THE ECONOMIC EFFECTS OF COMMUNICABLE DISEASE CONTROL

by

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The criteria upon which to base an economic evaluation of life vary according to the individual conception of the importance of a human being to the social structure of the world. How much is a man, a father, a husband, a woman, a wife, or a child worth? When we think of life and health, we do not think in terms of money - they have a much higher and deeper value for us than money. They are ends in themselves; they do not require any further justification for their conservation. However, the purpose of my paper is the economic effects of communicable disease control, so I will have to think of life and health not only as such but also in terms of collars and cents. There is an actual cost to maintain life and it also has a productive value. This productive value is not only greatly lessened by communicable disease, but in many instances it becomes nil. Communicable disease adversely influences the economic value of an individual in a number of ways; first, it produces partial or complete incapacitation during certain stages of the disease; second, in most cases of illness certain expenses are incurred which ordinarily are unnecessary, i. e., medical, nursing, housekeeping, hospitalization, etc.; third, it may be the immediate cause of death and when it is not so, it is very likely to shorten life materially; and fourth, in certain cases it may leave behind it peculiar impairments such as blindness, deafness, paralysis, etc., which very definitely curtail earning capacity. The view that human life has value, not only sentimental but actual economic value, is rapidly spreading throughout the world. The people are more and more being looked upon as the

community's greatest asset. When any of the people of the community are destroyed or put out of action, the community loses a great deal of its wealth. When they are preserved and brought up to maturity with the least amount of waste, the community profits and becomes enriched through the added productiveness of its citizens. It is when the breadwinner of a family is removed through accident and disease and the mother and children must become self-supporting that, first the dependents and later, the community realize the large capital value that has been lost. This economic value of an individual is universally granted by the laws and by our courts. Whenever an injury is inflicted upon an individual as a result of the carelessness of another, he or his dependents can collect damages which bear some relation to his economic value.

To properly understand the enormous amounts of money gained through the control of communicable diseases, we must comprehend the value of an individual from a standpoint of dollars and cents. Dr. Lotka and Dublin, in "The Money Value of a Man", have produced a series of tables which give the money value for persons of various earning capacities at different ages of life. They calculated the expense of bringing up a child in a typical American community to the age of 18, when he may become self-supporting. Having in mind, the average family whose total resources are about $2,500.00 a year, it takes about $10,000.00 in actual cash to provide even the very modest requirements of a growing child up to the age of 18 years. This figure is a very minimum and it should be looked upon as such.

From an economic standpoint, the bringing up of children is an investment, very profitable, not as much for the immediate family but for the community.

In considering the value of a man as a wage earner, I will consider only the average individual, the one in the $2500.00 income class. This does not include the value of the wife's services. Dublin calculated that at the age of 18, the future earnings of an individual in this class were well in excess of $41,000.00 and the present worth of his future expenditures less than $13,000.00. Therefore the present worth of the net future earnings of a man at the age of 18, in this economic class, was close to $29,000.00 The maximum value of a man in this income class is reached at the age of 25, when the present worth of his net future earnings is more than $32,000.00. With advancing age the present worth of net future earnings declines, so that at the age of 50 it is $17,510.00; at the age of 60 it is about $8,500.00; and after the age of 70 it is negative, because earnings cease and the cost of maintenance continues.

