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THIRTY YEARS' RESEARCH ON THE CONTROL OF CHOLERA EPIDEMICS

BY

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In 1908 to 1921 I reported on a curative treatment of cholera, based on the great loss of chlorides and alkalis from the blood revealed by biochemical estimations. These losses were counteracted by intravenous infusions of large amounts of hypertonic and alkaline salines, with the reduction of the case mortality to one-third to one-fourth of the former rate in the same hospital (Rogers, 1908, 1917, 1921).

Unfortunately the improved treatment was not practicable in the 85% of the population of India who lived in villages, with no doctors capable of administering the essential intravenous salines. It was not until 1925, after my return to England, that I was able to begin prolonged epidemiological studies in the hope of finding some method of controlling cholera epidemics, which during the half-century up to 1939 had been responsible for an average annual recorded death rate of 344,000 (Rogers, 1944) and during the nineteenth century had repeatedly spread as a pandemic over south-east Asia and Europe (see maps in *Cholera and its Treatment*, 1911, Oxford Medical Publications).

Seasonal Incidence of Cholera in Relation to Rainfall, Temperature, and Humidity

The first step was to tabulate the monthly cholera deaths in the eight provinces of India for thirty years and to chart the average rates per 100,000 population in relation to the average rainfall, temperature, and relative and absolute humidities so as to allow the seasonal incidence to be studied in relation to climatic conditions as illustrated by the *Indian Atlas of Meteorology*. This inquiry revealed the closest relationship between the monthly readings of the absolute humidity—a measure of combined heat and moisture—and the seasonal incidence of cholera in all parts of India.

The outline map (overleaf) shows the provinces of India and the endemic areas in the north-east and south-east in which cholera is prevalent at all seasons of the year, in contrast to the remaining epidemic areas in which the disease dies out completely with the fall of the absolute humidity to well below the critical minimum monthly reading of January of 0.400. In Bihar and the eastern part of the United Provinces to the west of the Bengal endemic area the disease declines to a very low level in January and February, with absolute humidities very little above the critical point, so the regular increase of the disease in this area is a recrudescence, with the March rise of that factor well above the critical point, and cholera outbreaks fur-

ther west occur as the absolute humidity rises well above the critical point in March, April, and May. The seasonal spring rise of cholera in the epidemic areas can therefore be foreseen by watching the absolute humidities, many illustrations of which will be found in my epidemiological papers of 1926 and 1928. Moreover, my conclusion that cholera does not become widely prevalent, or continue so, when the absolute humidity falls below the critical point of 0.400 has been confirmed in China and elsewhere (Rogers, 1926, 1928).

Relation of Summer South-west Monsoon Rains to Cholera Incidence in the Following Spring and Summer

A map of the thirty-year average cholera incidence of the different provinces of India, as well as of their subdivisions, with varying climatic conditions where indicated, enabled comparisons to be made with years of epidemic prevalence in the forty-five years for which cholera data of every province were available. Any marked deficiency of the rainfall during the previous year's monsoon was also recorded in view of the fact that the three most widespread epidemics had followed failures of the previous monsoon rains over large areas of India, resulting in extensive famines (Rogers, 1928).

Deficiencies of communications necessitate the concentration of the starving people in large camps, with inevitable outbreaks of cholera in such years. It is therefore of the greatest interest to note that my maps showed 41 provincial epidemics of cholera, and in no fewer than 40 of them previous monsoon rains had been greatly deficient in the epidemic regions. As deficiency or otherwise of the monsoon rains is evident by the beginning of October, or earlier, it follows that the likelihood of an epidemic arising in March to May of the following year can be foreseen five or six months ahead and any possible precautions taken.

The one exception to the rule occurred in 1894 at the twelve-yearly Kumbh Fair at Allahabad, with a million pilgrims camped on the sands of the Ganges. Although elaborate sanitary precautions had been taken, cholera broke out in the middle of January, about a month earlier than usual, and the dispersal of the pilgrims caused a widespread epidemic with one of the highest recorded death rates of the United Provinces. I found the explanation of this very exceptional occurrence in the fact that the absolute humidity had been greatly in excess during the winter months, and especially in February, when the main spread of cholera took place.

