DISEASES of the CHEST

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30,000 Per 100,000*

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The time has arrived when every physician, whether in general practice or a specialty, should actively engage in the tuberculosis eradication movement. In the history of man, the present moment offers the greatest hope for the ultimate eradication of this disease. It is no longer a problem of inability to diagnose early, to treat successfully in most instances, or to prevent its spread. These are reasonably well in hand. The current problem is the prevalence of tuberculosis. Even in so-called low incidence areas, more people have tuberculosis in some stage of its evolution than any other major disease.

The most serious disease scourge of mankind since the dawn of history, tuberculosis, wreaked destruction among animals and people until the present century. No effective weapon against it had been found. It long ran neck and neck with malaria as an incapacitator and killer. With the use of effective malaria control measures, tuberculosis is in bold relief as the cause of incapacity and death among the 2,400,000,000 people of the world. However, in a few places phenomenal accomplishments have been made in the last decades.

Mortality

When this century opened, almost 200 persons per 100,000 population in the United States were dying annually. However, the efficacy of education, sanatoriums, and control among animals soon became manifest. Mortality rates decreased, reaching 10.2 per 100,000 in 1954. In recent years, the age distribution of deaths is significant. The number of deaths among persons 25 years or younger decreased markedly. From 60 to 75 per cent of the deaths have been occurring among persons of 40 years or older, and approximately 40 per cent among those of 65 and older. These persons

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belong to that generation which received almost no protection against tuberculosis bacilli as infants and children. They are like the generations which preceded them, when approximately 100 per cent became infected during childhood. For this generation (now the older people, 40 or above) the sanatoriums were built. They paid the price in loss of life, which caused mortality rates to soar. They paid the price in prolonged incapacity which filled sanatoriums and left large numbers to be cared for in homes. They paid the price by infecting their children and other associates, many of whom were doomed to illness and death. The surviving members of this older generation are now contributing a preponderance of the deaths from tuberculosis annually. Apparently these older people are breaking down and dying from tuberculosis they contracted in childhood. They have ever since harbored tubercle bacilli in necrotic tissue. What happened to large numbers of the present older generation earlier in life is still happening to survivors, namely, the unleashing of their tubercle bacilli, resulting in clinical disease. Present phenomenally low mortality rates in the younger age groups show the effectiveness of effort against tuberculosis which has resulted in protection against infection.

**Morbidity**

When at the opening of this century the mortality rate was in the neighborhood of 200 per 100,000 population, the number of clinical cases was only estimated. There probably were approximately 10 such cases for every death, a case rate of about 2,000 per 100,000 population. As mortality began to decline, there was a corresponding decrease in morbidity which had reached 48.8 per 100,000 in 1955. Several factors now operating could markedly change morbidity rates. Evidence is accruing to suggest that antituberculosis drugs do not have the permanent effect as was earlier predicted. Therefore, persons thought to have been "cured" are still harboring organisms which may still result in reactivations of old lesions and development of new ones. Indeed, this is already in evidence on a large enough scale to cause alarm.

**Divergence of Mortality and Morbidity Curves**

In 1920, the number of newly reported cases of tuberculosis in some places does not appear much higher than those in 1955. A casual glance at the figures could lead to an erroneous interpretation. The situation in 1920 was markedly different from that in 1955. In 1920, the vast majority of cases reported were sick people. They went to their physicians, clinics, etc. because of symptoms. This was before it was generally known that chronic tuberculosis usually passes through a long silent period when it can be detected, if sought, in apparently well people. If methods of finding the disease before symptoms appeared had been in practice in 1920, the number of cases reported that year could have been well-nigh doubled. By 1955, apparently healthy people were being examined for tuberculosis in the offices of physicians, in hospitals, clinics, and mass surveys, and many persons without symptoms were found with evolving disease and were reported. If only those who sought assistance because of symptoms had
been considered in 1955, the number of cases probably would have been less than half of the total number reported.

Since 1947, antituberculosis drugs have been used extensively and so suppressed tubercle bacilli that many tuberculous persons were still alive in 1955, who without these drugs would have died. Thus the number of such persons still living has increased. While mortality rates decreased precipitously, case rates declined as usual. Among infected persons, the annual crop of gross disease evolved just as it had in previous years. If a drug had been available which could have destroyed tubercle bacilli in the necrotic lesions from which new disease emanates, the case rate could have dropped as rapidly as the mortality rate. Without such a drug, as much gross disease developed percentage-wise among infected persons as at any time in history. The decrease in number of cases which did occur was the result of earlier control measures which reduced the incidence of infection. The smaller the number of infected persons, the fewer gross areas of disease develop.

Magnitude of Problem Not Determined by Mortality and Morbidity Rates

In determining the magnitude of the tuberculosis problem, mortality rates have never been satisfactory criteria for such reasons as: 1) Many persons who have known clinical and even contagious tuberculosis do not die from this disease; 2) Many with unrecognized clinical tuberculosis die from other acute and chronic conditions; 3) In recent years, antituberculosis drugs have at least postponed deaths from tuberculosis on a large scale, and thus mortality rates have decreased precipitously without significant change in other phases of the tuberculosis situation.

