Long-Term Trend and Economic Factors Of Paresis in the United States

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ONE of the chief aims of public health measures for the control of syphilis is the prevention of the disabling complications of late syphilis. The reasons for this objective are the human suffering and social disintegration caused by these late manifestations; the high costs to individuals, private organizations, and taxpayers for the care of those disabled and their families; and the losses which society sustains in productive years of life of persons disabled or dying prematurely from syphilis. These costs are known to be high. To mention only a few examples, the maintenance in public institutions of patients with syphilitic psychoses cost an estimated $40,295,000 in 1951; maintenance and assistance to the syphilitic blind was estimated in 1951 to cost $12,500,000; years of life expectancy lost because of premature death from syphilis was estimated at 142,000 man-years in 1950 (*1*).

Long-Term Trends

While the present cost in human life and dollars seems clear, little has been published to indicate the long-term trends of these costs. This has been due primarily to a scarcity of data. Paresis or general paralysis of the insane, however, is one late sequela of syphilis for which there are sufficient data to indicate the long-term trend of incidence and loss of life and to suggest the possible savings or reductions in cost in man-years of life and personal income losses which may accrue through reducing the incidence of, and mortality from, the late complications of syphilis.

An analysis by Iskrant of the economic cost of paresis in the year 1940 was published in 1945 (*2*). Iskrant's study indicated that the annual loss of working years of life from this cause was 75,729 man-years and 23,645 woman-years. Income loss amounted to $112 million for men. The cost of maintaining paretic patients in mental institutions was $11.3 million. Because of great changes in the national economy and a lack of comparable data for recent years, no direct comparisons will be made between these estimates and recent costs. By other means, however, the reductions in costs or the economic savings accrued will be indicated.

Paresis death rates are available for some States since 1900, the year in which the Bureau of the Census began the annual collection of mortality data (*3*, *4*). The paresis mortality rates for the expanding registration area are shown in table 1. The addition of States as they entered the death registration area had little effect on the trend of paresis death rates. A measure of this effect can be gained from

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figure 1, which shows the comparative trends of paresis mortality rates for the registration States of 1900 and for the expanding registration area for the entire period, 1900 to 1951. The expanding registration area has included all States since 1933. Admission of several States between 1905 and 1908 lowered the paresis death rate in the expanding registration area about 1 to 1.5 per 100,000 population. The difference has gradually diminished over the years, and the rates now are in very close agreement. The differences in the rates during this early period may be attributed principally to differences in the age distribution of the populations of the two registration areas (*5*).

The definition of paresis in the International Lists of Causes of Death has been fairly uniform over the entire period of national mortality statistics. Consequently, the trend of paresis death rates has been little affected by the decennial revisions of the lists of causes of death. One possible exception is the sixth revision, which became effective in 1949. In this revision the number of deaths classified as due to syphilis is reduced by about 26 percent compared to the number so classified under the fifth revision. Preliminary data indicate a sizable reduction in paresis mortality as well as in total syphilis. The main change affecting reported paresis mortality resulted from the abandonment of the earlier system of fixed priorities for assigning the underlying cause of death from among several causes listed on death certificates and the placing of all responsibility for selection of the underlying cause of death on the certifying physician. Since sufficient data are not yet available for adjusting numbers of paresis deaths to compensate for the lack of comparability between the fifth and sixth revisions, the rates presented in this paper are based on deaths tabulated according to the revision of the international lists in effect in the year in which the deaths occurred.