Pilgrimages and Spread of Cholera

Kumbh Fair at Hardwar.—This fair, which is held every 12 years, takes place at the site of the issue of the sacred Ganges from the Himalayas near the eastern border of the Punjab. In 1891 this large fair passed off with only the average cholera incidence of 0.49 per 1,000. The previous monsoon rains had been good and careful sanitary precautions had been taken. In 1892 the conditions were different, for the previous monsoon rains had been very deficient, and by far the worst cholera outbreak of the 86 years of which we have records took place in the Punjab, with a cholera death rate of 2.70 per 1,000; and the pandemic spread across the north-west frontier of India to overrun South-East Asia and Europe. Yet the same sanitary precautions had been taken as in 1891. The explanation is simple: the water in the sacred bathing-pool—650 by 30 feet (200 by 9 metres) in extent—in which the 70,000 pilgrims present bathed and which they drank, and bottles of which they took home to infect their households, was stagnant because of failure of the previous monsoon rains. It is recorded that "two sufferers in the last stage of cholera were taken out of the [bathing] pool and died immediately afterwards." It is a religious custom of the Hindus—with which Europeans could not interfere without incurring a risk of provoking riots—to place pilgrims dying from cholera on the banks of any sacred water, of which they must drink. The Punjab medical records also show that, of the last 23 years in my chart

of the Punjab cholera incidence, in no fewer than 17 cholera was spread over that province by pilgrims returning from the Hardwar Fair (Rogers, 1928).

The Puri Pilgrimage Fair.—The Jaganath Temple at Puri, Orissa, on the east coast of India south of Calcutta, is visited yearly in March and July by many thousands of pilgrims from all parts of India. In specially sacred years 250,000 may be camped around an insanitary town of 49,000 people, their only water supply at the time I am concerned with coming from easily contaminated shallow wells and open tanks. No wonder Orissa for long has had the highest cholera death rate of any of the 200 divisions of India. Here again all the years with the highest cholera incidence had been preceded by very deficient south-west monsoon rains. The returning pilgrims spread the disease far and wide to Lower Bengal, Bihar, the Central Provinces, and North-East Madras, as indicated in the map.

The Pandarpur Pilgrimage.—Bombay Deccan lies to the east of the Western Ghats, with the Pandarpur pilgrim centre about the middle. Cholera is regularly spread by pilgrims returning to their homes from the June Fair. An exception was 1910, when there was no cholera within hundreds of miles to be spread. Here again all the more severe

epidemics followed serious deficiencies of the monsoon rainfall of the previous year.

Pilgrimages in the Madras Presidency.—This is an important endemic area, with the highest annual incidence and rainfall in the cold weather months, and absolute humidities of well over 0.400, as well as the highest rainfall from the north-east monsoon in October to December in the most densely populated south-east area. Madras has no very large pilgrimages, yet has a total of 2,500,000 pilgrims a year, who have been repeatedly recorded to have spread cholera.

Returns from India show an average of 20 million pilgrims travelling every year to attend the major fairs, so the problem of preventing spread of cholera by them is one of great magnitude.

Map showing Indian provinces (before 1948), cholera endemic areas (shaded), pilgrim centres, and the January absolute humidity line of 0.400.

Forecasting Cholera Epidemics in India

The evidence summarized above convinced me that the approximate dates of the spring outbreaks of cholera can be foreseen by watching the absolute humidity data, and the probability of their reaching epidemic proportions in any given area can be estimated from the monsoon rains of the previous summer. To test the correctness of that conclusion I arranged for the necessary data to be supplied from India at the end of the south-west monsoon early in October, and was able to send my forecasts by air mail in time to be published in the *Indian Medical Gazette* before the annual spring rise of cholera incidence. They proved remarkably correct, as was noted in the annual medical reports of the Government of India (1930, 1933).