With the rapid decline in death rates from tuberculosis, obviously a sense of false security on the part of the public was sure to emerge. To overcome this situation, much emphasis has recently been placed on morbidity rates, which are less reliable than mortality rates. For example, reporting of clinical cases has rarely been satisfactory as evidenced by the number of which health departments are first notified by death certificates. Also, there is marked disparity in reporting. In some places only proved active clinical contagious cases are reported, while in other areas, almost any pulmonary abnormality is recorded as a case of tuberculosis. Mass x-ray surveys have resulted in much reporting of this kind. In 1955, in the United States, 78,618 new cases were reported under the category of active or probably active. Obviously, the probably active cases were not well documented in that tubercle bacilli were not recovered and the question as to how many of them were tuberculous is justified. It is well known that persons are still reported and sent to sanatoriums as tuberculous whose disease proves to be malignancy, sarcoidosis, etc. Recently, enough cases of pulmonary histoplasmosis were found in one sanatorium where they were being treated for tuberculosis to warrant the estimate of 1300 such cases now in sanatoriums in the histoplasmosis endemic area. Among 24 persons being treated in a hospital for tuberculous pleurisy with effusion, thoracotomy and biopsy revealed that nine were nontuberculous.
Accomplishments of Veterinary Profession

To date man's greatest victory over tuberculosis has been accomplished by the veterinary profession and its allies. Between 1890 and 1916, they acquired the fundamental information that made this achievement possible. Despite almost intolerable opposition at times, they pressed forward with a tuberculosis eradication program, which began in 1917. The year before, at the points of federal inspection, 40,746 cattle were condemned as inedible because of tuberculosis. In 1953, only 391 animals were so condemned, a decrease of 98.6 per cent. In 1916, one year before the nationwide eradication program began, enough cattle were condemned by federal inspectors to make a 15-mile solid train load of live cattle. In 1955, such animals could be accommodated in a train less than 0.3 mile long.

From 1917 to 1955, 369,606,820 tuberculin tests were administered to cattle of this country and the 4,034,297 reactors were slaughtered. The veterinarian's accomplishment has been phenomenal. By 1955 he had reduced the incidence of tuberculous infection among the cattle of America to 0.12 per cent. There is evidence to indicate that some of the relatively few animals which now become infected annually receive their tubercle bacilli from human associates rather than from other cattle. There are large areas in this country where no infected animal can be found.

The bovine type of tubercle bacillus was found capable of producing just as disabling and killing disease among people as the human type. In countries which have not controlled tuberculosis among the cattle herds, the bovine type of tubercle bacillus continues to wreak havoc among children and young adults, causing 50 per cent or more of all cases of tuberculosis of the skin and peripheral lymph nodes, 20 per cent of tuberculous meningitis and miliary disease, and 1 to 6 per cent of the cases of pulmonary tuberculosis.

Veterinarians have also done much to prevent tuberculosis in people by controlling it among other domestic animals and pets such as dogs, cats and parrots.

Wherever tuberculosis has been controlled among cattle there has followed definite decrease in infection attack rates, mortality and morbidity among people of the same areas.

A New Era Has Dawned

By the old definition, tuberculosis was considered present only when gross lesions were detectable by x-ray shadows, had resulted in illness, or tubercle bacilli were recoverable. All the stages in the evolution of the disease, from the initial invasion and focalization of tubercle bacilli to the presence of extensive disease, were ignored. Failure to find lesions in many tuberculin reactors by physical examination, including x-ray film inspection of the chest, led to the erroneous deduction that most reactors have infection but no disease. It was the minuteness and location of lesions that so long deceived physicians. Ghon3 clarified this situation in the second decade of the present century by meticulous necropsies on the bodies of 184 persons who during life had no evidence of tuberculosis except the
tuberculin reaction. Detection of some of the pulmonary foci was “a very

difficult task and often required considerable time.” He also said, “The

smallest foci were scarcely found at all in the cases with anatomical healing.

This fact is of importance; it explains to us why it is often difficult to find

such foci . . .” Ghon’s observations, together with the vast post-mortem

experiences of veterinarians in the United States on apparently healthy

animals (more than 4,000,000) slaughtered because they reacted to tuber-

culin, leave no doubt that, where there is infection manifested by the tuberculin reaction, there are lesions. In reality, therefore, the tuberculin

reactor has tuberculosis.

This is the era of eradication of the tubercle bacillus. In the past, most

funds, time, and effort have been spent on finding and trying to repair

damage produced by the tubercle bacillus. When the 20th century opened,

such inroads had been made by this disease that the ill and the dying de-

manded every attention that could be mustered. The work was done so

well and the disease is now so in hand that the era of tubercle bacillus

hunting and destruction is upon us. The medical profession and its allies

are now in possession of all the necessary information and have at hand

the armamentarium to eradicate tuberculosis.

