A preliminary report on the influenza pandemic of 1918 in India / by the Sanitary Commissioner with the Indian Government [F. Norman White].

A

PRELIMINARY REPORT

ON

THE INFLUENZA PANDEMIC OF 1918 IN INDIA

BY

THE SANITARY COMMISSIONER WITH THE GOVERNMENT OF INDIA.

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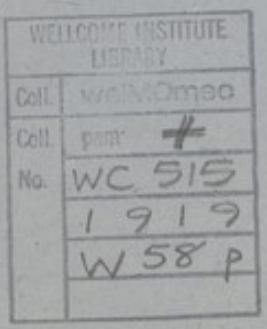

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The pandemic of influenza, from which India, in common with most other countries in the world, has been suffering, was more widespread and more virulent than any recorded in the history of disease. No other outbreak hitherto experienced has approached it in intensity and it is doubtful whether any epidemic disease in the world's history has ever devastated such large areas of the globe in so short a time, and to such a degree, as did influenza in 1918. The virulence of the outbreak far exceeded that of the influenza pandemics of 1803, 1833, 1837, 1847 and 1890, which were the five years of out-standing influenza mortality in the last century. Moreover, in respect to the frequency of serious complications, the recent outbreak was exceptional in most of the affected areas from which reports are available. In many countries the epidemic assumed the proportions of a national calamity. This was certainly the case in India. From the incomplete information, at present available, it would appear that no country suffered as severely as did India, during the last quarter of 1918. Altogether influenza was responsible for a death-roll of approximately five millions, in British India alone. Detailed information regarding the incidence of the disease in Native States is not available at the time of writing, but it is unlikely that the influenza mortality therein fell short of one million. Without fear of exaggeration, it can be stated then that in a few months influenza was responsible for six million deaths in India, that is to say, more than half the mortality attributable to plague in the twenty-two years during which plague has prevailed in epidemic form in this country.

2. The world had grown accustomed to the presence of a certain amount of "influenza" in its midst. Partly on this account, and partly owing to the fact that nearly 30 years had gone by, since the last severe epidemic, the disease had come to be regarded as a not very serious or fatal complaint. "Influenza" uncomplicated is certainly not a very fatal disease, in ordinary circumstances, but never again will its presence in our midst be regarded as anything but a most serious menace to the public health.

3. In the earliest stages of the outbreak in India, as in most other countries affected, the disease ran a mild course and the case mortality rate was almost insignificant. With the onset of the second epidemic wave fatal complications chiefly affecting the lungs and respiratory tract became very prevalent and were responsible for mortality rates which in many cases were without parallel. The disease spread with lightening rapidity and very few sections of the population escaped. Town and village alike suffered, but, on the whole, the mortality and distress was greater in rural than in urban areas.

4. With the rapid increase in mortality, which accompanied the second epidemic wave, wild rumours as to the nature and causation of the disease, having little or no foundation in fact, became extremely prevalent and it would be well to clear the air of some of these, should such false ideas still prevail.

There is not the least evidence that the disease was any other than influenza: it was in no sense a new disease. It was not an unusual manifestation of plague; the two diseases are completely separate and distinct. There is no evidence which directly connects the epidemic with the war; influenza is not a "war-disease" and it prevailed more virulently in countries remote from the war areas than it did in those which were the scene of military operations. There is no evidence that the disease originates in malnutrition; it prevailed in virulent form in countries such as the United States of America, where food was by no means scarce; the well-to-do

classes were in no sense immune to attack. The incidence of the disease was very high in the well-fed British troops in India; incidentally it may be noted that the incidence was greater among British than among Indian troops. Though no claim that the disease originates in malnutrition can then be substantiated, it cannot be denied that malnutrition was occasionally a factor of importance in determining a fatal issue. A sufficiency of nourishing food both during the attack and during convalescence is more than desirable and it was most unfortunate that the epidemic should have afflicted India in a year when the monsoon had failed. During the latter half of 1918 the stocks of food grains in India were relatively low, prices were abnormally high and a scarcity of fodder was responsible for the scarcity of milk which was in some places almost unprocurable. Such wild unfounded rumours as those which attributed the pandemic to the extensive use of poison gas on the western front, or to the evil machinations of our unscrupulous enemy, would scarcely have deserved mention, had they not been so current in India during the months of October and November.

5. The wide prevalence of the disease under the most diverse climatic conditions makes it impossible that unusual meteorological conditions should have played any important part in producing the high morbidity rates and they appear to have had, in India, but little effect on mortality. The recent outbreak has in fact demonstrated conclusively that influenza can spread with almost equal facility under most diverse climatic conditions. In this connection the second virulent wave, which inflicted so great a death-rate on the world's population, was experienced in nearly every country at or about the same time. As widely separated and dissimilar places as England, Scotland, Ireland, France, Germany, Switzerland, Tangier, Sierra Leone, South Africa, Canada, United States, Aden, Persia, Mesopotamia, Afghanistan and all parts of India, all suffered from a very virulent epidemic wave in the month of October. The disease persisted into the following month towards the end of which there was an appreciable decline in the morbidity and mortality rates almost everywhere. This synchronization of outbreaks of the disease in an extremely virulent form in places so diverse as regards climatic and other conditions, is a phenomenon impossible to explain on any theory that has ever been advanced to solve the problems presented by the rise and decline of great epidemics.