Recommendations for Control of Cholera Epidemics in India

The epidemiological inquiries summarized above convinced me that the only possible way to control cholera epidemics in India was the use of wholesale inoculation of millions of pilgrims *before* they reached the fairs after long journeys by road and rail, usually through cholera-infected districts. The elaborate sanitary measures for long in use at the places of pilgrimage could not prevent their infection either on their long journeys to the fairs or at the place of pilgrimage, in view of the religious customs above described at the Hardwar Fair of 1892. I therefore drew up a memorandum on the history of the repeated outbreaks of cholera at these fairs and their wide diffusion by the pilgrims, especially in unfavourable years after failure of the previous monsoon rains, together with their occasional extensions to Europe as pandemics for which India is responsible. I advised compulsory anti-cholera inoculation as the only possible way to prevent such catastrophes, but a unanimous verdict of the public health officers that my proposal was "impracticable" was endorsed by the responsible administrative authorities. It was justly pointed out that the use of compulsion

might provoke riots on the ground of interference with the religious customs of the people. That decision had to be accepted and more propitious conditions awaited.

Compulsory Inoculation of Pandarpur Pilgrims Successfully Carried Out

The good seed had, however, been sown, and it was not long before it came to fruition. In the meantime the provincial administrations had been handed over to Indians, and in 1936 the medical authorities of the Bombay Presidency realized that all the conditions favourable to a serious outbreak of cholera at the June Pandarpur Fair were present. They therefore had the courage to order the compulsory inoculation of all pilgrims *before* their admission to the fair, either before setting out on their dangerous journey, or *en route* by the doctors who had for years past accompanied each band of pilgrims. This was accomplished with very little difficulty, and at the end of the cholera season the medical authorities were able to report that "the spread of the disease was thus effectively prevented." Four years later the Bombay public health office recorded that "since the year 1937"—that is, following the year in which compulsory inoculation was introduced at Pandarpur—"there has been no outbreak of cholera at the fair." This favourable report was confirmed by an analysis I recorded of the cholera and meteorological data of the Bombay Deccan for the six years before and seven years after introduction of the new measures (Rogers, 1944).

As the direct result of the above success the Central Advisory Board of Health in 1939 appointed a committee, which reported favourably on the Pandarpur trial; so the Board sanctioned trials of the new measure in every province of India. Moreover, an Indian member rightly pointed out that in the performance of their religious duties the pilgrims must not endanger the lives of other people by spreading cholera infection as the result of refusing to be protected by inoculation. In 1952 an Indian colleague sent me news of the remarkable success of the new system of cholera control all over India, and I recorded the information obtainable in this country at the time (Rogers, 1952).

Through the kindness of Colonel Pasricha, I.M.S., I also obtained the cholera data of the Indian State and the monsoon rainfalls from 1940 to 1951, which enabled me to complete my studies of the available records from 1866 to 1951—a period of 86 years—and recorded the results in 1953.

Extension of Compulsory Inoculation of Pilgrims Over All India

The following figures show the gradual increase of voluntary cholera inoculations of pilgrims in India during 1928–39 and of the very large increase of compulsory inoculations in 1940–51, after their use, which I had urged in 1926–8, was sanctioned in 1940.

1928–33	Average yearly inoculations	2,700,000	voluntary
1934–9	"	6,694,000	voluntary except in Bombay Deccan
1940–51	"	22,500,000	compulsory for pilgrims

As the result of the general sanction of compulsory inoculation of pilgrims in 1940 the 5,608,310 inoculations performed that year rose to over 12,000,000 in 1941 and 1942; and in the famine years 1943 and 1944, owing to high wartime food prices, they reached 19,860,715 and 28,805,514 respectively. During 1945 and 1951 they varied between 20 and 28 million (Rogers, 1953).

The annual cholera deaths and the previous monsoon rains, and the high rates due to the famine, are dealt with in my paper of 1953, so it will suffice to mention here the following recorded effects of the unprecedentedly increased inoculations.