When Tuberculosis Begins

The evolutionary processes from the initial invasion of the human body

with tubercle bacilli to death of their victim are known. In the earlier

years of effort against this disease it was thought to begin when symp-

toms were first in evidence. This opinion had prevailed since the days of Hippo-

rates. With the extensive use of the x-ray film, beginning in the early

1920’s, many persons were seen who had shadow-casting lesions which

later proved to be tuberculous, yet symptoms were absent. Therefore, it

was said that the x-ray film finds tuberculosis at its beginning. Later,

extensive and prolonged observation showed that x-ray shadows often do

not appear until years or decades after the disease has been present, and

in a great many people the x-ray film never reveals evidence of disease,

although it is present in abundance.

Experimental work has shown that tuberculosis begins within an hour

after the invasion of tubercle bacilli. In that time organisms introduced
directly into the blood streams of animals have been phagocytosed by white

blood cells (neutrophils) and focalized.

Focalization and subsequent tubercle formation occurs in many places

in the body simultaneously. Some may be in the brain, spleen, liver, kidneys,

bones, joints, etc. More are likely to lodge in the lungs than anywhere else

because of their numerous small capillaries. Thus the established micro-

scopical foci of tubercle bacilli are multiple and any one or more of them

may at some subsequent time result in destructive disease.

Diagnosis

During the first weeks of the existence of tuberculosis, the tissues of

the body including the skin become sensitive to tuberculoprotein. This

sensitivity, also known as allergy, can be detected by the reaction to tuber-
tuberculin within three to seven weeks after the initial invasion of tubercle bacilli. The sensitivity of the tissues persists as long as tubercle bacilli remain alive in the body. Therefore, by the tuberculin reaction the physician diagnoses tuberculosis while lesions are still microscopical.

In many persons who develop these minute lesions, the disease never progresses to clinical proportions. However, everyone who does develop clinical disease passes through the stage when no phase of the most complete examination reveals its presence except the tuberculin reaction.

The old theory that persons with tuberculous infection as manifested by sensitivity to tuberculin walk in a charmed circle of safety, has been replaced by the fact that such persons walk within the circle where all illness and death from tuberculosis occur.

As yet, we have no way to determine which persons who react to tuberculin will at some subsequent time develop clinical disease. Therefore, everyone who is found to be a reactor should have those parts of the body which clinical tuberculosis frequents examined periodically. If the individual is in infancy, the parents should be instructed to inform the physician at once if symptoms appear suggestive of miliary or meningeal tuberculosis.

If the individual is in early childhood, one must watch for extrathoracic lesions, particularly those of bones and joints, and especially the spine, hip and knee joints. Only rarely does chronic pulmonary tuberculosis develop in children. Among individuals approaching adolescence or who are in later periods of life, including old age, the lungs must be examined periodically. Throughout adulthood, 10 to 15 per cent of clinical tuberculosis develops extrathoracically.

Inasmuch as 85 to 90 per cent of clinical tuberculosis develops in the lungs of adults, it is important that every adult tuberculin reactor be alerted to the necessity of periodic examinations. However, these should always include but never be limited to x-ray inspection of the chest.

By x-ray film inspection one is able to detect chronic gross clinical lesions earlier in their evolution than by any other phase of examination. These chronic lesions usually evolve slowly so six to 12 months intervals between examinations are adequate. Among those persons in whom such lesions are destined to evolve, they can often be found by the shadows they cast long before symptoms appear and before they are contagious. As yet, we have no method of preventing such lesions from evolving in a considerable percentage of infected persons and, obviously, our only recourse is to find them as early as possible.

Values of the Tuberculin Test

1. When the disease is found by the tuberculin test as soon as the tissues have become sensitized, one has made the earliest possible diagnosis of tuberculosis. This is usually long before symptoms or x-ray shadows are in evidence, or contagion is present. Knowing that tuberculous lesions containing tubercle bacilli, even though microscopical, are present places the physician on the alert and makes it mandatory that the individual, regard-
less of age, be kept under close observation for the earliest possible evidence of clinical lesions that may evolve.

2. Finding tuberculosis soon after allergy appears enables the physician and the health officer to locate the source of the infection in adult associates much more often than by any other method. There is nothing more fascinating in medicine than picking up the trail of tuberculosis by the tuberculin test and following it to its headquarters in the body of a person or an animal.

3. By finding tuberculosis promptly after allergy appears the physician and the courts should be able to place responsibility for the individual's infection. In many places tuberculosis is now compensable for such groups as industrial workers, students, interns, residents and other employees of hospitals. The industry or institution that permits its employees, students, or other personnel to be infected in line of duty is in reality responsible for the clinical tuberculosis which may subsequently develop.

4. Keeping persons recently infected under observation by periodical examinations enables the physician to find those destined to develop clinical reinfection type of pulmonary disease while lesions are small, before they have caused symptoms or become contagious and when they can be treated successfully. Moreover, it is possible that the tuberculin test may determine the time to treat tuberculosis with antituberculosis drugs, with the hope of actually curing the disease and thus avoiding much destruction of tissue, illness, or death. This refers to recent converters whose lesions are microscopical and vascular. It depends upon whether present or future drugs prove to be germicidal. If so, in such cases, the tuberculin test may determine when sufficient treatment has been administered. When all bacilli have been destroyed, the individual's tuberculin sensitivity should revert.