Table 1. Paresis mortality rates per 100,000 population, expanding registration area, continental United States, 1900–1951

Year	Mortality rate	Year	Mortality rate	Year	Mortality rate
1900	7.4	1918	7.4	1936	3.5
1901	7.3	1919	5.8	1937	3.2
1902	7.8	1920	5.8	1938	3.5
1903	7.4	1921	6.3	1939	3.4
1904	7.8	1922	6.6	1940	3.4
1905	8.0	1923	6.6	1941	3.2
1906	7.3	1924	6.3	1942	3.4
1907	5.1	1925	5.8	1943	3.5
1908	5.2	1926	5.6	1944	3.5
1909	5.2	1927	5.0	1945	3.3
1910	5.6	1928	4.7	1946	2.9
1911	6.8	1929	4.3	1947	2.5
1912	6.8	1930	4.1	1948	2.0
1913	7.0	1931	3.9	1949	1.2
1914	7.2	1932	3.8	1950	0.9
1915	7.5	1933	3.6	1951	0.7
1916	7.3	1934	3.8		
1917	7.2	1935	3.6		

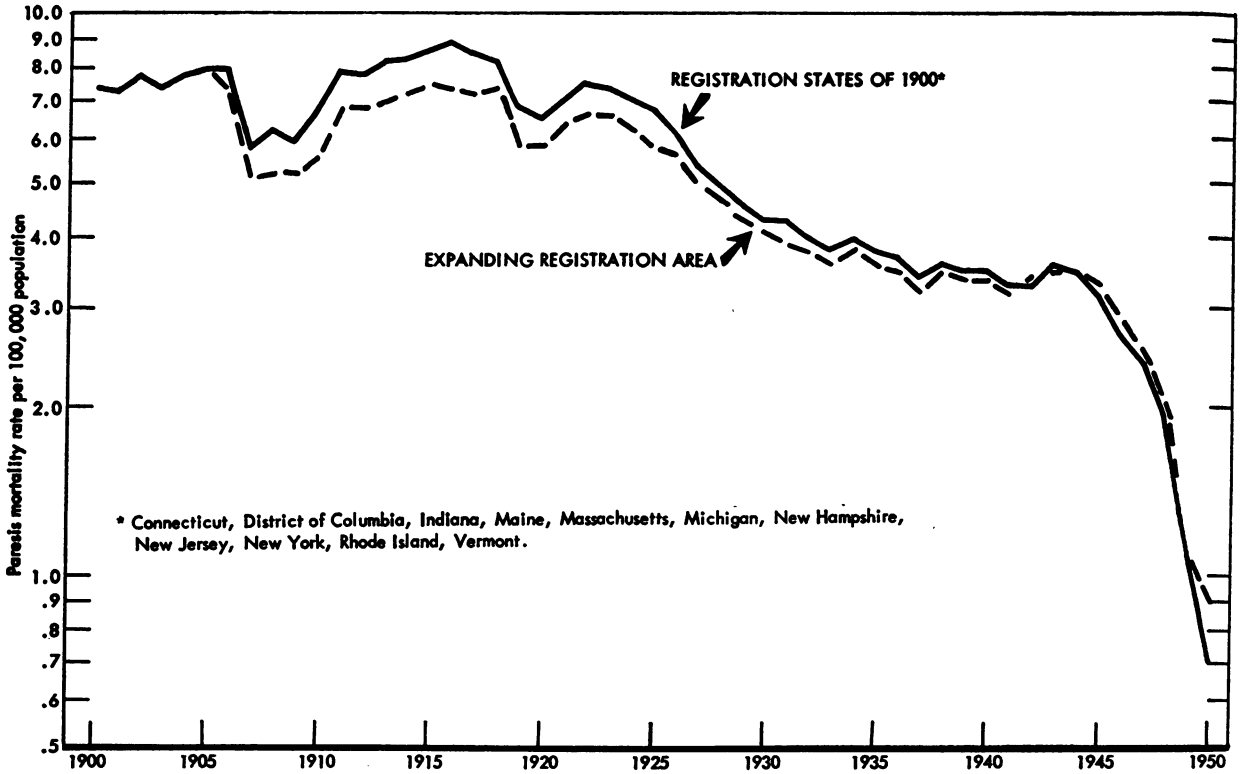
For purposes of this study, paresis death rates have been divided into three time periods (fig. 2). The first period includes the years 1900 to 1923, a period of practically no preventive effort to control syphilis and of ineffective therapy. The second period, 1923 to 1938, is one of little preventive control, but a period during which malaria and other fever therapy were in general use. The third period covers the years 1938 to 1951, the period of the national syphilis control program.