Results of Compulsory Inoculation of Pilgrims Attending Kumbh Fairs

I had especially urged the compulsory inoculation of the one to three million pilgrims attending the 12-yearly excep-

tionally large Kumbh Fairs at Hardwar and Allahabad, because any success under these difficult conditions would ensure the general adoption of the measure. Two such fairs took place in the decade under consideration, and Table I, from my paper of 1953, compares their cholera

TABLE I.—*Cholera Deaths Per 1,000 at 12-yearly Very Large Kumbh Fairs*

Allahabad Kumbh Fair Years					Hardwar Kumbh Fair Years			
Year	Bihar-Orissa Deaths per 1,000	United Provinces Deaths per 1,000	Monsoon Rains in Previous Year	Compulsory Inoculation of Pilgrims	Year	Punjab Deaths per 1,000	Monsoon Rains in Previous Year	Compulsory Inoculation of Pilgrims
1870	(No record)	—	—	—	1867	2.4	?	Nil
1882	3.38	2.02	Good	—	1879	1.4	Good	"
1894	4.88	3.80	"	Nil	1891	0.49	"	"
1906	4.06	3.14	Deficient	"	1903	0.37	"	"
1918	5.90	2.56	Good	"	1915	0.68	"	"
1930	4.60	1.35	"	"	1927	0.55	"	"
Average 1942	4.65	2.57	"	1,249,506 in Bihar and U.P.	1938	0.19	"	"
Reduction 1954	6½-fold	25-fold	Good	2,007,749	Average 1950	0.92	"	Over 1,000,000
Reduction	39-fold	69-fold			Reduction	92-fold		

mortalities with those of such fairs back to 1867. Thus, in the case of the five more fatal Allahabad Kumbh Fairs from 1882 to 1930 without compulsory inoculation, the average deaths in Bihar and Orissa of 4.65 per 1,000 were reduced to 0.7 per 1,000 in 1942; in the United Provinces the decline was 25-fold. The total saving of lives in the two provinces in 1942 I estimate at 146,200.

Likewise the introduction of compulsory inoculation of one million pilgrims attending the Kumbh Fair at Hardwar in 1950 resulted in a 92-fold reduction in the cholera mortality as compared with the average figure of the seven previous Kumbh Fairs back to 1867; but in this case the saving of life was much less because the Punjab has the lowest cholera death rate of India, owing to its being furthest removed from the north-east endemic area from which it was yearly reinfected.

In 1954 a further Allahabad Kumbh Fair took place. Compulsory inoculation of the pilgrims was again carried out, 2,007,749 inoculations having been recorded in the United Provinces that year. The cholera death rate per 1,000 in Bihar and Orissa fell to 0.12, or a 39-fold reduction of the average figures before the adoption of compulsory inoculation of pilgrims. Similar data for the United Provinces show a death rate of 0.04 per 1,000, being 69-fold reduction on the pre-inoculation days, with a considerably larger saving of life than in the similar fair of 1942.

The unprecedentedly good results of the new measures of control are borne out by the following records of the public health officers, who carried through the immense task involved in the inoculation of millions of pilgrims. Thus Dr. A. C. Banerjee (1951) recorded that "only 11 cases [of cholera] occurred in connexion with the 1950 Kumbh Fair at Hardwar; they were all imported ones, which were all detected and isolated, and no secondary ones occurred." Moreover, "no cholera outbreaks occurred from this fair in the United Provinces or in adjoining provinces," which included the Punjab.

A control to the above is furnished by the record of a pilgrim fair at Sumaria, in Bihar, "which was overlooked by the medical authorities owing to its recurring at long and irregular intervals. Consequently neither the usual sanitary precautions nor anti-cholera inoculations were carried out; with the result that a smart outbreak of cholera followed this fair."

Reduction in Cholera Mortality in India Following General Adoption of Compulsory Inoculation of Pilgrims

In 1928 I showed the great yearly variations in cholera mortality in India to be due to deficiencies of the south-west monsoon rains of June to September of the previous year. The other main factor is the spread of the infection by the one to three million pilgrims attending the 12-yearly Kumbh Fairs at Hardwar and Allahabad. Unless these potent factors are taken into account one series of years cannot safely be compared with another series. I have therefore prepared Table II to illustrate this point. Cholera