5. The tuberculin test determines the magnitude of the tuberculosis problem in any group of people since it readily detects those who are harboring tubercle bacilli, and it is they who constitute the problem.

6. The effectiveness of a tuberculosis control program can be determined accurately and with reasonable promptness only by the tuberculin reaction. Testing all with tuberculin before the program starts fixes the base line. Five years later testing the children born since the program began determines whether they have been better protected than those of the same age preceding the program.

*The Present Problem and Its Solution*

Tuberculosis constitutes an important item in our national defense. There is no other major disease with such a strong foothold among our citizenry. Failure to take full cognizance of this fact in World Wars I and II, the Korean War, and other military activities proved extremely destructive to those involved and to the nation.

Tuberculosis is said to be costing this country $600,000,000 annually. If all costs were considered, including loss of time of patients and deaths, the actual amount would be at least five times this estimate.
In 1954, 16,392 of our citizens died and in 1955, 78,618 active or probably active new cases of tuberculosis were reported.

If eradication is to be our goal, locations of tubercle bacilli must be known and the attack begun against them. If we continue to consider only the mortality rate of approximately 10.2 per 100,000 or the "case" rate of about 48.8 per 100,000, with an estimate of 500,000 "cases" in the entire country, eradication will never be achieved. The numbers of deaths and so-called cases being reported annually are no longer enough to insure continuing interest and support of the public in this disease. If the estimate of 500,000 so-called cases were accurate, it represents only approximately 3/10 of 1 per cent of our entire population.

Our sights must be raised and precise aim taken at the tubercle bacillus rather than the gross disease it produces. The only unerring method of determining the magnitude of our present and future situation consists of determining where the remaining tubercle bacilli are by finding with the tuberculin test those who are harboring them. Although testing has been extremely limited, particularly among older adults, enough has been done to indicate that approximately one person in three is now harboring tubercle bacilli. Each one of these persons, regardless of apparent good health or clarity of x-ray films of the chest, has areas of disease containing tubercle bacilli. Thus, in the strict sense of the word, each one is a case of tuberculosis, and many who do not already have gross areas of disease will have such lesions evolve before their spans of life are completed. Therefore, we should now inform our citizenry that the case rate is 30,000 per 100,000 of our population. The exact rate for each area can be determined only by testing the entire population with tuberculin. In some counties in the upper midwest where such testing has been done, the case rate has been found to be 22,000 per 100,000. There are probably areas where a lower rate obtains, and most likely there are parts of states, particularly large cities, with definitely higher rates.

Only Successful Methods

In those parts of the world where tuberculosis has been so dramatically reduced over the last few decades, certain operations against the disease have been almost universally employed. These have consisted of good diagnostic work, isolation of contagious cases, best available treatment, and protection against the bovine type of bacillus. This result also is seen in parts of the same countries or certain population segments, notably those hospitalized for mental illness and the American Indians, where tuberculosis was rife until the above factors were introduced.

Wherever the above procedures have been even reasonably well operated for the past few decades, their effectiveness has been so apparent that such areas now stand in bold relief on the world map. It appears to have made no difference how little or how much else was done. Moreover, in parts of the world where these procedures were not in operation but other methods were employed, the decrease in tuberculosis has not been outstanding.

Methods that have been responsible for such marked reduction in
tuberculosis and which probably are adequate to eradicate the disease are now on such sound footing that the medical profession around the world can take a cue from them.

Physicians Must Take Initiative

Physicians should promptly assume leadership since they must do the diagnostic and therapeutic work. However, the solution of the problem will require every possible ally as Osler indicated in a "last word message" to the general practitioner. "The leadership of the battle against this scourge is in your hands. Much has been done, much remains to do. By early diagnosis and prompt, systematic treatment of individual cases, by striving in every possible way to improve the social condition of the poor, by joining actively in the work of the local and national antituberculosis societies you can help in the most important and the most hopeful campaign ever undertaken by the profession."

FIGURE 1: Each of the 166 figures represents a million persons. On the basis of the small amount of tuberculin testing done it is estimated that about 30 per cent (shown in black) of our 166,000,000 people are harboring tubercle bacilli.
Our allies must be supported to the nth degree. They include every citizen. Lack of information about tuberculosis, misunderstanding, and the like have resulted in complacency on the part of many individuals and even organizations. Just now, this is resulting mainly from the marked decreases in mortality and morbidity. Never in history has such a powerful and effective group of people banded together to fight a single disease as those of the National Tuberculosis Association with its 3,000 component state and local societies. This organization delivers messages to the people in every nook and cranny of this country. More than any other group, it is qualified to inform our citizenry of the magnitude of the tuberculosis problem which is less than half solved. Dissemination of such information is essential if physicians are to have complete cooperation in conducting the necessary professional work.

Tuberculin testing the 166,000,000 citizens in this country is well within the realm of physical possibility, and it is essential if eradication of the tubercle bacillus is our goal (Figure 1).