1900–1923

The initial period, from 1900 to 1923, is characterized by a level mortality trend, with an average of 6.7 deaths per 100,000 population (geometric mean). There are two sharp dips in the death rates in the years 1907 to 1910 and 1919 to 1921. There is apparently no logical explanation for the deviations from 1907 to 1910. The 1919 to 1921 trough is similar to a dip which occurred in the mortality for all chronic diseases and apparently is associated with the influenza epidemic of that time (*6*). The same dips may be observed in the trend for the registration States of 1900, indicating that this phenomenon is not associated with the expansion of the registration area. A semilogarithmic curve fitted to the rates for the years 1900 to 1923 has a slope which does not differ significantly from zero (at the level $P=0.95$).

Malaria therapy for paresis, developed in Europe by von Jauregg, was introduced into the United States about 1923. This and other types of fever therapy quickly gained acceptance and their use increased rapidly. The Committee on Evaluation of Fever in the Treatment

Figure 1. Paresis mortality rates per 100,000 population for the registration States of 1900 and the expanding registration area, 1900–1950.



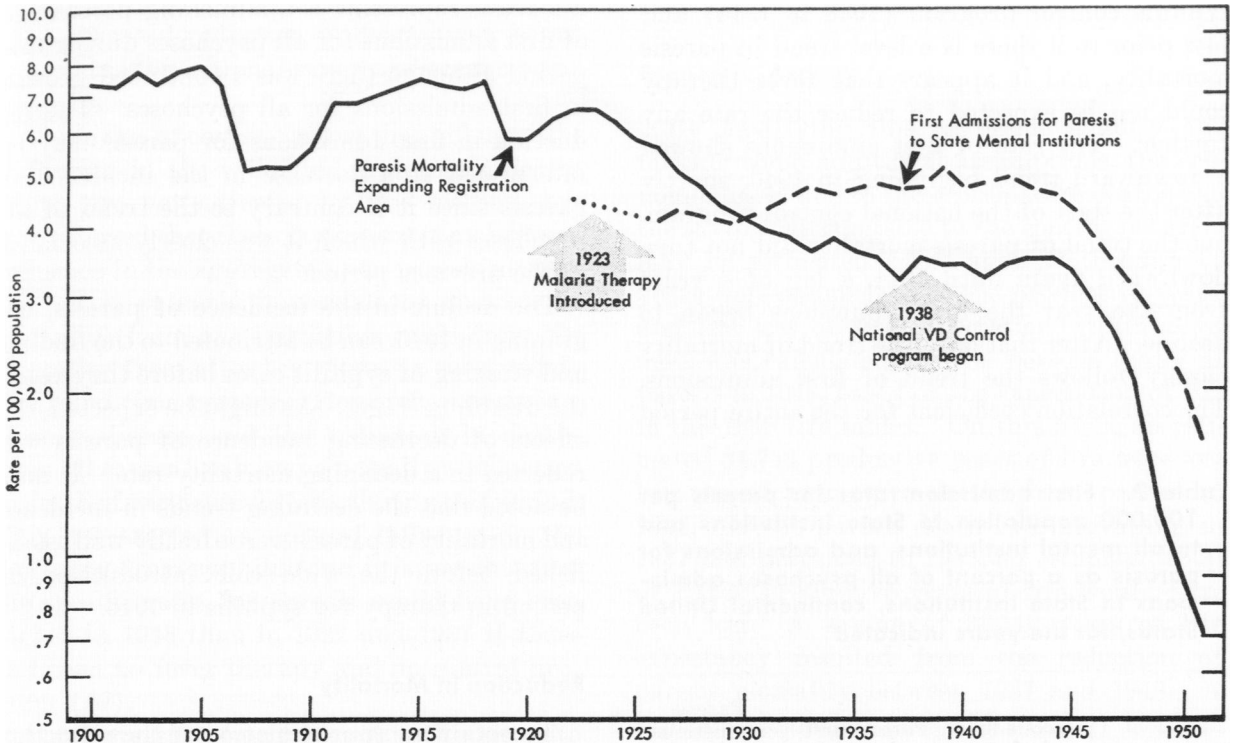
of Paresis in 1940 reported the following results on 1,420 patients (*7*) : "The chances of clinical remission in patients with mild paresis were approximately 1 out of 2; in patients with intermediate paresis, 1 out of 4; and in patients with severe paresis, 1 to 10 out of 100." Clinical remission was defined as response sufficient to enable the patient to return to his normal socioeconomic status. The crude fatality rate within 3 months of treatment was 13 percent with malaria and 8 percent with artificial fever (*7*). Patients having paresis complicated by cardiovascular disease or other serious physical conditions could not be treated with fever because of the high mortality risk (*8*).