TABLE II.—Analysis of Cholera Mortality Rates of India for 75 Years

Period	Average Yearly Deaths and Rate per 1,000	Maximum Yearly Deaths and Rate per 1,000	Minimum Yearly Deaths and Rate per 1,000	Causes of High Yearly Cholera Mortalities
1880-9	291,800 1.50	1887 473,875 2.45	1880 118,532 0.65	Deficient monsoon rains in 3 years 1882. A.K. Fair spread cholera
1890-9	398,858 3.40	1892 724,384 3.40	1898 151,510 0.71	Deficient monsoon rains in 4 years 1892. Famine year. Spread over Europe 1894. A.K. Fair spread cholera
1900-09	417,962 1.91	1900 797,273 3.72	1904 192,835 0.85	1900. Famine after general failure of 1899 monsoon 1908. Widespread failure of 1907 monsoon 1906. A.K. Fair spread cholera
1910-19	386,519 1.63	1919 578,426 2.43	1917 267,002 1.12	1919. Widespread failure of 1918 monsoon 1915. A.K. Fair spread cholera
1920-9	227,438 0.94	1921 450,608 1.87	1928 73,002 0.30	1921. Widespread failure of 1920 monsoon 1928. Partial failure of 1927 monsoon
1930-9	170,512 0.65	1930 337,322 1.40	1932 67,219 0.24	No failures of previous monsoon rains 1930. A.K. Fair spread cholera 1938. H.K. „ „ „
1940-5	260,966 0.87	1943 459,930 1.50	1940 86,132 0.35	1942-44. Famines due to war-time high food prices 1942. A.K. Fair. Pilgrims inoculated. 25-fold reduction of cholera
1946-55	79,057 0.39	1948 162,370 0.7	1954 13,554 0.554	No widespread monsoon failures 1950. H.K. Fair. Pilgrims inoculated. 92-fold reduction of cholera 1954. A.K. Fair. Pilgrims inoculated. 69-fold reduction of cholera

data became available for greater Bengal and Assam only in 1877-8, so the table shows the data for each decade from 1880 to 1955 except for the exceptional period of 1940-5, on account of the unique famine due to a several-fold increase of food prices during the second world war.

In considering such a long period it must first be borne in mind that during the 75 years dealt with there has been a steady improvement in the sanitary conditions of the towns, but very little in the vast number of small villages, in which 85% of the population live out their lives. Secondly, there has been a great rise in the population, so the rates of cholera deaths per 1,000 are most comparable.

In each of the first five decades from 1880 to 1929 there were two or more years of very high mortalities due to failure of the monsoon rains of the previous year or to the occurrence of an Allahabad or Hardwar Kumbh Fair, or to both. It will be observed that there was no material decrease in the average cholera mortality per 1,000 in those five decades except a decline in 1920-9 to 0.94 from 1.63 in the previous decade; this is partly accounted for by the

absence of any Kumbh Fair in that decade. The steady improvement in railway communications may have helped by reducing the necessity for long marches through infected villages. On the other hand, 1930-9 is the first decade in which there had been no failure of the previous monsoon rains; so it is significant that the only years of high cholera incidence were those of Kumbh Fairs at Allahabad in 1930 and at Hardwar in 1938. Accordingly the death rate fell from 0.94 in 1920-9 to 0.65 in 1930-9, the lowest up to this time. Yet in the succeeding period of 1940-5 the figure rose once more to 0.87, due to the great rise in wartime food prices already mentioned, with a maximum cholera mortality of 459,930 or 1.50 per 1,000, and that too in spite of previous good monsoon rains and the then recently adopted compulsory inoculation of pilgrims.

Thanks to the kindness of Colonel Pasricha, I.M.S., and of the Director-General of the India State in sending me the cholera records of the last four years, 1952-5, I am able to summarize them in Table II and to give the yearly figures in Table III, in view of their great significance. It is fortunate that in the last decade (1946-55) there was no material failure of the monsoon rains and that Kumbh Fairs took place at both Allahabad and Hardwar, making it as comparable as possible as regards the cholera death rates with the decade 1930-9, just before the adoption of the new compulsory inoculation of pilgrims all over India. The total

TABLE III.—Cholera Deaths and Rates Per 1,000, 1946-55

	No. of Deaths	Rate per 1,000	Averages
1946	123,727	0.5	0.5
1947	103,101	0.4	
1948	162,870	0.7	
1949	74,326	0.3	0.29
1950	96,716	0.4	
1951	41,543	0.2	
1952	55,327	0.2	
1953	98,663	0.35	0.05
1954	13,554	0.05	
1955	13,970	0.05	
Total 1946-55	783,793		
Average	78,380	0.39	

deaths, however, for the last period are those of the Hindu Republic of India, and do not include those of the Mohammedan Pakistan; but as the latter area is mainly composed of the Western Punjab, with the lowest cholera mortality in the Indian peninsula, this does not materially affect the cholera death rate, so the decline of that figure from 0.65 per 1,000 in 1930-9 to only 0.39, an unprecedented decline of 40%, can only be due to the large-scale adoption of compulsory inoculation of pilgrims in the last decade.