The program now becomes one of refinement in tracking down tubercle bacilli and keeping them corralled. The magnitude of the problem demands greater activity than has yet been seen in the tuberculosis eradication movement. It will require larger funds and more workers, as the entire citizenry must be informed to insure cooperation in the fight against the tubercle bacillus rather than just the damage it causes. Nurses and physicians everywhere, and particularly those in general practice, must be in the campaign. Indeed, they will need to do the lion's share of the work, and they are capable of doing it. There are over 200,000 physicians in this country, of whom 90,000 are in general practice. Trudeau's appraisal (1905) "On the general practitioner and the dispensary physician rests a great responsibility of detecting the disease in its incipiency. It is to them and not to the specialist that the patient first applies" is as applicable today as when it was written.

There are more than one-half million registered nurses in the United States who can do a large volume of work. In physicians' offices and clinics, nurses give hypodermic injections and intradermal tests. There is no reason why they should not administer tuberculin tests in a national program. In fact, they have already been assigned this responsibility and are carrying it out in many places in this country. With good organization and some experience, one person can administer 300 intracutaneous tuberculin tests per hour with ease.

When tuberculin testing is done, reactors need to be examined, including x-ray film inspection of chests of adults, not forgetting that 10 to 15 per cent of all clinical tuberculosis develops extrathoracically. Among tuberculin reactors one would expect 1 per cent or less to show evidence of clinical disease on first examination. Some of these persons are already contagious and need to be managed accordingly. Others have evolving lesions that have not yet become contagious which can be promptly controlled. The remaining 99 per cent have lesions, but most of them are
not now large enough or do not have the consistency to cast visible x-ray shadows. Some have lesions which are located in the 25 per cent of the lungs not visualized on usual films, and in others lesions are located extrathoracically.

From this 99 per cent an annual crop of evolving clinical lesions will have to be harvested. This necessitates periodic examinations of all reactors. Laments of tuberculosis workers have long been heard because such a high percentage of persons had the disease in an advanced stage when first found. Among the 78,618 active or probably active cases reported in the United States in 1954, 78 per cent were in an advanced stage (Figure 2). The solution of this problem consists of finding the individuals who are harboring tubercle bacilli and examining them periodically. This has been done in sufficient volume and over long enough time to leave no doubt as to its efficacy. It results in finding 95 per cent of chronic lesions destined to evolve while they are minimal, before they have caused symptoms, before they are contagious, and when nearly all can be treated successfully and returned to usual activities of life in a relatively short time (Figure 3).

Children and adults alike who have not been infected and therefore do not react to tuberculin must be retested periodically. Among those who are found to convert to tuberculin reactors, destruction of all their bacilli with antituberculosis drugs may become possible. If not, they must be re-examined periodically like those who reacted on first examination.

**Precedents Established**

The medical profession is now in position to render an outstanding public service. Already in a few places physicians have demonstrated their

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**FIGURE 2:** When the tuberculin reaction is ignored. A. From roentgenogram taken December, 1923 of chest of a 12 year old girl. No evidence of significant shadow-casting lesion. Annual film inspection for five years. No change. Thereafter connotation of tuberculin reaction ignored. B. From roentgenogram taken June, 1947 of same chest after symptoms appeared. Lesions proved to be those of advanced contagious and fatal pulmonary tuberculosis.
ability to contribute such service. In Meeker County, Minnesota, in 1941
the medical society set out to control tuberculosis. They instituted a county-
wide demonstration. During this demonstration period, they made the
necessary time and effort a gift to the citizenry of the county. No charge
was made for administering and reading the tuberculin test, exposing,
developing, and reading x-ray films, or completing examinations when
indicated. This demonstration revealed that about 22 per cent of the citizens,
mostly older people, were harboring tubercle bacilli. Among them, 16 were
found to have clinical tuberculosis.

This public service greatly increased the confidence of the citizenry in
its medical profession. It demonstrated that local physicians are capable
of doing modern tuberculosis work. It squelched those who believe and
teach that physicians are interested only in fees.

During the demonstration period, the public was informed that all
persons who did not react to tuberculin should have the test repeated at
least annually, while all who reacted then or subsequently should be ex-
amined at least once a year for the detection of clinical lesions which might
evolve. Ever since the demonstration closed, a great many people from
Meeker and adjacent counties have gone periodically to physicians' offices
and hospitals as private patients to have tuberculin tests, x-ray films, or
whatever was recommended.

The physicians of three other counties in the same state have since
conducted such demonstrations. Another has just been completed in Hast-
ings, Minnesota, with a population of approximately 7,000. There 90 per
cent of the entire citizenry responded for tuberculin testing which was
done without charge by the local medical profession. X-ray films of chests
of reactors were exposed, developed, and read at cost.

Another excellent example of such work is that of the St. Louis Academy

FIGURE 3: When the tuberculin reaction is heeded. A. From a roentgenogram taken
August, 1945 of the chest of a man of 22 years. At age 14 he reacted to tuberculin.
Annual x-ray films of chest including this one were clear. B. From roentgenogram
December, 1946. Note small shadow-casting lesion left apex. Tubercle bacilli re-
covered from stomach washings. Brief period of treatment. No manifestation of
clinical tuberculosis since. Nearly all chronic pulmonary tuberculosis can be found
in this stage by periodically examining tuberculin reactors.
of General Practice with approximately 200 members. In 1951, this Academy adopted tuberculin testing in schools as its main project. This has since been in continuous operation as a public service with 100,000 tests having been administered as of January 1, 1956. Examinations have been completed as indicated and sources of children's infections have been sought with considerable success.