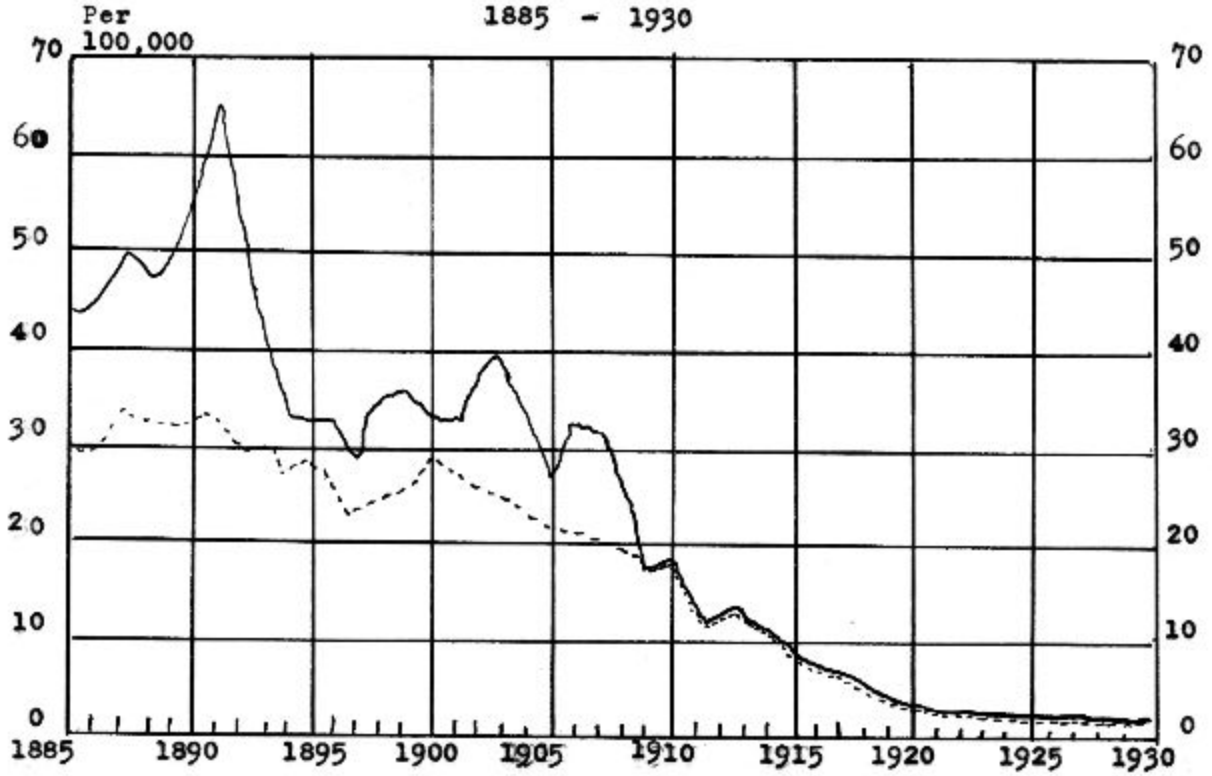
With these figures as a background we are now in a position to realize somewhat the money gained by reducing the incidence and mortality of communicable disease. Not long ago, typhoid fever was a common cause of sickness and death in the United States. The death rate in 1900 was 37 per 100,000 population in the registration area. With the installation of good water systems, chlorination etc. the typhoid fever rate dropped in an amazing manner as can be seen in Figure I.

FIGURE I

TYPHOID FEVER MORTALITY IN AMERICAN STATES

AND CITIES

1885 - 1930



The experience of Pittsburg offers a most interesting proof of the big and immediate returns to the community which were enough to make the necessary investment to provide their people with an adequate supply of pure water. In the Pittsburg survey, it was shown that for the 4,283 cases of typhoid fever in 1907, the direct cost was $540,000.00 and the 409 deaths involved a life waste of $2,500,000.00. The life waste of typhoid in Pittsburg for the years 1904 to 1907 was estimated at $9,000,000.00 of community money or enough to have built the $5,720,000.00 plant of the city and the 41 additional filter beds for serving Allegheny City and the entire urban district.

In the city of New York where hundreds of millions of dollars have been spent to insure a safe water supply, the immediate returns are so large as to make it one of the best investments the city has ever made, not only because of the very many deaths that have been prevented, but also because it reduced sickness to a very great extent. For every death from typhoid fever, there are at least ten cases of serious, prolonged and very expensive disease. Among those who recover from typhoid fever, there is double the expected mortality during the next three years. Another important economic consideration in this condition, is that the greatest incidence and mortality is in that period of life in which the individual is most productive, between the ages of 20 and 30 years. Also, the water which carries typhoid fever germs most usually carries other sources of illness, which if not as fatal as typhoid, are conducive to wide-

spread sickness and disability. Barely a case of typhoid fever or death which could be traced to the city of New York's water supply has occurred in years. And it is because of its wise sanitary precautions that this city has been enabled to grow to an extent consistent with its economic possibilities.