1923–1938

Fever therapy evidently was successful in reducing the mortality from paresis. Paresis death rates from 1923 to 1938 show a general downward trend with a tendency to level off after 1936 (fig. 2). A semilogarithmic curve fitted to the death rates for the 1923 to 1938 period indicates a marked downward slope. A decline of this magnitude may be expected to occur by chance less than once in 1,000 times under similar circumstances. The geometric mean value of the rates for these years is 4.3 compared to 6.7 for the previous period.

It is important to note that the reduction in mortality from paresis in this second period was the result of the treatment of patients and not the result of a reduction in the incidence of paresis. Some indication of the incidence picture can be gained from data on admissions to mental institutions (*9*). The rate of first admissions for paresis to State mental institutions increased from 4.1 in 1926 (the first year of the continuing census of mental institutions) to a peak of 5.1 per 100,000 population in 1939. In view of this, a fall in the incidence of paresis during this period appears to be unlikely. On the other hand, the rise in paresis admissions is closely related to a rise in admissions for all psychoses during this period, and thus paresis represents a fairly constant percentage of the total first admissions for psychoses (table 2). Consequently, the rise in first admissions for

Figure 2. Paresis mortality and first admissions to mental institutions in the continental United States. Rates per 100,000 population, 1900–1951.



paresis more likely represents an increase in hospitalization of paretic patients associated with an increase in hospitalization of all patients with psychoses rather than increased incidence of paresis.

The conclusion that treatment of patients rather than decreases in incidence was responsible for the declining mortality, 1923 to 1938, is further supported by the relationship between first admissions and mortality. A good inverse correlation ($r = -.82$) indicates that increases in first admissions were closely associated with the fall in mortality, very probably as the result of an increasing proportion of cases being brought to treatment and hospitalization.

It is interesting to observe that in 1922, and probably until 1926, the deaths from paresis exceeded the first admissions to public and private institutions in the corresponding year (table 2). It is probable that a great many paretic patients were not hospitalized prior to and during the early 1920's. At present, the number of deaths in mental institutions attributed to all forms of syphilis greatly exceeds the number of deaths from paresis, and it is likely that most deaths from paresis occur among patients hospitalized in mental institutions.

Although malaria and other fever therapy were instrumental in reducing the mortality from paresis, the burden of the support of paretic patients during their stay in a mental institution and the cost of their treatment still fell largely upon the taxpayer. Fever therapy tended to increase this cost by extending the length of stay of many patients. Reduction of the incidence of paresis could have saved much of this expense.

The trends of the paresis mortality and first admissions statistics for the years 1938 to 1951 (fig. 2) appear to be best described by negative growth or decay curves, and no slope figures have been calculated for this period. The geometric mean death rate for this period is 2.4 compared to 4.3 for the period of fever therapy (1923 to 1938), and 6.7 for the prefever period (1900 to 1923). The change in classifications of death after 1948 brought about by the sixth revision of the international lists, however, may have exaggerated the decline in paresis mortality rates in recent years.