Table III gives the yearly total cholera deaths and the rates per 1,000 population in the decade 1946-55. It is remarkable in that it shows a steady decline in the yearly cholera death rates, averaging 0.5 in the first three years, 0.3 in the next five years, followed by an unprecedented fall to 0.05 in the last two years of the decade. It should be mentioned that the recent data for 1955 are wanting for three areas, but they have been estimated on a liberal scale from the rates of neighbouring areas, so can be relied on as being approximately correct. They reveal a cholera death rate of 0.05, against one of 0.65 in the decade 1930-9. This cannot but be due to a cumulative effect of the compulsory anti-cholera inoculations of the last 15 years, which now amount to approximately 300 millions, or a considerable proportion of the Hindu population of India.

Table IV has therefore been worked out to show the relative decreases in the endemic and epidemic areas respectively in the minimum years 1954 and 1955, as compared with the average deaths per 1,000 in 1930-9, immediately before the large-scale adoption of compulsory inoculation of pilgrims—a measure which was expected to exert the

greatest preventive effect in the epidemic areas, which have been so frequently infected by the movements of pilgrims. This is confirmed by the data in the lower part of Table IV. Thus the Bombay Presidency shows a 45-fold reduction, and it was in connexion with the Pandarpur Fair that com-

TABLE IV.—*Cholera Incidence Before and After General Inoculation of Pilgrims*

Province	Before Inoculations 1930-9		After Inoculations 1954-5		
	Average Cholera Deaths	Rates per 1,000	Average Cholera Deaths	Rates per 1,000	Reduction to
Assam	4,410	0.63	24	0.01	1/63
Bengal	50,220	1.08	2,065	0.08	1/13
Orissa	37,400	1.10	859	0.11	1/10
Bihar			4,924	0.12	1/9
Madras	23,580	0.39	2,522	0.04	1/10
Total endemic areas ..	115,610		10,394		
United Provinces	21,500	0.50	2,350	0.04	1/12
Punjab	820	0.04	Nil	Nil	—
Bombay	8,550	0.45	376	0.01	1/45
Central Provinces	12,740	0.91	434	0.02	1/45
Total epidemic areas ..	43,610		3,160		
Grand total ..	159,220		13,554		

pulsory inoculation of pilgrims was first adopted in 1936. The Central Provinces, which also had a 45-fold reduction, are liable to infection from three sides by pilgrims from Puri, Allahabad, and Pandarpur. Moreover, in the Punjab epidemic area cholera has been eliminated in the last two years. The United Provinces—endemic area—however, show only a 12-fold reduction, but the eastern divisions are early infected from the Bengal endemic area.

On the contrary, in the endemic areas shown in the upper part of Table IV, of the rates per 1,000 in 1954 and 1955, the reductions, as compared with 1930-9, amount to from 1/13 to 1/9, with the exception of Assam, which has poor communications with Eastern Bengal, showing a figure of 1/63.

Nevertheless the reductions to an average of 1/10 in the endemic areas is greater than might have been expected; so they bear out my suggestion that cholera incidence in India as a whole is gradually being brought under control by the general adoption of compulsory inoculations of the immense numbers of the moving bands of pilgrims throughout India.

Since the above paragraph was written news of a serious failure of the north-east monsoon rains of October to December, 1956, in Ceylon, and consequently in the densely populated south-eastern districts of Madras, has been received. Cholera epidemics under such conditions have been recorded (Rogers, 1928), so it will suffice to recall that the highest cholera deaths in the Madras presidency were 148,193, or 5.08 per 1,000, in 1876, and 357,430, or 12.24 per 1,000, in 1877, immediately following serious failures of the monsoon rains in two consecutive years; against only 313 deaths, or 0.01 per 1,000, in 1874. The most serious famine of southern India also resulted from these failures of the rains. The next highest cholera mortality in Madras occurred in 1897 following a similar failure of the north-east monsoon, when the Madras Presidency recorded 180,000 deaths, or 4.38 per 1,000.