6. There is no doubt whatever that the virus of influenza is a living germ capable of being transmitted directly from man to man. The nature of this germ is still a matter about which dogmatic assertions are unwarranted. The so-called influenza bacillus was certainly almost constantly present in the cases investigated during the second severe epidemic wave in India; it does not appear to have been demonstrated so frequently during the early mild stages of the epidemic. Whether the influenza bacillus is the true cause of the disease, or merely a constant concomitant, is a question that is open to doubt. Recent observations that have been made in France indicate the possibility that the true cause of the disease is in some stage of its life history ultramicroscopic, or in other words a germ so infinitely minute that the highest powers of the microscope are unable to de nonstrate it. Be the primary cause of influenza what it may the mortality of the recent outbreak was almost entirely due to secondary infections with other disease-producing germs, notably the *pneumococcus*, the germ which commonly causes pneumonia. The pneumococcus was constantly associated with fatal cases in India. Much of the mortality in England and other European countries was ascribed to secondary infection with a *streptococcus*—another disease producing germ. No constant association of germs of this latter class with severe influenza cases was noted in India though its occurrence has been reported, for example from Assam.

7. Another very striking feature of the recent outbreak was the extreme rapidity with which the disease spread over the globe, a rapidity so great that modern increased facilities for rapid human intercourse fail to supply an altogether adequate explanation.

8. Some authorities affirm that one attack of the disease confers very slight and transient, if any, immunity. If true, it is rather difficult to explain the very short duration of the severe outbreaks, which have been experienced in India, and the complete, or almost complete, disappearance of the disease from places, which a few months back were in the throes of a most virulent outbreak. Several reports that have been received call attention to the rarity of two attacks in the same individual.

9. The incidence of an unusual wide-spread epidemic seems to have been first noted in Spain during the months of April and May. According to statements in the French lay press eight million cases of the disease occurred in Spain in the latter month, but the case mortality rate seems to have been remarkably low. The disease spread to France, Britain, Germany and other European countries where its distribution was widespread, but was unaccompanied, as in Spain, by anything in the nature of an alarming mortality rate. By the end of July the pandemic appears to have been definitely on the wane both in England and on the continent of Europe.

10. The first intimation that we had in India of the incidence of an unusual cause of sickness was in the month of June. Towards the end of that month many employees of offices, banks, etc., in the city of Bombay were incapacitated by fever: mill-hands and others were likewise suffering. The mortality in Bombay city during the first half of June was not abnormal. In the middle of June sporadic cases were noted in Calcutta, and in Madras towards the end of June. The cases that occurred early in the outbreak were so mild and the mortality caused thereby was so insignificant that it is almost impossible to fix a date for the commencement of the epidemic in India. Consequently it is extremely difficult to ascertain the source from which infection was introduced. It is by no means certain that infection was not already pre-existent in India. In this connection the Sanitary Commissioner to the Government of Bombay describes an outbreak of infectious disease in the Thana district during the early months of 1918, which in certain respects resembled influenza very closely. It is noteworthy, however, that some of the earliest cases diagnosed in Bombay occurred on board a transport that arrived in that port at the end of May; while in dock a number of cases of influenza occurred among the crew, who had free communication with the city. The fact that no cases of influenza were noted on board the transport prior to its arrival in Bombay makes it by no means certain that the vessel in question was instrumental in importing infection into that city. Influenza was likewise reported from Karachi in the month of June. In the month of July the disease was fairly widespread, being reported as far afield as the Punjab and the sub-montane districts of the United Provinces. Reports of outbreaks of influenza among troops were received in July from Maymyo, Karachi, Lansdowne, Jubbulpore, Abbottabad, Khandwa, Fort Lockhart, Quetta, Dehra Dun, Muttra and Chakrata. Though widespread throughout the country during July and August, the disease was not accompanied by any very appreciable increase in the mortality rates. In the middle of September, however, the mortality in Bombay city began to rise in an alarming manner until the 6th of October on which day 768 deaths were recorded. This second virulent epidemic wave occurred somewhat later in other parts of India and the total mortality of India in the month of October is without parallel.

11. Before describing the subsequent progress of the disease in the various parts of India and the relative incidence among various sections of the community, it might be well to refer to the criticisms that have been levelled at the inadequacy of our medical organization to cope with the epidemic. Though I should be the last to deny that our health organization in India is in urgent need of expansion and reform, it must be acknowledged that had we possessed health and medical organizations comparable in efficiency to those of the most progressive states of the world, we should even then have been unable to effect anything appreciable in checking the ravages of the disease. Though efficient health organizations throughout the rural areas of India would have given earlier information regarding outbreaks, and so indicated those places where medical relief was most urgently required, they would have been quite unable to arrest the progress of the disease. The medical arrangements were inadequate in every severely affected country, few of the administrations of which escaped adverse criticism. Medical personnel possesses no special immunity to the disease and the fact that their calling brought them into closer contact with infection than any other, resulted in a large percentage of them becoming incapacitated, when their services were most in demand. There is no specific cure or certain preventive for influenza and when it spreads with the alarming rapidity to which reference has been made, medical science can do but little to check its incidence. Overcrowded, ill-ventilated dwellings and large congregations of people offer unrivalled facilities for the rapid

dissemination of epidemic diseases of the influenza type. Unfavourable environmental conditions doubtless contributed in many instances to the severity of the outbreak, but even the most up-to-date sanitary surroundings by no means postulate complete immunity from influenza.