The question is not whether physicians can afford to conduct demonstrations gratis but rather that they cannot afford to overlook such opportunities. It is an excellent way of securing and maintaining confidence, good will and support of the citizenry. These are the factors which are so needed in returning the greater part of the tuberculosis problem to the offices of local physicians, particularly those in general practice. When this is accomplished, we may expect the most effective attack of all time upon the tubercle bacillus.

Special Techniques to Hasten Eradication

Spot Maps. By tuberculin testing the people of any area are promptly divided into two groups: those who are and those who are not harboring tubercle bacilli. This places the subsequent attack on tuberculosis on a scientific and practical basis. The percentage of tuberculin reactors varies

FIGURE 4: Map of Kittson County, Minnesota, a so-called tuberculosis low incidence area. Dots indicate the residents of persons harboring tubercle bacilli as manifested by the tuberculin reaction.
somewhat from place to place. There are probably entire counties where
not more than one-fifth of the individuals, mostly in the upper age bracket,
will react to tuberculin. There are other areas where 40 per cent or more
may be infected, and likely the average for the nation is about one in three.

Formerly spot maps were produced indicating with thumbtacks where
persons had died from tuberculosis. Later maps were made to show where
clinical cases had been found. Now a map should be made for each of the
3,070 counties in the United States showing where each person resides who
is harboring tubercle bacilli as manifested by the tuberculin reaction. Miss
Mary Goddard, Public Health Nurse, Kittson County, Minnesota, in co-
operation with the local medical profession, the State Department of Health,
and the State Tuberculosis and Health Association has produced such a
map (Figure 4). She and coworkers know where tubercle bacilli now reside
in that county. Moreover, they know how to keep them corralled. Kittson
is a county of so-called low tuberculosis incidence since three "new cases"
were reported and one died in 1954. Indeed, there were only 13 persons
currently registered as having tuberculosis. Nevertheless, 2,100 persons
still harbored tubercle bacilli among Kittson County's population of 9,600.
In contrast, among the 15,526 cattle of the county, no tuberculin reactor
was found in 1954.

Certification of Schools. Techniques already in operation in several states
will hasten the solution of the problem. For example, the Committee on
Tuberculosis of the American School Health Association (A. O. DeWeese,
M.D., Executive Secretary, Kent University, Kent, Ohio) has devised a
method of working in schools which consists of officially certifying indi-
vidual and groups of schools that meet standard qualifications. As schools
qualify, the certificates are signed by the president and executive secretary
of the American School Health Association, the executive secretary of the
State Tuberculosis and Health Association, and the chairman of the state
subcommittee of the American School Health Association. This project,
which has been in operation for a decade, stimulates interest and activity
in tuberculosis eradication not only in the schools but in the entire com-
munity supporting them. It is not unusual for every person in the com-
munity to be examined for tuberculosis before the project is completed.
It has spelled the doom of the tuberculous teacher, bus driver, etc., as well
as students, particularly those of high school age, transmitting tubercle
bacilli to personnel and students. Its educational value is immense.⁵

In 1954 there were in the United States more than 16,000,000 pre-school
children. From five to 14 years inclusive, there were 27,118,000 children,
and from 15 to 19 years, 12,854,000. There were more than 1,000,000
professional and approximately 200,000 non-professional employees in
the schools of this country. The best kind of education comes through
actual participation of children and personnel alike. Opportunities are
unlimited among the children and the personnel members of our schools.
This group, which constitutes nearly one-third of our total population, can
promptly be converted into a mighty army against tuberculosis as its
members learn about the disease by participating in school programs.
Program Economically Sound

The soundness of this program economically is beyond question. Although additional funds are necessary to locate the tubercle bacilli and to keep them corralled, many times the immediate initial cost will be saved in reduced illness, death, etc., in both animals and people. A good example is the eradication program among cattle. It cost the owners of these animals $300,000,000 every ten years prior to the initiation of the national eradication program. It cost only $260,000,000 to reduce the disease so each state qualified for modified accredited rating. The present cost of the program, which is rapidly approaching eradication of this disease, is a mere fraction of what it was in the beginning. This country no longer has to expend vast sums of money in reimbursing owners of cattle for those condemned to rendering tanks. Funds are now being spent more profitably to test and retest animals periodically and thus find most of those that have become infected before the disease is contagious and when little loss is suffered by owners.

Among humans, caring for the ill and dying will gradually be obviated and thus money and personnel can be transferred to more refined activities. Chronic pulmonary lesions that are detected as soon as possible after they start to evolve require much shorter periods of treatment than those of long duration and many of them do not need hospitalization. Most of them can be prevented from becoming contagious and thus the tubercle bacillus cannot perpetuate itself in other human and animal bodies.

