effect on malaria morbidity and mortality. In Venezuela, for example, mortality rates plummeted from 179 to only two per 100,000 in just four years.⁽²⁵⁾ A Center in Atlanta for Malaria Control in War Areas began using DDT around military training areas in 1945 and later was given responsibility for a major national program for malaria eradication.⁽²⁶⁾ Malaria transmission ceased in the United States, an event which encouraged the eradication initiative. However, Langmuir was to discover surveillance data were seriously deficient until the 1950's and, based on later evidence, it is probable that transmission had actually ceased, or nearly so, before the national program began.⁽²⁷⁾ Screening and the Flit gun had already done the job.

These and other successes, real or imagined, fired the imagination of the eradicationists with Soper their chief spokesman. Thus, PAHO began a regional malaria eradication program.

Substantial bilateral resources were made available through U.S. foreign assistance but far from enough. Greater support was

The eradicationists argued for a massive international effort to be undertaken as an emergency measure to eradicate malaria before the problem of resistance became widespread.⁽²⁸⁾ To those who doubted its feasibility, Soper quoted the President of the U.S. National Malaria Society who said in 1945, "Malaria eradication in the U.S. is an untenable concept as we do not know where and under what conditions the disease occurs."⁽²⁹⁾ Only a few years later, it became apparent that, even as he spoke, the interruption of transmission in the U.S. was already imminent.

In 1955, WHO embarked on a global program for malaria eradication. The fact that its Director General, Marcelino Candau, had grown up in Soper's vector control program in Brazil gave the program a special impetus. The visionary goal was doubted by a number of scientists^(30,31) but uncritically welcomed by politicians and international agencies alike. They supported it as no other international health program before or since. Over the decade 1955-1965, WHO malaria staff posts increased to more than 600. One estimate prepared by AID indicates that \$1.4 billion was expended during a 10-year period.⁽³²⁾

The genesis of the program rested more on a foundation of evangelistic commitment than upon sound science or empirical experience. Illustrative is the fact that in 1953, Dr. Brock Chisholm, then in his last year as WHO Director-General, had proposed a smallpox eradication campaign.⁽³³⁾ However, delegates from disparate areas objected. Included among these were delegates from the USA, United Kingdom, India and Australia. They said

delegates from disparate areas objected. Included among these were delegates from the USA, United Kingdom, India and Australia. They said "insufficient knowledge was available, that the problem was vast and complicated and that a world-wide machinery for such a campaign was not then available." Only one year later, under the new Director-General Candau, the smallpox proposal was buried, but that same year the goal of malaria eradication was adopted by the World Health Assembly - one which was vastly more costly and complicated.

The organization and strategy of the program echoed that of the great *Aedes aegypti* programs of the 1920's and 1930's. A separate and autonomous malaria eradication service, entirely independent of the health authority, was called for, which would have no other duties than those concerned with malaria eradication.⁽³⁴⁾ Higher pay scales than those in the health service were provided in order to attract the best staff. The numbers involved were enormous. In some countries they outnumbered the total of all other health personnel. Not surprisingly, the health staff resented the more affluent and well-equipped malaria service.

Highly detailed, standardized manuals of procedures were developed which described in minute particulars the duties of every person on the staff. The strategy focused on the application of DDT to the walls of dwellings. Traditional methods of mosquito control such as drainage and larviciding were largely abandoned - as was research. The problem was perceived in Soper's terms to be

primarily one of meticulous administration and application of known measures.

Through the early 1960's, reasonable progress could be documented. This progress however, was confined largely to the more affluent countries and those where year-round mosquito breeding did not take place. By 1966, it had become apparent that the program was lagging seriously in many countries and that the very costly measures of the so-called "attack phase" would have to be extended over many additional years.⁽³⁵⁾ Four years later, international confidence and support had begun to diminish, and by 1973 the demise of the malaria eradication program had been officially acknowledged. Jeffrey, one of its senior statesmen, ruefully pointed out that "The science of malaria control, developed slowly and painfully from the beginning of the century to a relatively high level of sophistication, was almost overnight converted to the rather simplistic technology of malaria eradication, which basically required that one know how to deliver 2 grams of something to every square meter of a sometimes elusive interior wall."⁽³⁶⁾ A similar view was expressed differently by McGregor, who lamented the diminishing number of "malariologists" and the proliferation of "eradicationists."⁽³⁷⁾

The Impact of the Vector-control Eradication Campaigns

Of what relevance is this ancient history to today's challenges in international health, to the prospects for disease eradication or to the smallpox eradication campaign in particular?

These events, in fact, have a great deal to do with all of the above.