It is interesting to note the trend of typhoid fever in the armies and to compare their relative efficiency. In the past centuries, typhoid fever was one of the most potent causes of sickness and death in the armies. This was probably due to the fact that the average age of a soldier covers that period of life in which man is most exposed to this disease. This fact together with the necessity of drinking contaminated water, and the crowding which is necessary in military life, often made typhoid a greater factor in the death rate than even the weapons of the enemy. It was estimated that during the Civil War there were in the Union Army 75,361 cases of typhoid with 27,056 deaths. And these figures do not include many cases which we now know were typhoid but were then reported as typho-malaria.

In 1898, during the Spanish American War, the typhoid fever commission made a study of typhoid fever among various regiments of the United States Army. They studied 92 regiments, consisting of 107,973 officers and men. The total number of cases of typhoid occurring here during a period of less than four months was estimated to be 20,738. This is an incidence of about 20%.

Now to contrast the prevalence of typhoid fever during the World War with that of the past wars. In the fall of 1914 there were four armies in Flanders, the British, French and Belgian on one side and Germany on the other. The British were the only ones satisfactorily vaccinated. There were 20,000 cases of typhoid fever in the German Army, during the winter of 1914 to 1915. In the Belgian Army there were about 2,000. The British Army reported 827 cases. An epidemic of typhoid fever appeared in the region of the French Army in November 1914. By January 1915, there was an incidence of 7.24 per 1,000. At this time thorough vaccination was begun. In February 1915, the figure had fallen to 4.38 per 1,000; in March it was 2.49 per 1,000; in April it was 1.6 per 1,000; and in February 1916 there was not a single case of typhoid fever in the entire French Army. Vincent estimated that if the disease had continued for the thirty eight months of actual hostilities as it had started, there would have been 1,000,000 cases and 145,000 deaths out of the entire 4,000,000 soldiers in the French Army, and it is very evident as to what chances France would have had to win the war if typhoid fever had not been controlled.

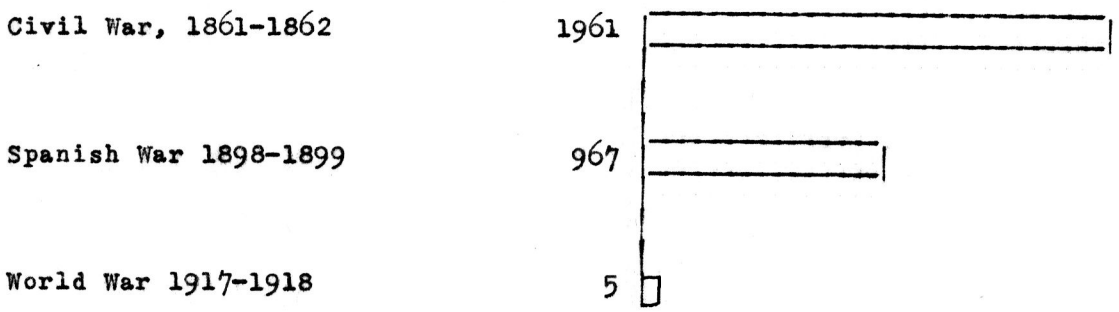
The records of the United States Army are still more enlightening, because no soldier went from this country to France without the protection afforded by typhoid vaccination. The total number of officers and men in the army were 4,128,478; the total number of cases of typhoid was 1,529; and the total number of deaths from typhoid fever was 227. This means that for every 100,000 men there were

37 cases and 5 deaths from typhoid fever. With the same admission rates for typhoid fever in 1917 and 1918 as there was in 1861 and 1862, there would have been 226,000 cases and 62,694 deaths; and with the same rates as in 1898 and 1899, there would have been 291,637 cases and 30,916 deaths. Figure II shows the marked reduction in typhoid fever mortality in the United States Army during the World War, as compared to that of the Civil and Spanish American Wars.

FIGURE II

COMPARISON OF TWO YEAR PERIOD

Rate per 100,000



(Copied from the Report of the Surgeon General, United States Army, Vol. 1, 1919, p.1009).