The Goal

The ultimate goal is eradication of tubercle bacilli. Unless some method of destroying these organisms in avascular lesions in living tissues is devised, eradication of these organisms will be accomplished only by keeping them corralled in the bodies of people who now possess them as long as these individuals live. Thus, if from this moment no more new infections occurred, eradication is as far away in point of time as the death of the last person now harboring tubercle bacilli. It is true in this country that the vast majority of tubercle bacilli have taken refuge in the bodies of older people who will die within the next few decades. With their passing there will remain the relatively few infected persons who are now younger but in whose bodies bacilli must be kept corralled for the remainder of their lives.

Infants infected today may remain in good health through long lives but still may become clinical and contagious cases of tuberculosis in senility from progeny of tubercle bacilli which invade their tissues today. Thus, if infants are infected now, the tuberculosis eradication goal is no nearer than it was when this century began.

Eradication of tubercle bacilli must apply to the three now known pathogenic types—human, bovine, and avian. Each of them produces clinical disease in more than one species of animals and all cause such disease in people. It is of little avail to eradicate the human type with the others extant and vice versa. Therefore, it is important that the medical profession
cooperate with the veterinary medical profession in the all out eradication movement.

Although veterinarians and their allies are approaching the bovine eradication goal and have attained it in many places, they continue to tuberculin test the entire cattle population of this country periodically. A. G. Karlson, D.V.M., Mayo Foundation, says: "An animal that reacts positively to the tuberculin test is properly considered as a dangerous individual . . . in spite of the great advances in control, there is a constant potential hazard as long as only a few infected animals exist." This statement is equally true of people.

We must agree with David T. Smith, M.D., Duke University, when he says that even in this country where so much has been accomplished, we have not even reached the halfway mark in our eradication program. The more difficult and laborious work remains to be done. Any tuberculosis association that sets eradication as its goal and is willing to do the necessary work will have plenty to do throughout the lifetime of every person now engaged in the work. Much will remain to be done by our successors.

Just as we strove through the decades of this century to drive downward the mortality rate from about 200 and the morbidity rate from 2,000 per 100,000, we must new strive to drive downward the case rate of approximately 30,000 per 100,000 population. Our future success must be measured in reductions of this real case rate, and the goal will not be reached in any community or state until there is no case of tuberculosis manifested by the tuberculin reaction.

SUMMARY AND CONCLUSIONS

In some parts of the world tuberculosis is now so well under control that its eradication is contemplated.

Here lies one of the great opportunities of the medical profession which possesses information and armamentarium to accomplish this goal.

With the tuberculin test all persons harboring tubercle bacilli can be identified. They have multiple lesions, some of which are large and can be located but most of which are microscopical. X-ray film inspection of chests reveals gross lesions but misses all others. Among the tuberculin reactors with clear x-ray films, many will have gross lesions evolve later. Therefore, periodic x-ray film inspections of their chests are necessary to harvest this crop while the lesions are minimal, asymptomatic, non-contagious, and most treatable. When periodic examinations are not done, late harvest yields a preponderance of advanced cases.

Tuberculin reactors have multiple tuberculous lesions even though they are well and present clear x-ray films of their chests. In reality, each reactor is a case of tuberculosis and must be managed as such to keep his tubercle bacilli corralled.

If tuberculosis eradication is desired, each community, county, and state should locate the existing tubercle bacilli which are in the bodies of people and animals who react to tuberculin and act accordingly.
Physicians must do the diagnostic and therapeutic work. Thus, they should initiate and perpetuate such work everywhere. Cooperation with all organizations and individuals is essential to insure community-wide participation. Precedents have already been set by medical organizations. Private offices of physicians can constitute our best tuberculosis eradication centers.

Tuberculosis eradication is a national defense measure, and the opportunity to accomplish it should not be overlooked by the medical profession.

RESUMEN Y CONCLUSIONES

En algunas partes del Mundo la tuberculosis se encuentra tan bien controlada que su erradicación ya puede avizorarse.

Esta es una de las oportunidades de la profesión médica que posee la información y el equipo para llegar a este objetivo.

Con las pruebas de tuberculina todas las personas que tienen en su organismo bacilos de la tuberculosis puede descubrirse.

Ellas tienen lesiones múltiples, algunas de las cuales son grandes y pueden localizarse, pero la mayoría son microscópicas.

La búsqueda por los rayos X, revela las lesiones grandes, pero omite el descubrimiento de otras. Entre los reactores a la tuberculina con películas radiológicas limpias, muchos tendrán lesiones gruesas más tarde. Por tanto, es necesaria la inspección periódica del tórax para sorprender las lesiones en su etapa mínima, asintomática no contagiosa y más tratable.

Cuando no se hacen exámenes periódicos las investigaciones más tarde rinde un volumen con preponderancia de casos avanzados.

Los reactores tuberculínicos tienen lesiones múltiples aunque estén bien y tengan radiografías normales. En realidad todo reactor es un caso de tuberculosis y como tal debe ser tratado paramantener sus bacilos acorralados.