Bear in mind that during a 50-year period in the Americas, the dominant and pervasive international programs were those for vector control and/or eradication to address the problems of yellow fever and malaria. In most of Asia as well as in WHO, malaria eradication campaigns dominated health agendas and budgets for well over two decades throughout the formative years of their public health programs. They operated outside of the health service structure; their demands on funds both in international assistance and of national budgets were insatiable; and they were deeply resented. Those engaged were well-meaning and preoccupied with what was truly a major health problem but, in consequence, other community-based health programs received little attention and, indeed, were ignored or opposed by those who pursued the Holy Grail of global malaria eradication. National immunization programs were all but non-existent, sanitation schemes received little attention, and the development of basic preventive services was postponed until the "malaria eradication program could be integrated into the basic health services."

Given the extraordinary public expectations and the expenditures, it is not surprising that the collapse of malaria eradication had profound repercussions. The credibility of public health expertise was called into question. Illustrative of attitudes in the late 1960's was that of UNICEF, once a major supporter of malaria eradication, which withdrew its support and

refused later to contribute to smallpox eradication.⁽³⁸⁾ Most bilateral agencies responded similarly. Dislike and perhaps jealousy of the autonomous malaria programs and their better paid staffs led many in the health services to reject out of hand all other categorical programs, however structured. Family planning and smallpox eradication were both recipients of this backlash as were later immunization programs and those for oral rehydration therapy. Categorical programs of whatever stripe were suspect and so, for many years, we labored in the gray twilight of policies designed to promote integrated primary health programs, few of which had stated goals. Meaningless interminable debates raged on all sides about "vertical" and "horizontal" programs.

Lessons from Smallpox Eradication

As I reflect on the implications which smallpox eradication has had for the future, I believe that most important, it retrieved a needed focus and direction for meaningful public health policy and gave an impetus to many countries to undertake other targeted community-wide prevention initiatives. Operating within and as part of the health services structure, the program embraced an important shift in strategy - from autonomous armies of vector-control technicians meticulously following manuals to more flexible, community-based prevention programs adapted to work within existing health structures and sociocultural realities. It is now echoed in the expanded program of immunization, family planning, oral rehydration therapy, Vitamin A supplementation and

others. An answer as to how and why these developed and flourished is partially provided by the question put to me two years ago by the Director-General of WHO and the Secretary-General of UNICEF. They asked: "Where do we find the next generation of capable field staff?" I innocently asked as to which was the last generation. They said - "Why the smallpox eradication staff, of course, but they are now fully engaged in senior positions in these other programs."

The foundation and structure of the smallpox eradication program was built by younger people who were given support, a challenge and a goal as well as an opportunity to innovate and to learn. The goal was a specific one - zero cases of smallpox. It was an outcome objective which required surveillance. In undertaking surveillance, much was learned about the epidemiology of the disease and how and where programs worked and how and where they didn't. If this bears a resemblance to the practical application of epidemiology in disease control and to the Epidemic Intelligence Service which Langmuir fostered, this should be no surprise given the training which many of us received. Notably, however, the program bore little resemblance to the many mindless programs which even today do no more than count the numbers vaccinated or procedures performed, which estimate coverage rates and recipients of services but wholly ignore whether or not disease incidence is or is not actually diminishing.

Smallpox eradication embraced one other important feature. It was a targeted program whose objective and progress could be

understood by politicians and the public alike. To quote a well-known public health director, "The point is too often missed by public health administrators that theirs is a selling as well as an administrative job.⁽³⁹⁾ Selling an understandable and specific product is a wholly different problem than selling a vaguely defined but perhaps no less worthy general improvement in a system. Deans know only too well that they can far more readily obtain funds for research on or treatment of a disease than they can for the School's general endowment. Quite candidly, there is little interest in a program which vaguely proposes to develop the basic health services.

The Future of Eradication

Not surprisingly, there is renewed interest in disease eradication,^(40,41,42) some sort of effort which would galvanize attention, garner funds and mobilize efforts. Such efforts began with hookworm eradication, migrated to yellow fever, then to *Aedes aegypti*, and finally to malaria. In each instance, these decisions, as I hope I have illustrated, were driven more by evangelism than by science, by emotions more than by reason, by the belief that answers lay in diligent administration rather than good epidemiology and innovative research, by the belief that it was better to try and fail than not to try at all. By the time smallpox eradication emerged, the most feasible of all programs, public health credibility was at a low ebb. We have recaptured some of that credibility.

Today, there are those who would have us embark on new eradication campaigns - measles, poliomyelitis, Guinea worm - and, yes, even such as tuberculosis, leprosy, yaws, hunger and who knows what other problems. Any and all can be considered and I support that effort. Before embarking on such programs, however, let us examine first the science and empirical experience because important policy and resource allocations are implied.

We as public health professionals can ill afford to again squander our credibility in ill-founded delusions rather than realistic dreams.

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