Diphtheria is a disease which can be eradicated, if the proper cooperation can be had between the Health Departments and the people of the United States. This disease is already being abolished from the community's health problems. For each of the seven years prior to the introduction of antitoxin (1887-1893), the number of deaths from diphtheria in New York City were 145 per 100,000 people. Whereas, in the five years after the use of antitoxin be-

came general, the number of deaths dropped to 63 per 100,000 people, annually. In 1900, when the first registration figures became available, there was a death rate of 43.3 per 100,000 population. In 1910, the death rate was 22.5 per 100,000 population. In 1920, the death rate was 17.4 per 100,000 population. And in 1928, it was 7.2 per 100,000 population. Not only were many lives saved, but the incidence of the disease had decreased accordingly. What does this mean to the individual and to the community? It means that about one-fifth of the amount of money that was spent in caring for these individuals in 1900 is being spent now, and that the people lost to the community by death from this disease has been reduced to about 15 per cent of what it was in 1900. And not only that, but there are many more children growing to manhood and womanhood without partial and in some cases total incapacitation. How much must we pay for all of these advantages? The returns of the Committee on Municipal Health Department Practice show that child welfare work including the control not only of diphtheria, but of all other contagious diseases, cost only between seven and eight cents per capita a year, in 72 of the larger cities of the country where information is available. In most communities an expenditure of about fifty cents per capita would provide adequately for the control of all communicable diseases, including nursing service, hospitalization and other measures usually administered by health departments.

The report of the Surgeon General of the United States Public Health Service for 1924 stated that small pox remained the most

widely distributed plague in all the world and that one-fifth of all the cases of small pox reported in the world during 1923 and 1924 occurred in the United States, 45 states reporting a total of 30,771 cases.

Small pox was prevalent in the United States during the year 1924 and in Detroit, Michigan, the number of cases and virulence so increased, that during the period from March 16 to June 1, there were in that city 795 cases and 129 deaths. It was later found that in the great majority of the cases those who suffered from the disease or died of it were persons who were not vaccinated. Then Detroit saw its problems and one million people were vaccinated during the winter and spring months, in connection with a very rigid regime, and small pox disappeared. One very severe epidemic occurred in the city of Minneapolis in December 1924, where in 31 days there were 373 cases and 129 deaths. It cost Michigan $150,000 a year to take care of indigent small pox patients and to protect the unvaccinated.

A study of detailed data shows that the number of cases of small pox that occur each year has a definite relationship to the number of unvaccinated persons present in the community. States with good vaccination laws have few cases of small pox over a period of years, while those with no vaccination laws have a large number of cases of small pox. During a five year period ending with 1923, there were reported from Massachusetts 114 cases of small pox and from Michigan and California over 15,000 each. Massachusetts has a law requiring the vaccination of school children. This situation can

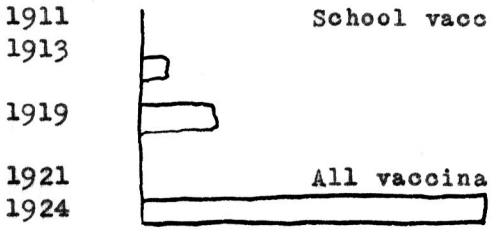
further be seen in Figure III.

FIGURE III

COMPARISON OF SMALL POX RATES WITH AND WITHOUT VACCINATION LAWS

STATE OF WASHINGTON

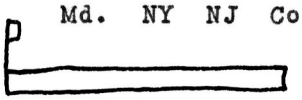
STATE OF CALIFORNIA



TWO GROUPS OF STATES IN 1900.

Four states with laws — Md. NY NJ Conn.

Two states without laws — Oregon, Michigan.

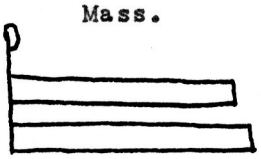


THREE STATES FOR YEARS 1919-23

State with vac. laws — Mass.

State without vac.laws — Michigan

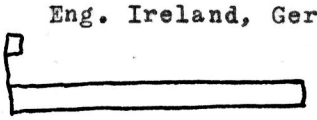
State without vac.laws — California.



ELEVEN FOREIGN COUNTRIES FOR FOUR YEARS

With vaccination laws — Eng. Ireland, Germany, Scotland, Sweden

Without vaccination laws — Austria, Belgium, Italy, Russia, Spain, Switzerland.