Si se desea obtener la erradicación de la tuberculosis, toda comunidad, condado o estado debe localizar el bacilo tuberculojo que se encuentra en los cuerpos de los hombres y de los animales que reaccionan a la tuberculina y debe actuar sobre él.

Los médicos deben hacer el trabajo terapéutico y diagnóstico.

Así ellos deben iniciar y mantener tal trabajo en todas partes.

La cooperación con todas las organizaciones e individuos es esencial para asegurar una participación en toda la extensión de la comunidad. Ya hay precedentes establecidos por organizaciones médicas. Los consultorios privados de los médicos pueden constituir los mejories centros de erradicación.

La erradicación de la tuberculosis es una medida de defensa nacional y no debe pasarse por alto esta oportunidad por parte de la profesión médica.

RESUME

Dans quelques parties du monde, la tuberculose est si bien jugulée qu'on peut penser à son eradication.

Ici réside l'une des plus belles actions du corps médical, que possède les données et l'armement nécessaires pour arriver à ce but.
Avec la tuberculine, tous les individus porteurs de bacilles de Koch peuvent être identifiés. Ils ont des lésions multiples, quelques-unes sont très importantes, et peuvent être localisées, mais la plupart d'entre elles sont microscopiques. L'investigation radiologique des thorax décèle les lésions grossières, mais laisse échapper toutes les autres. Parmi les individus qui réagissent à la tuberculine, avec des radiographies normales, plusieurs auront des lésions importantes qui évolueront ultérieurement. C'est pourquoi les examens radiologiques systématiques sont nécessaires pour faire la moisson de ces cas alors que les lésions sont encore minimes, asymptomatiques, non contagieuses, et la plupart du temps curables. Quand les examens systématiques ne sont pas faits, la moisson suivante apporte une prépondérance de cas avancés.

Les individus réagissant à la tuberculine ont des lésions tuberculeuses multiples même s'ils sont bien portants et si leurs radiographies thoraciques sont normales. En réalité, chaque individu réagissant à la tuberculine est un tuberculeux, et doit être considéré à ce titre comme un réservoir de bacilles.

Si l'on désire l'éradication de la tuberculose, chaque communauté, région et état, devraient localiser les bacilles tuberculeux existant dans le corps des individus et des animaux qui réagissent à la tuberculine, et agir en conséquence. Les médecins doivent faire le diagnostic et le travail thérapeutique. Ensuite, ils devraient introduire et perpétuer partout cette activité. La collaboration de toutes les organisations et des individus est capitale pour assurer une large participation de la communauté. Des précédents ont déjà été créés par des organisations médicales. Les cabinets privés de consultation peuvent constituer nos meilleurs centres d'éradication de la tuberculose.

L'éradication de la tuberculose est un moyen de défense nationale et sa réalisation ne devrait pas être sous estimée par l'ensemble du corps médical.

ZUSAMMENFASSUNG UND SCHLUSSFOLGERUNGEN

In einigen Teilen der Welt steht die Tuberkulose heute so gut unter Kontrolle, dass ihre Ausrottung diskutiert wird.

Hier liegt eine der grossen Chancen für den ärztlichen Beruf, der Kenntnis und Rüstzeug besitzt, um dieses Ziel zu erreichen.

Mit Hilfe des Tuberkulin-Testes können alle Personen, die Tuberkel- bakterien beherbergen, erfasst werden. Bei ihnen finden sich mannigfache tuberkulöse Veränderungen; bei einigen sind diese Veränderungen gross genug, um lokalisiert werden zu können, aber bei den meisten sind sie nur von mikroskopischer Größensordnung. Die Röntgen-Untersuchung des Thorax lässt nur ausgedehntere Veränderungen erkennen, aber ergibt bei allen anderen kein Resultat. Unter den Tuberkulinpositiven ohne Röntgenbefund werden sich später bei vielen sichere Veränderungen entwickeln. Deshalb sind periodische Röntgen-Untersuchungen erforderlich, um diese Prozesse zu erfassen, solange sie noch am wenigsten ausge- dehnt, symptomlos, nicht ansteckend und mit besten Aussichten behand-
lungsfähig sind. Wenn solche regelmäßigen Kontrollen nicht durchgeführt werden, dann wird späterhin die Zahl der fortgeschrittenen Fälle überwiegen.

Tuberkulinpositive haben multiple tuberkulöse Veränderungen, selbst dann, wenn sie sich gesund fühlen und einwandfreie Röntgenbilder bieten. In Wirklichkeit ist jeder Tuberkulinpositive ein Fall von Tuberkulose und muss als solcher betrachtet werden, um den Ausbruch einer fortschreitenden Erkrankung zu verhindern.

Wenn die Ausrottung der Tuberkulose angestrebt wird, sollte jede Gemeinde, jeder Kreis und jedes Land bemüht sein, die Lokalisation der Tuberkelbakterien bei Menschen und Tieren, die tuberkulinpositiv reagieren, zu erfassen und die notwendigen Massnahmen einleiten.


Die Ausrottung der Tuberkulose ist eine nationale Abwehrmaßnahme und die günstige Gelegenheit zu ihrer Durchführung sollte vom Ärztetstand nicht übersehen werden.

REFERENCES