The crucial test, mentioned above, of the control of cholera epidemics by the large-scale inoculation of moving bodies of the people on pilgrimages, or in famine years in search of food, is at hand, but the greatly improved rail and road communications should much simplify the problem of feeding the people in their own villages. The public health services will doubtless see the necessity of immunizing any who have to be moved to famine camps. The results of the new control measures under the present very unfavourable conditions will be awaited with the greatest interest.

The Outlook

The remarkable decline of cholera in the last decade was favoured by the unusual absence of any material failure of the monsoon rains, which in the nature of things cannot continue much longer. The crucial test will come in a year following a widespread failure of the monsoon rains. The outlook, however, is now more favourable than in the half-century 1880-1929, illustrated in Table II, with a yearly average of 344,000 cholera deaths.

In the first place if the recent decline of cholera mortality in the endemic areas to one-tenth of the rate before the adoption of general protective inoculations of pilgrims is maintained, it will have greatly reduced the sources of infection of the large epidemic areas. Secondly, the steady improvement of railway communications has been greatly augmented by a remarkable development of motor services and construction of new roads, which will much facilitate the distribution of food to formerly remote villages. This will do away with the necessity of feeding people in large famine camps, in which cholera was rampant in earlier days. I would urge that where such camps may still be necessary all entrants should be inoculated, preferably before admission, for the people are now fully aware of its advantages. Thirdly, the successful extension of the curative treatment to the villagers by means of field hospitals and ambulances will doubtless save many lives in future.

Summary

Studies of the cholera vital statistics of the last 90 years are described which led me in 1926 to advocate the compulsory inoculation of some 20 million pilgrims yearly, as the only method of controlling cholera epidemics in India. At that time the medical and administrative officers found this suggestion to be impracticable, but in 1936 it was carried out with success in the Bombay Deccan, and as a consequence was extended all over India, with very satisfactory results. During 1941-55 some 300 million pilgrims have been inoculated against cholera in India, with satisfactory results, and the outlook for the continued success of the measures for controlling cholera epidemics are considered to be good.

The nineteenth century was characterized by the frequent spread of pandemics of cholera over Europe. They should prove to be preventable in the future.

REFERENCES

- Banerjee, A. C. (1951). *Indian J. med. Res.*, 39, 17.
- Rogers, L. (1908). *Proc. roy. Soc. B*, 81, 291.
- (1917). *Lancet*, 2, 745.
- (1921). *Ibid.*, 1, 1097.
- (1926). *Proc. roy. Soc. Med.*, 19, Sect. Epidem. State Med., 59.
- (1928). *Indian J. Med. med. Res.*, Memoir 9, 1.
- (1930). *Proc. roy. Soc. Med.*, 23, 793.
- (1933). *Trans. roy. Soc. trop. Med. Hyg.*, 27, 217.
- (1944). *Ibid.*, 38, 73.
- (1952). *Brit. med. J.*, 2, 1219.
- (1953). *Trans. roy. Soc. trop. Med. Hyg.*, 48, 42.
- and Mackelvie, M. (1908). *Indian med. Gaz.*, 43, 165.

In November, 1857, John Murray published David Livingstone's *Missionary Travels and Researches in South Africa*. In reviewing the book, the *British Medical Journal* declared that Dr. Livingstone "never would have accomplished his adventurous journey had it not been for acquaintance with the healing art. The various savage tribes whose territories he had to traverse were deaf to the voice of the missionary, but were capable of appreciating the good services of the medical man. A knowledge of the healing art is acknowledged by Dr. Livingstone to be indispensable to those who would penetrate the untrodden wilds of this vast continent; and he frankly confesses that all missionaries " . . . should possess a competent knowledge of medicine. This is indeed a high testimony to the benevolent and all-powerful character of our profession."