After reading the above and seeing what can be done with small pox, it is appalling to learn how much money and how many lives are lost each year from a disease which we all know can very satisfactorily be controlled with a little effort and a very little expenditure of money, practically nothing compared with what the disease is costing us. The Kentucky State Board of Health reports that small pox during a few years had cost county and city treasuries over a half million dollars actual cash, with an estimated loss from interference with business and travel of over one and a quarter million, and that judiciously expended this would be more than enough to keep every person in Kentucky vaccinated for a generation, so that the existence of anything but an imported case of small pox would be an impossibility. The Health Commissioner of the City of St. Louis, in an address late in 1924, stated that it cost the City of St. Louis more than $150.00 to care for every case of small pox, but to prevent a case of small pox by vaccination cost but four cents. These figures do not include the immense economic loss to the community from the loss of earning power of those so long ill with the disease.

In the Revolutionary War, small pox was almost constantly present in our armies. At any one time one-fourth to one-fifth of the whole army were ill with this disease. In the Civil War, there were 12,236 cases of small pox with 4,717 deaths. 1,166 cases were followed up closely as to whether or not the patient had been vaccinated; of 679 not vaccinated 40.8 per cent died, while in those vaccinated much less than 1 per cent died (3 out of 487). In the

Franco-Prussian War in 1870-71, the German Army, among which there was a considerable amount of vaccination being done, there were 4,835 cases with 276 deaths. The French Army was much smaller and there were 125,000 cases and 23,470 deaths. In other words, there were 26 times as many cases and 86 times as many deaths as in the German Army. In the World War, the French Army had only 4 cases and no deaths. The British Army in France had 12 cases and 3 deaths. In the United States Army out of 4,000,000 soldiers there were 979 cases of small pox with only 15 deaths, and probably the reason for this number of cases is that many of the soldiers came from places withno vaccination laws.

The anti-tuberculosis movement is an example of the most extensive and successful effort of the civilized world to rid itself of awidespread disease, unaided by a specific cure. In 1900, just before the National Tuberculosis Association was founded, the mortality rate from tuberculosis in the registration states was 195.2 per 100,000 population, which means that two persons out of every thousand died of tuberculosis. By 1910 the death rate had dropped to 164.7; by 1920 it had dropped to 112.0; and by 1928 it had dropped to 79.8 per 100,000 population. The most important fact is that the rates of mortality and morbidity are dropping at a faster and faster rate from decade to decade. If the 1900 death rate had prevailed, there would have been 225,445 deaths from tuberculosis in 1928. There actually were only 101,992, which means an actual cash saving of about $550,000,000 each year, which does not include the money lost