12. Before considering the incidence of influenza mortality in the various administrations it is necessary to call attention to the fact that the registration of vital statistics in India is still in a very backward condition. Deaths are recorded under six main heads of mortality which do not include influenza; in any case but little reliance can be placed on the recorded cause of death except in the case of a few large towns. The reporting agency is for the most part completely ignorant of medicine and some are hardly literate. The total number of births and deaths recorded has, however, some claim to accuracy and such figures may be taken as being reasonably close approximations of the truth. In the case of the widespread epidemic which we are considering the delays and difficulties attendant upon the collection of vital statistics in India were more in evidence than usual, owing to the fact that so large a proportion of the reporting and recording agency fell victims to the disease. The figures which are discussed in this report deal only with a period ending November 30, 1918. By that date the disease was almost everywhere on the wane, and in most parts of the country the death rates had fallen almost to normal. The influenza mortality has been estimated by deducting the normal mortality for the period of the year under consideration from the actual mortality recorded in 1918, due allowance being made for the co-existence of other epidemic disease. Had it not been for influenza the latter half of 1918 would have been abnormally free from epidemic disease; the present plague epidemic is the mildest experienced since 1898 and the failure of the monsoon determined a malaria incidence below normal. The influenza mortality figures here reproduced are thus approximations only: they in no wise overstate the case. It has, of course, been quite impossible to arrive at any accurate estimate of the number of cases of influenza that occurred. For the purpose of gauging the case mortality rate the army and jail statistics are of considerable value. The army statistics also permit a comparison of the incidence of sickness and death among Europeans and Indians, respectively.

13. The full force of the outbreak was felt by the Central, Northern, and Western portions of the Empire in comparison with which Bengal, Burma, Bihar and Orissa, Madras and Assam suffered but lightly. The outbreak was extremely severe in Persia and Afghanistan, apparently as severe and as widespread as the synchronous epidemic that ravaged the North-West Frontier Province, the Punjab, Delhi and the west of the United Provinces. Further east there was a gradual diminution in intensity. Below are tabulated the Administrations of British India detailing the estimated number of deaths directly, or indirectly, attributable to influenza that occurred in each. The provinces are arranged in order of the severity of incidence of the disease. Only deaths that occurred prior to November 30, 1918, are included: the vast majority occurred in the two months, October and November:—

Province.	Population (census 1911).	Total estimated influenza deaths.	Influenza death-rate per thousand.
Central Provinces and Berar	13,916,308	790,820	56·8
Delhi	416,656	23,175	55·6
Bombay	19,587,383	900,000	45·9
Punjab	19,337,146	816,317	42·2
North-West Frontier Province	2,041,077	82,000	40·0
United Provinces	46,820,506	1,072,671	22·9
Coorg	174,976	3,382	19·0
Madras	40,005,735	509,667	12·7
Assam	6,051,507	69,113	11·4
Bihar and Orissa	34,489,846	359,482	10·3
Burma	9,855,853	60,000	6·0
Bengal	45,329,247	213,093	4·7
Total for British India*	238,026,240	4,899,725	20·6

*The small British province of Ajmere-Merwara, with a population of half a million, is not included in the table. No detailed report regarding the incidence of influenza therein has yet been received: it suffered considerably.

It will thus be seen that influenza within the space of four or five months was responsible for the death of 2 per cent of the total population of British India, the percentage of persons falling victims varying between 5·7 in the Central Provinces and 0·4 in Bengal. As regards the incidence of the disease in Native States but little information is, at present, available, with the single exception of Mysore. The total number of deaths ascribed to influenza in Mysore, in 1918, was 127,651, which is equivalent to a death-rate of 22·37 per thousand. The epidemic was extremely severe throughout the Central India States. The Administrative Medical Officer, Central India, has not yet received full reports, but is in a position to assert that the influenza mortality in Central India, as a whole, was not less than 6 per cent of the population, which approximates nine millions.

14. With regard to the relative incidence of the disease among various classes of the population, our information is, at present, meagre. Among troops serving in India, the incidence of the disease was greater among British than among Indians, though the Indian mortality rate was very considerably in excess of the British. For British troops the hospital admission rate per thousand of strength was 218·2 for influenza and 3·1 for pneumonia, as compared with 135·6 and 20·2 for Indian troops. The death-rates for British troops were 8·96 for influenza and 0·65 for pneumonia, as compared with 15·21 and 6·18, respectively, for Indian troops. The normal incidence of pneumonia among Indian troops is nearly four times that among British troops. Medical officers who have had experience of outbreaks of pneumonia, uncomplicated by influenza, among Indian troops in the North-West of India will agree that the *pneumococcus*, the common causative organism of pneumonia, is very much more toxic for Indians than it is for Europeans, and that the clinical manifestations of pneumonia among Indians are widely different to those presented by cases of pneumonia as seen in Europe, the toxæmia being much more profound. It is not surprising, therefore, to find the influenza and pneumonia death-rates of Indian troops in appreciable excess of those of European troops; on the contrary, it is perhaps surprising that the difference was not greater.

15. A study of the figures hitherto received indicates that influenza as experienced in India was especially fatal between the ages of 10 and 40 and that females suffered to a somewhat greater degree than males. Below is set out in tabular form the percentage increase in mortality at the various age periods for males and females, during the influenza epidemic, over the normal age and sex distribution of deaths in the province concerned. Figures are given for the Central Provinces, United Provinces, and Assam, the first of which suffered more than two and a half times as severely as the second and the second twice as severly as the third.