1938–1951

During the opening years of the national syphilis control program (1938 to 1944) and just prior to it there is a level trend in paresis mortality, and it appears that fever therapy could not be expected to reduce the rate any further. The rate of first admissions showed a downward trend beginning in 1940, shortly after the start of the national control program, but the trend of paresis mortality did not turn downward again until 1944, a lag of 4 years from the year the first admissions began to decline. After that date, the trend of mortality closely follows the trend of first admissions. The correlation coefficient for the entire period from 1938 to 1951 is plus .98, indicating a very close relationship between the two series.

Table 2. First admission rates for paresis per 100,000 population to State institutions and to all mental institutions, and admissions for paresis as a percent of all psychoses admissions in State institutions, continental United States, for the years indicated

Year	Paresis first-admission rates, all institutions [1]	Paresis first-admission rates, State institutions	Paresis admissions as a percent of all psychoses, State institutions
1922	5.7	4.5	10.1
1926		4.1	9.5
1927		4.3	9.6
1928		4.2	9.3
1929		4.1	8.9
1930		4.1	8.7
1931		4.3	8.7
1932		4.5	9.2
1933	5.7	4.7	9.2
1934	5.8	4.6	9.3
1935	5.8	4.7	9.1
1936	5.9	4.8	9.0
1937	5.8	4.7	8.7
1938	6.0	4.7	8.8
1939	6.1	5.1	9.3
1940	5.7	4.7	8.7
1941	5.7	4.8	8.5
1942	5.6	4.9	8.3
1943	5.3	4.7	8.1
1944	5.3	4.6	7.8
1945	5.1	4.3	7.6
1946	4.4	3.8	6.9
1947		3.4	6.4
1948		3.0	5.4
1949		2.5	4.6
1950		2.1	3.8
1951		1.6	3.0

[1] Includes Federal, State, county, city, Veterans Administration, and private facilities; excludes temporary care institutions. Available only for the years indicated.

Paresis represents a diminishing percentage of first admissions for all psychoses during this period although there was a continued growth in first admissions for all psychoses. The reduction in first admissions for paresis may be interpreted as a decrease in the incidence of paresis since it is contrary to the trend of all psychoses with which it was closely associated in the previous period.

The decline in the incidence of paresis, beginning in 1940, can be attributed to the finding and treating of syphilis cases before they reach the disabling stages. As might be expected, the effects of decreasing incidence of paresis was reflected in a declining mortality rate. It may be noted that the declining trends in incidence and mortality of paresis were already well established before the wide-scale introduction of penicillin therapy for syphilis in 1946.

Reduction in Mortality

To obtain an approximation of the reduction in paresis mortality attributable to fever therapy and to the national venereal disease control program, it was assumed that the rates of mortality due to paresis for the prefever period and the precontrol program period applied to the present population. Rates for paresis deaths specific for age, race, and sex groups for the registration States of 1922, the year just prior to the introduction of malaria therapy, were applied to the United States population of 1948. The year 1948 was chosen to insure comparability since it was the last year before the adoption of the sixth revision of the International Lists of Causes of Death. If the premalaria therapy mortality conditions of 1922 had applied to 1948, 11,255 deaths would have resulted from paresis instead of the 2,913 recorded, a reduction of 8,342 deaths which may be attributed to the combined factors of fever therapy and control measures.

The paresis mortality rates by race, sex, and age of the final precontrol program year of 1937 were applied to the 1948 population to estimate the mortality in 1948 had there been no control program. The number of deaths that would have occurred in 1948 at 1937 rates is estimated

to be 4,851, a difference of 1,938 from the 2,913 deaths actually recorded. Since paresis mortality exhibited a level trend in the late 1930's, this estimated reduction in deaths may be attributed to the national venereal disease control program.