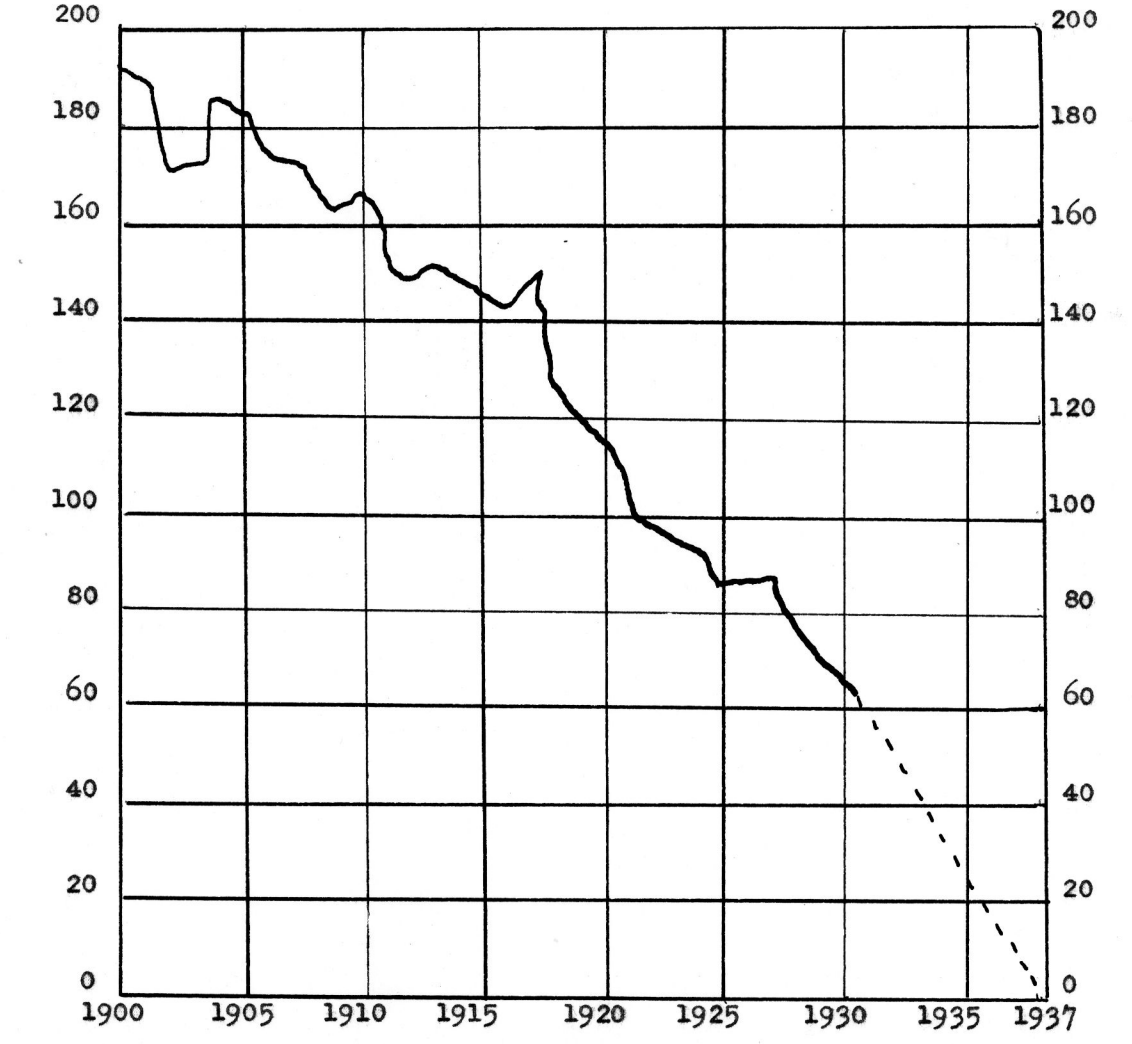
because of disability and also the money earned had the individual continued to live and work. Since there are 10 cases to each death, it means that there are a million and a half persons up and about and attending to their vocations rather than being in bed and in sanatoriums and suffering from the effects of the disease. The figures in Figure IV shows the decline in tuberculosis and what will happen to this disease if the trend line of thelast three decades will continue without change until 1937.

Tuberculosis disables the great majority of its victims in middle years of life, when they are worth most to the community and it is for this reason that the control of the disease is so important from an economic standpoint.

Another disease which has been attacked by the health authorities with success is malaria. The control of malaria is an excellent illustration of the large financial returns which have resulted from well conducted public health effort. Until very recently this disease was wide spread over the southern states. It lay like a heavy weight on the country, sapping the energy of large populations and in certain areas rendering them non-productive. Then an effort was launched toward the control of this disease and it was demonstrated that not only could it be done, but that it cost so little as to be out of all proportion to the value of the lives thus protected. In a number of instances in the South, themorbidity rates from malaria have been reduced a third in the short period of two to three years. During 1920, 45 towns and villages initiated

FIGURE IV

STATUS OF TUBERCULOSIS IN 1937 IF PRESENT RATE OF DECLINE CONTINUES



malaria control campaigns. The cost varied from $.42 to $2.52 per capita per year and averaged $.80. The cost of maintenance the second year and thereafter will run about one-fourth to one-third of that of the first year, because a great share of the work of ditch digging etc. will already have been done. Also, the cost will depend upon the frequency and the amount of rainfall during the year. Agencies developing hydro-electric power in the Southern States spend millions of dollars for the prevention of malaria, because if malaria is prevalent their efforts are useless. In some states and counties we find malaria prevalent in sparsely settled rural districts. Where the income of such counties is small, screening of farm homes and farm tenant homes is a practical thing. During the summer of 1927, the Red Cross screened about 8,000 farm tenant homes in the flooded area of the Mississippi River and the average cost was $10.00 per home. This amounts to about $.50 per capita per year in a family of five. This amount, of course, is only a very small fraction of what is gained through the reduction of cases and the prevention of deaths as a result of malaria. The campaigning against malaria has resulted in a complete change in the economic and social life of large areas in the Southern States. In one of the Mississippi River counties, the owner of the largest cotton plantation states that the screening of his colored farm tenant homes and keeping them screened, is the best investment he ever made.