	Under one year.		1—5		5—10		10—15		15—20		20—30		30—40		40—50		50—60		Over 60.	
	M.	F.	M.	F.	M.	F.	M.	F.	M.	F.	M.	F.	M.	F.	M.	F.	M.	F.	M.	F.
Percentage increase in mortality during influenza epidemic at each of the age periods specified over the normal mortality in—																				
(1) Central Provinces ..	64	75	215	221	418	482	672	769	865	984	966	930	809	922	522	583	314	312	168	158
(2) United Provinces ..	70	69	205	198	405	377	463	465	765	733	795	852	653	745	462	521	328	351	205	217
(3) Assam	50	57	147	154	194	260	249	320	294	283	283	269	272	269	201	188	133	106	79	69

16. It is hardly possible to arrive at definite conclusions regarding the case mortality rate of influenza among the free civil population of India. The army and jail figures, however, are of considerable use in this regard, though their interpretation is not free from possibilities of error. During the influenza period there was a notable increase in the number of hospital admissions and deaths attributed to pneumonia, both among British and Indian troops. If we assume, as perhaps

we are justified in doing, that influenza was responsible for this increased incidence of pneumonia, the case mortality rates are high. Among British troops there were 18,757 admissions for influenza, 770 of which terminated fatally, a case mortality rate of 4·1 per cent. During the same period there were 217 admissions for pneumonia, 56 of which succumbed, a case mortality rate of 20·7. If the two sets of figures be combined the case mortality rate for British troops amounts to 4·3. Among Indian troops 45,310 hospital admissions were ascribed to influenza with 5,082 deaths, giving a case mortality rate of 11·2; for pneumonia there were 6,764 admissions with 2,064 deaths, a case mortality rate of 30·5. If the influenza and pneumonia figures be combined, the case mortality rate amounts to 13·7 per cent. Outbreaks that occurred in certain outposts garrisoned by Indian troops, notably in Persia, were characterised by an appalling virulence: in one small post there were no fewer than 90 deaths among a garrison of 125; that is to say, 72·8 per cent of the total strength succumbed. This is an extreme case, but it indicates in what fatal forms the disease appeared on occasions.

The jail case mortality rates varied somewhat in the different provinces: in Bombay it was 10·3 per cent for prisoners and 7·8 per cent. for establishment; in the United Provinces the figure was 7·05 per cent which is considered locally to be an over-statement; in Bihar and Orissa 5·35 per cent of the jail cases of influenza terminated fatally; in Assam the jail case mortality rate was only 1·69 per cent; in Burma the jail case mortality rate varied between 1·0 and 4·1 per cent; in the jails of Madras 3·43 per cent of the influenza patients treated succumbed; in the Central Provinces the jail case mortality rate amounted to 7·31 per cent.

The figures above quoted indicate the wide limits within which the severity of the disease varied in different provinces and among various communities. From the figures available it is not possible to frame a mean case mortality rate for India as a whole. In the earlier stages of the epidemic the mortality was negligible; whilst during the second virulent wave there were villages that lost more than half their population.

Central Provinces.

17. The first mild wave of influenza appeared in the Central Provinces in July. The disease was so mild in type that it produced but little effect on the mortality rate and it occasioned but little alarm. The second fulminating wave which appeared in September was the most violent outbreak of disease of which we have record in India. Practically all the 791,000 deaths attributable to influenza occurred in the two months October and November. The Provincial Sanitary Commissioner considers this figure ' an under-estimate ' because of the disorganised condition of the registration personnel. No districts escaped the ravages of the disease, though the incidence was by no means uniform. During the six months June to November, four districts had death-rates from all causes in excess of one hundred per mille: these were Damoh 129·42 (22·20); Yeotmal 116·86 (22·54); Akola 106·69 (22·75); and Saugor 103·77 (22·97). The figures in brackets denote the mean mortality rates in these districts for the corresponding six months of the previous five years. There was no other epidemic than influenza prevalent during the period, so the excess mortality can be ascribed to that disease without fear of over-stating the case. The rural areas suffered considerably more than did the towns. The average urban death-rates during the six months under consideration was 56·67 as compared with 74·95, the rural rate. The lowest district death-rates during these six months were reported from Bilaspur 36.28 as compared with a mean 16·15 and Raipur 47·98 as compared with 16·31, the mean.

The following towns, population in brackets, had death-rates during the six months in excess of one hundred: —Pussa (6,862) 120·22; Umakhada (5,822) 116·28; Balgaon (5,788) 116·27; Dulgaon (6,026) 105·70; Sahora (5,432) 102·91; and Mangrupur (6,072) 102·05.

The epidemic had not quite spent its force at the end of November, up to which date alone information is at present available.

The disastrous nature of the outbreak will be better appreciated when it is said that during two months influenza claimed as many victims in the Central

Provinces as died during the whole of 1897—the disastrous famine year. Two months of influenza caused twice as many deaths as have twenty-two years of plague in these provinces. In certain aboriginal villages the mortality was very great; poverty, scarcity of food and clothing and the fact that these villages are in an endemic malaria region appear to have contributed to the high mortality rates. Well-to-do people suffered lightly as compared with the poor villager in remote areas. Females suffered rather more than did males but the difference was not marked. Here, as elsewhere in India, the men are infinitely better cared for and tended when they fall sick than are their women-folk.

The Jail reports of the Central Provinces show that of 1,683 cases admitted to hospital 128 died, a case mortality rate of 7·31. This is a higher rate than that reported by some other Administrations, but that it is an over-estimate for the disease as it occurred in this part of India is hardly likely for in two months influenza killed 5·7 per cent of the total population of the province. Much of the mortality here, as elsewhere in India, was attributable to the impossibility of securing for the sufferers sufficient attention or any attention at all. It was by no means infrequent to find all the members of a household down with the disease at one and the same time, and each had to fend for him or herself as best they could.