There are, of course, factors that influence the difference in the estimated and actual deaths which are not adjusted by this method, but it is believed that these factors exert an upward influence in the aggregate upon paresis mortality. It is patently impossible to divorce the mortality from one particular cause from the mortality from all other causes in such widely separated time periods. However, paresis is a chronic disease, and the reduction in deaths from all causes has been principally a reduction in deaths from acute diseases during this period. This has exerted an upward influence on the mortality from syphilis, and it is possible that the specific rates for paresis would have been higher in 1948 than in 1922 and 1937 if there had been no fever therapy and no control program (*10*).

Another assumption inherent in this estimate is that the incidence of syphilis and paresis would have remained essentially the same throughout the time period from 1922 to 1948 had there been no control program. While this hypothetical trend is not subject to mathematical evaluation, it is probable that, in the absence of control measures, the incidence of paresis would have increased under the pressure of wartime social conditions. It is believed that the technique used herein to estimate the reduction in mortality has yielded a conservative figure.

Since every death from paresis is preventable, the death of any individual at a particular age represents a loss of some additional years of life which that person might have lived had he not died prematurely of paresis. By use of a life table technique, this loss of life expectation may be calculated. The number of deaths occurring to individuals of specific 5-year age groups, by race and sex, in 1948 was multiplied by the average number of years of life remaining to individuals of that population group, according to 1948 life tables (*4*). The summation of years of life lost by deceased paretic patients of each age, race, and sex group yielded an estimated 63,057 years of life expectancy lost to all persons who died from paresis in 1948.

Economic Aspects

By modifying this technique slightly and making some additional assumptions, the economic losses due to these premature deaths and the savings attributable to the control program may be estimated. The ages 20 through 65 years were assumed to be the productive years, and the loss of life expectation within these ages was calculated for the persons dying of paresis in 1948, based on the expectation of life in the 1948 life tables. On this basis, an estimated 34,713 productive years of life were lost because of premature deaths from paresis in 1948. If the paresis death rate prevailing in 1937 had pertained to 1948, an estimated total of 72,826 productive years of life would have been lost. A saving of 38,113 years of life expectancy resulted from the reduction of paresis mortality between 1937 and 1948. A typical calculation (for white males) is given in table 3.

Since not every person is employed or seeking

Table 3. Expected productive years of life lost from paresis in 1948 and savings of productive life expectation, white males, 1937–48

Age group	Expectation of life to age 65 in 1948	Estimated number of deaths in 1948 at 1937 rates	Actual deaths in 1948	Estimated loss of life expectation in 1948	
				At 1937 death rates	At 1948 death rates
20–24 [1]	40.8	[1] 23	[1] 8	938.4	326.4
25–29	36.2	34	8	1,230.8	289.6
30–34	31.5	127	20	4,000.5	630.0
35–39	26.8	277	55	7,423.6	1,474.0
40–44	22.2	351	99	7,792.2	2,197.8
45–49	17.7	355	174	6,283.5	3,079.8
50–54	13.3	425	172	5,652.5	2,287.6
55–59	9.0	411	259	3,699.0	2,331.0
60–64	4.7	293	254	1,377.1	1,193.8

Total loss of productive years in 1948 at 1937 rates	**38,397.6**
Total loss of productive years in 1948	**13,810.0**
Savings	**24,587.6**

[1] Includes all estimated and actual deaths under 25 years of age, but includes loss of life expectation only from age 20 to 65.

Table 4. Present value of the losses and savings of expected earnings as a result of reduced mortality from paresis, white males, 1937–48

Age	Expectation of life to age 65	Present value of $2,212 [1] per year to age 65 at 3 percent interest	Number of persons expected to be employed if living of those dying in 1948		Income lost in 1948	
			At 1937 death rates	At 1948 death rates	1937 death rates	1948 death rates
20–24	40.8	$51,656.56	20	7	$1,033,131.20	$361,595.92
25–29	36.2	48,441.14	33	8	1,598,557.62	387,529.12
30–34	31.5	44,670.45	122	19	5,449,794.90	848,738.55
35–39	26.8	40,340.23	271	54	10,932,202.33	2,178,372.42
40–44	22.2	35,476.62	344	97	12,203,957.28	3,441,232.14
45–49	17.7	30,032.98	340	167	10,211,213.20	5,015,507.66
50–54	13.3	23,963.24	407	165	9,753,038.68	3,953,934.60
55–59	9.0	17,222.87	368	232	6,338,016.16	3,995,705.84
60–64	4.7	9,557.89	262	227	2,504,167.18	2,169,641.03