In 1925, Director Arthur Stringer of the Gorgas Memorial Institute, declared that in the United States mosquitoes cause annually three million cases of malaria, with an economic loss of

$100,000,000 annually.

The St. Louis Southwestern Railway had rendered a "remarkable public service" in the eradication of malaria in the communities served by its lines. The "Cotton Belt", the area traversed by this road, had been invaded by malaria for a very long time and the vitality and efficiency of the residents along this line, have been greatly reduced as a result of this disease. The road, together with other employers, had suffered through the reduced vitality of many of its men, through the disorganization of forces resulting from temporary absence, due to sickness and because of the reluctance of many people to remain in that area. The railroad saw the necessity of doing something about this and they undertook a campaign in the cities and towns served by the road. "The net result of the railroad malaria program since its inception in 1917 has been the lowering of general hospital admission rate for malaria from 100 per 1,000 men employed to less than 3 per 1,000 men, together with the stimulation of mosquito eradication work in the St. Louis Southwestern cities and towns having an estimated combined population of over 600,000."

It is now universally admitted that the French failure to build the Panama Canal was not because they lacked engineering skill, but because they could not combat the mosquito. There are no available figures to show the losses sustained by the French from yellow fever and malaria, but it is known that they were immense. The superintendent of the old French Hospital states that in one day three

of his medical staff died of yellow fever and in one month nine died. Of 36 Catholic Sisters brought over as nurses from France, 24 died of yellow fever. Of 18 young engineers brought over from France all but one had died from yellow fever within a month after their arrival. In 1881 to 1890, while the French were attempting the construction of the Panama Canal, there was a mortality from malaria of 1509 per 100,000 employees, and most observers think that this figure is not nearly as high as it should be. The contractors were charged a dollar a day for each man taken care of in the hospital. One can easily see, that with conditions as they existed then no project could be successfully carried out. So when the United States undertook to dig the canal in May, 1904, they knew that the first problem with which they had to cope was that of yellow fever and malaria. The first Panama Commission, therefore, took Dr. W. C. Gorgas, the one man who had most to do with freeing Havana of yellow fever, to look after sanitation. He was Chief Sanitary Officer throughout the entire work of construction of the Canal. His aides were all men who had a great deal of experience in this line of work and the first two years were, therefore, spent in an attempt to clear up the canal zone of disease. After a severe epidemic in 1905, the last case of yellow fever occurred in Panama and in Colon in May, 1906.

An idea of the incidence of malaria and its decline can be obtained from the following figures:

Year	Percentage of malaria cases among employees admitted to the hospital.
1906	82.1
1907	42.6
1908	28.2
1909	21.5
1910	18.7
1911	18.4
1912	11.0
1913	7.6

During the first year of the French work in 1881, 63 per cent of the employees were sick with 6.7 per cent deaths. During the first year of the United States work 9,000 men were employed with 40.1 per cent sick and a mortality of 1.46 per cent. During the ten years of digging the average death rate was 1.7 per cent for each year, meaning that there were 6,630 deaths during ten years as compared to the mortality of 7,800 per year during the French work.

The cost of mosquito control activities in Panama, exclusive of screening homes, was about $.01 per capita per day. Of course, that meant operating about 300 days each year, while in the greater part of our malaria belt the mosquito control period is only 130 working days for the anopheles. $3.65 per capita each year may seem a lot of money, but when you consider that it enabled the United States to do what it was impossible for France to do - that is build the Panama Canal, and also the financial returns derived from the Canal - you see that $3.65 per person each year is an insignificant amount.

The prevention of all or any of these communicable diseases

will result in a still further reduction of morbidity and mortality and an incomputable gain economically for the homes, which year after year receive a visitation of one or more of these diseases. Also, taxes would be lowered because reducing the morbidity of the communicable diseases will certainly reduce the number of public charges and there would be less need for the erection and maintenance of public institutions.

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