Delhi Province.

18. Influenza was first noted in Delhi during the month of August and cases continued to occur throughout September, but there was nothing to give rise to alarm. Early in October, however, a fulminating outbreak was experienced which produced an appalling mortality. Delhi Province has an urban population of 225,471 and a rural population of 187,512. In Delhi city during the months of October and November influenza was responsible for 7,044 deaths equivalent to a death-rate of 31·2 per mille. During the same period 16,131 deaths attributable to influenza were reported from rural areas. This is equivalent to a death-rate of 86·0 per mille. In these two months 5·55 per cent of the total population of the province fell victims to the disease. In Delhi city the largest number of deaths reported on any one day was 418 on the 26th of October. About this time, it would not be an exaggeration to state that more than three-quarters of the total population of Delhi were either suffering or recovering from an attack of influenza. The number of deaths declined fairly rapidly to 55 on the 12th of November, by the end of which month the mortality was not appreciably in excess of the normal. The sudden onset of the disease in a severe form simultaneously in all parts of the province was noteworthy.

The writer had an intimate personal experience of the outbreak in Delhi Province. Pneumonia in some form or another was almost invariable in fatal cases though a few cases with very acute delirium early in the attack, succumbed before definite signs of lung involvement were noted. Though malnutrition appeared to be a factor of little or no importance in determining an attack of influenza, the insufficiently nourished members of the community offered a very feeble resistance to the disease. In other words malnutrition did appear to be a factor of importance in determining a fatal issue. No drugs appear to have any specific curative value but given nourishing food in a readily assimilable form, care and attention, it was surprising what apparently desperate cases ultimately recovered. In Delhi Province, as in other parts of India, the disposal of the dead was a matter which tried the resources of all concerned. The heart-rending scenes witnessed by all who took an active part in endeavouring to combat the influenza outbreak in India in 1918 will never be forgotten.

Bombay.

19. The Bombay Presidency was the first province in India to report the existence of epidemic influenza in 1918. It is generally believed that infection was introduced into the Presidency by two ships, the first of which arrived in Bombay on May 29, the second in Karachi on June 20. Cases did not occur on board the ships, however, until they had been in port some 48 hours, a period no shorter than the incubation period of the disease. Moreover, as the Sanitary Commissioner for the Government of Bombay points out, fatal cases of "influenza" occurred in the jails in 1917 and the mortality rates during March and April throughout

the Presidency and Sind were appreciably in excess of normal, which excess mortality does not appear to have been attributable to the more common Indian epidemic diseases.

The mild wave of influenza that was noted in June spread inland from Bombay city; the second virulent wave of September-October appeared to originate in the Deccan and spread thence to the coast. The usual epidemic diseases were less in evidence than usual in the Bombay Presidency in 1918, so it is probable that the excess mortality over the mean under-estimates the number of deaths attributable to influenza. October was the month of maximum mortality and the Provincial Sanitary Commissioner asserts that the number of deaths that occurred in that month approximates the total annual mortality of an unhealthy year. Complete mortality returns from the Bombay districts for the month of November are not all available and the rough estimate of 900,000 influenza deaths during September, October and November is likely to prove an under-estimate. That figure is equivalent to a death-rate of 45·9 per mille of the total population of the Presidency.

In Bombay city the first epidemic which began in June lasted barely four weeks. "In that short period," the Health Officer writes, "it cost the city over 1,600 lives, at least a million working days, and an incalculable amount of discomfort, expense and inconvenience." After an interval of nearly two months a second virulent outbreak occurred. After September 10, the daily mortality rose rapidly. The highest daily mortality was 768 on October 6, of which 161 deaths were reported as due to influenza, 461 to "respiratory diseases," and 161 to "ague or remittent fever." Between the 10th of September and the 10th of November the mortality exceeded the normal by 14,678, the total mortality during this period amounting to 20,258, an average of 326 deaths a day. Had mortality continued at this rate throughout the year the death-rate of Bombay city would have been 121·76 per thousand of the census population. Of the 20,258 deaths 9,752 were among females. For every hundred men in the city there are only 53 women, so the figure indicates the much higher rate of mortality among the female sex that was noted in many parts of the country. Thirty-six per cent of the deaths occurred among persons between 20 and 40 years of age. The incidence of mortality among the various communities was as follows:—Low caste Hindus, 61·6; Hindus other castes, 18·9; Mohammadans, 19·2; Parsees, 9·0; Jews, 14·8; Indian Christians, 18·4; Eurasians, 11·9, and Europeans, 8·3.

In the jails of the Bombay Presidency (10,644 prisoners, 2,987 establishment) the influenza incidence rate was 320·7 per thousand for establishment and 347·9 for prisoners. The mortality rate was 35·9 per thousand for prisoners and 25·1 for establishment. The case mortality rate was 10·3 per cent for prisoners and 7·8 per cent for establishment. With these figures as a rough guide it is probable that the number of attacks of influenza throughout the Presidency in 1918 approximated nine millions.

Punjab.