Income which would have been lost in 1948 at 1937 rates	**$60,024,078.55**
Income actually lost in 1948	**$22,352,257.28**
Savings to national income through reduction of paresis mortality, 1937–48	**37,671,821.27**

[1] Average earnings per employed civilian wage earner in 1948 (*11*, *12*).

employment, some adjustment of these figures is necessary before lost earnings may be estimated. The assumption was made that the proportion of the persons in each age and sex group of the general population in the labor force in 1948 (*11*) would also be typical of the paretic patients in this study. For example, 98.0 percent of the males aged 35 to 39 in the general population were in the labor force, but only 36.9 percent of the women in this age group were employed or seeking employment. The number of paresis deaths in each age bracket was adjusted downward by the appropriate percent before additional calculations were made. It was assumed that this proportion would remain constant over the expected years of life of each group, and that the estimated number in the labor force would be continuously employed.

In 1948 the average wage per employed civilian was $2,212 (*11*, *12*). Although this figure may be somewhat high for persons in the socioeconomic groups in which most paretic patients are found, it is probably the best estimate obtainable at present. If it is assumed that paretic patients would have earned this average figure for each year of the years of life expectation lost up to age 65, this series of annual earnings for the expected productive years of the persons concerned may be reduced to a single equivalent cash value in 1948. The cash value of these earnings in 1948 is the amount which, invested in 1948 at a nominal interest rate, will earn enough so that interest and principle would be sufficient to cover the annual earnings as they accrued. The calculation for white males is shown in table 4. The conservative rate of 3 percent interest was used as the basis for the present value of the estimated earnings. As estimated by this method, the value of total earnings lost to persons who died from paresis in 1948 amounted to $45,714,160 compared to $95,127,717 which would have been lost under precontrol mortality conditions. A savings of $49,413,557 in earnings may therefore be attributed to the control program. The effect of the loss of this earning power upon the families of these persons is not included in this estimate, nor is the cost of the yearly burden of maintaining these paretic patients in mental institutions. In 1951 alone this cost of maintenance is estimated to be in excess of $30 million. It should be emphasized that these figures pertain only to the mortality of a single year, 1948, and that similar estimates could be made for other years.

Although these estimates are based upon several broad assumptions, it does give some indication of the magnitude of the economic effects of paresis and the value of controlling syphilis. If the present downward trend of paresis incidence and mortality continues as expected, the investment in syphilis control will continue to yield abundant returns.

Summary and Conclusions

1. For the period 1900 to 1923 during which there was no effective syphilis control program and no effective therapy, the trend of paresis deaths was irregular and the slope of the trend line was not significantly different from zero.

2. Malaria and other fever therapy were successful in reducing the mortality from paresis in the years 1923 to 1938, but the incidence of paresis as measured by first admissions figures did not diminish during this period.

3. Mortality from paresis apparently had reached a plateau shortly before the start of the national syphilis control program in 1938 and no further reductions seemed likely through fever therapy.

4. Soon after its inception, the national syphilis control program apparently was effective in reducing the incidence of paresis. Reductions in paresis deaths followed after a period of about 4 years.

5. Further reduction in first admissions and in mortality from paresis is indicated by the present trend.

6. Losses of expectation of life due to premature death from paresis amounted to 63,057 years and loss of income associated with this loss of life totaled $45,714,160.

7. The savings of productive years of life expectation for the estimated deaths prevented in 1948 by the national venereal disease control program amounted to 38,113 years. The value of the earnings of the persons saved in 1948 was estimated to be $49,413,557.

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