20. Influenza made its appearance in the Punjab in July and in the month of August mild epidemics were experienced in numerous towns, all with a low case mortality. In September most of the province was infected. In October the disease suddenly took on an excessively virulent form, and an extremely fatal type of pneumonia was a common complication. Young adults suffered most. During October and November influenza was responsible for more than 800,000 deaths. The following extract from a report by the Provincial Sanitary Commissioner gives a vivid description of the severity of the epidemic, an epidemic without parallel in the history of the province. The description is equally applicable to conditions prevailing in other severely affected tracts, outside the Punjab: "The hospitals were choked so that it was impossible to remove the dead quickly enough to make room for the dying; the streets and lanes of the cities were littered with dead and dying people; the postal and telegraph services were completely disorganised; the train service continued, but at all the principal stations, dead and dying people were being removed from the trains; the burning ghats and burial grounds were literally swamped with corpses, whilst an even greater number awaited removal;

the depleted medical service, itself sorely stricken by the epidemic, was incapable of dealing with more than a minute fraction of the sickness requiring attention: nearly every household was lamenting a death, and everywhere terror and confusion reigned."

No part of the province escaped. The total estimated influenza mortality during October and November amounted to 816,317 which is 4·2 per cent of the provincial population. Figures are not yet available which enable an estimate of the case mortality rate among the civil population of the Punjab; it may be pointed out, however, that a case mortality rate of 5 per cent postulates that nearly every person in the province suffered from the disease, which was certainly not the case. The poor and rural classes suffered most; the Provincial Sanitary Commissioner attributes this to the fact that such classes were adversely affected by economic conditions resulting from the war and failure of the rains; food prices were high, milk was scarce, and blankets and warm clothings very difficult to obtain.

North-West Frontier Province.

21. The estimated number of influenza deaths among the civil population of the districts of the North-West Frontier Province up to November 30 is 82,000, which is 4 per cent of the provincial census population of 1911. In addition to this some 55,000 deaths occurred in the trans-frontier area. Very little reliance can be placed on the approximate accuracy of this latter figure, as no organised system of registration is in force across the border.

United Provinces.

22. The first cases of influenza were noted in the montane and sub-montane districts in the month of July. The fact that such districts are the recruiting centres for hill-men may account for the first appearance of the disease in these relatively inaccessible parts of the province. The first mild epidemic wave affected most of the districts and lasted from the beginning of August to the middle of September; the second severe wave began in October, reached its height in the middle of November, after which the disease died down gradually. During this second wave lung complications were extremely prevalent and the mortality rate was very high. Between August 1 and November 30, influenza was the cause of 1,072,671 deaths. This figure has been arrived at by deducting the mean mortality from the actual mortality of the period, making due allowance for deaths caused by cholera and plague. The incidence of mortality in municipalities and rural areas was strikingly similar: thus in 15 Municipalities which employ Health Officers, with a combined population of 1,446,790, there were 33,817 deaths, equivalent to a death rate of 22·9 per mille. The remainder of the province, with a population of 45,373,766, had an influenza mortality bill amounting to 1,038,854 which is equivalent to a death rate of 22·8 per mille. No district escaped though the incidence of the disease was by no means uniform. During the four months we are considering 11 districts of the 48 had influenza death rates in excess of 100 per thousand *per annum*; these were:—Agra 149·05; Hamirpur 145·91, Meerut 141·02; Bijnor 131·27; Jhansi 127·61; Bulandshahr 126·26; Unao 123·37; Lucknow 115·06; Farrukhabad 107·69; Banda 100·88; and Muzaffarnagar 100·33. It is noteworthy that none of these districts are in the east of the province. The three districts of Almora, Pilibhit and Ballia escaped very lightly; here the influenza death rates *per annum* amounted to only 6·06, 7·21, 8·31 per mille, respectively. The epidemic reached its height in Cawnpore on October 28; in Agra, October 30; Lucknow, November 5; Benares, November 11, and Allahabad, November 13. Cawnpore, Agra and Muttra suffered more than any of the other large towns; here the actual influenza death rate during these four months amounted to 38·4, 35·6 and 34·1 per thousand of the population.

These figures are sufficient to show how severe was the outbreak in many parts of the province. Such a huge number of deaths occurring within so short a time made the disposal of corpses a matter of very great difficulty, with the result that numberless bodies were thrown into the rivers of the province. The authorities did everything in their power to cope with the matter but the difficulties were enormous. The methods of water purification in those towns which draw their water-supply from the rivers, appear to have been effective and no serious harm seems to have been done by this most objectionable practice.

From the jail statistics of the province, it appears that there were 8,335 admissions to hospital for influenza out of the total jail population of 28,163—an admission rate of 29·5 per cent: 588 of these cases terminated fatally, a case mortality rate of 7·05 per cent. The Inspector General of Civil Hospitals, United Provinces, considers this case mortality rate too high, as the mildest cases would not be admitted to hospital; he considers that the rate was probably not more than 5 per cent. In this connection the experience of certain mills in Cawnpore is of interest; here it was assumed that absence from work for two or more consecutive days during this period signified influenza. On this assumption the Elgin Mills, whose employees number 2,430, had an influenza rate of 61 per cent and a case mortality rate of 2·2 per cent. Three other Cawnpore mills giving employment to 6,628 people, reported an influenza incidence rate of 52 per cent in one month and a case mortality rate of 3·8 per cent.

It is the general view that anything from 50 to 70 per cent of the total population of the United Provinces suffered from influenza; assuming 50 per cent to be approximately correct, the case mortality rate for the province as a whole works out at 4·6 per cent. It was the general opinion in the province that both incidence and mortality were greater among women than among men.

Madras.

23. Nothing like full information is at present available from Madras. The mortality from all causes except plague, cholera, small-pox, dysentery and diarrhœa, and injuries, during the first eleven months of 1918, exceeded the mean mortality for these months by 509,667. This figure is by no means an over-estimate of the number of deaths that may be attributed to influenza. On this hypothesis the mean influenza death-rate for the Madras Presidency works out at 12·7 per thousand which is very much lower than that of the other provinces we have hitherto considered.

In Madras city influenza was responsible for 3,481 deaths, a death rate of 6·6 per thousand.

In the Madras jails, with a total population of 10,600, there were 3,378 attacks with 116 deaths, a case mortality rate of 3·4 per cent. It would thus appear that the disease was neither as prevalent nor as virulent in Madras as in the central, northern, and western parts of India. Nevertheless the whole of the Presidency was affected and no large areas appear to have escaped altogether.

Assam.

24. During September, October and November the estimated number of deaths due to influenza amounted to 69,113, which on the population of the last census gives a mortality rate of 11·4 per thousand. The epidemic had not come to an end on November 30 and the information from certain parts of the province is incomplete: it is certain, therefore, that the above figures are an underestimate of the severity of the disease as it affected Assam. In towns in which some sanitary organization exists the influenza mortality rate was only 6·8 per thousand. The Assam Jail Reports show that of a population of 2,381 there were 836 cases of influenza, 14 of which terminated fatally, a case mortality rate of 1·67 per cent.

Bihar and Orissa.

25. Here as in other parts of India influenza was first noted in July: the cases were mostly sporadic and mild. The second epidemic wave began in September and attained a maximum degree of severity in the middle of October. This second wave appeared first in the towns and travelled rapidly through the rural areas which suffered still more severely. During the months of July—November the total number of deaths reported exceeded the quinquennial mean mortality for these months by 359,482. No other epidemic disease was prevalent in the province and this excess mortality can all be ascribed to influenza without fear of exaggeration. This mortality is equivalent to a death rate of 10·3 per thousand of the provincial population. Of the excess deaths no fewer than 201,731 occurred in November. The disease was nearly twice as severe in rural areas as it was in towns, the urban mortality rate being only 5·8 as compared with

10·6 the rural rate. Of 1,625 cases of influenza treated in the Jail hospitals, 87 died, a case mortality rate of 5·35 per cent.

BURMA.

26. During the five months June—October, 44,235 persons are estimated to have died of influenza in Burma. The disease prevailed throughout November and has not yet completely disappeared. It is certain that the influenza death-roll will be found to have exceeded 60,000, which is approximately 6 per mille of the provincial population. The disease appeared in Rangoon at the end of June; about the middle of July it was present in epidemic form. Though undoubtedly a most serious factor in the vital statistics of the province, the influenza outbreak in Burma was mild when compared with the incidence of the disease in the Central Provinces, Bombay and the north-west of India.

BENGAL.

27. It is not known whether Bengal became infected by ship or by rail. Some of the earliest cases, in Calcutta appeared among employees of the Port Commissioners, a fact of some significance. Calcutta was the first place in the province to report influenza and the disease spread thence along the railway and steamer routes; the rural areas were last affected. No part of the province escaped. The first outbreak in Calcutta commenced in June and reached its height in the third week of July. The second outbreak appeared in Calcutta in the middle of September, in the dock area. The first outbreak spread very rapidly, but the disease was uncomplicated and the mortality was very low: the disease was largely confined to towns. The second outbreak was less widespread, spread somewhat more slowly than the first, but was very much more severe; mortality rates were very high and villages suffered more than the towns. There is a local consensus of opinion that the incidence of mortality was greater among the poor. Economic stress arising from high prices of food and clothing, insanitary over-crowded environment and the presence of endemic malaria, are considered by the local Sanitary Commissioner to have been factors of importance in determining high morbidity and mortality rates. The inmates of jails and asylums, Europeans, and well-to-do Indians appear to have enjoyed a relative immunity in Bengal. The mortality was highest in December. Deaths were more numerous among females than among males. Old people generally appear to have escaped. The disease was specially severe in malarial districts where it is stated the use of quinine as a preventive against malaria appeared to produce some protection from influenza. This observation is at variance with army experience, which showed that the daily administration of five grains of quinine or the admininstration of larger doses at intervals, was entirely valueless as a prophylactic against influenza.

Altogether 213,098 deaths were attributable to influenza in Bengal up to the end of November, a death-rate of 4·7 per thousand. This rough approximation almost certainly understates the case; complete figures are not yet available and, as has already been stated, the December influenza mortality exceeded that of the previous month. All the same, the incidence of and the mortality caused by influenza in Bengal was incomparably less than in most other Indian Provinces.

In Calcutta there were 3,673 deaths caused by influenza between September 1 and December 31, a death-rate of 4·1 per thousand. Kidderpore, with its large poverty-stricken coolie population living under most insanitary conditions, suffered much more than the other wards of the city, reporting an influenza death-rate, for the same period, of 21·1 per thousand. No other ward had a death-rate exceeding 6·6. The case mortality rate in Calcutta has been estimated from the available data as approximating 3 per cent. Males and females were attacked in like proportion; Hindus suffered more severely than Mohammadans; non-Asiatics and Anglo-Indians suffered much less than either Hindus, Mohammadans or Native Christians.

28. No detailed reference can be made in this report to the very virulent outbreaks of influenza that were afflicting the people living across our North-West Frontier and the populations of Afghanistan, Baluchistan and Persia. In all these areas the disease appears to have prevailed with all the intensity experienced in the adjacent parts of British India, if not with even greater intensity. Outbreaks in all these areas synchronized with the second virulent epidemic wave in India.

29. The main purpose of this preliminary report has been to summarize from the incomplete data at present available, some of the more important features of the havoc wrought by the influenza pandemic on the population of India. Anything like a complete epidemiological study is impossible at present: this must pend the receipt of more complete statistical data. The incomplete returns received are sufficient to enable one to realize something of the appalling nature of the calamity, beside which all other Indian epidemics, of which records persist, fade into insignificance.

30. A preliminary note of this nature would be incomplete, however, without some reference to the whole-hearted endeavours made by provincial administrations to ameliorate the sickness and suffering occasioned by the outbreak. In their efforts in this direction they were nobly seconded by non-officials, both medical and lay, philanthropic societies, educational establishments, and a host of philanthropic workers. Never before, perhaps, in the history of India, have the educated and more fortunately placed members of the community, come forward in such large numbers to help their poorer brethren in time of distress. The one bright feature in the long record of misery and death, afforded by a perusal of the provincial influenza reports, is to be found in the appreciations of philanthropy and private charity which were in evidence in most parts of the country. The epidemic struck India at a time when she was least prepared to cope with a calamity of such magnitude. War demands had depleted her medical personnel, which at the best is inadequate when compared with the size of her population. The over-worked medical personnel that remained was stricken down in large numbers. Still more serious were the effects of the almost total failure of the monsoon, practically throughout the country. The staple food grains, were at famine prices and the scarcity of fodder enormously reduced the quantity of milk available. The price of blankets and warm clothing was extremely high. Actual famine conditions prevailed nowhere, though there was undoubtedly a greater degree of malnutrition than has been the case during many years past.

31. In all the larger towns, where severe epidemics occurred, numerous additional dispensaries were opened and numerous agencies were employed for the free distribution of drugs and milk. In certain towns municipal grain shops were opened which supplied grain below the market rate. The villagers in far remote rural areas were in worse plight and, in certain cases, it was almost impossible to do anything appreciable to alleviate the suffering therein. In certain provinces notably the United Provinces, travelling dispensaries did a large amount of useful work, and in most provinces the whole of the vaccination staff were engaged in alleviating suffering and want. Endeavours were made by all administrations to instruct the people as to the nature of the disease, measures of prevention, and measures to be adopted when attacked. Circulars and pamphlets were widely distributed. Everything that could have been done with the agency available was done. In spite of this the vast majority of sufferers were without skilled attention of any kind. With a population as uneducated as is that of India to-day, and with the relatively low standard of living pertaining, the control of so virulent an epidemic is completely outside the present scope of human endeavour.

32. Summary of some of the scientific work carried out in India in connection with the bacteriology of the pandemic and the preparation of a vaccine.

On the appearance of the second epidemic wave, with its attendant high mortality, investigations into the cause of the disease, then recognized as an entity, were immediately commenced in our bacteriological laboratories. As usual popular opinion demanded an immediate explanation and the demand for a panacea in the form of a vaccine was insistent. It was commonly forgotten that research into the causation of disease is, as a rule, a matter of months or years and not of days. The perhaps not-unnatural demand for immediate results by the ill-informed is rather an embarrassment than a help to researches of this nature.

The epidemiological aspects of the disease resembled in many ways those of the less severe pandemic of 1891 which was, to the extent possible in that day, studied bacteriologically. The weight of evidence at that time pointed to a bacillus, named after its discoverer, Pfeiffer's influenza bacillus, as being the cause of the 1891 pandemic. This organism appears to exist in large numbers in the lung, throat, and nasal

secretions of sufferers during an epidemic: it is however by no means absent in non-epidemic times. Presuming it to be the true cause of the disease the factors that exalt its virulence, in times of pandemics, still remain completely unknown.

The literature dealing with the earlier stages of the epidemic in England emphasises the infrequency with which this organism was isolated from the sputum of influenzal patients, or from the lungs of cases dying from pneumonia. Later, however, owing to the use of specialized media for cultivating the organism, chiefly such media as have trypsinized, or heated, blood as a basis, Pfeiffer's bacillus was recovered from the majority of cases, in association, in England, with other organisms notably the *Pneumococcus*, *Streptococcus*, and *Micrococcus catarhalis*. In India also these initial difficulties in the detection and isolation of Pfeiffer's bacillus were experienced. Later special media, similar to those used in England, showed the bacillus to be almost uniformly present in cases of the disease. In this connexion it should be noted that two workers in the Parel Laboratory, Bombay, Drs. Sopankar and Gore, working independently, produced media which gave excellent results and which are not dissimilar to media that have been brought into use in Europe since the commencement of the present epidemic, the existence of which was unknown to them.

Work in the Central Research Institutes in Kasauli, in which Majors Harvey, Cunningham and Brown participated, demonstrated that Pfeiffer's bacillus grows best in symbiosis with other organisms: the observation was utilized for the manufacture of vaccine.

Extremely valuable work has been carried out by Major Greig and Captain Maitra in Karachi. They found that Pfeiffer's bacillus and the *Pneumococcus* were the only two disease-producing organisms that were constantly met with in fatal cases of the disease, an observation that was also made by Lieutenant-Colonel Liston in Bombay. In the Karachi series of cases these two organisms were found in pure culture in the accessory sinuses of the nose and ear.

In Madras Dr. Gibson found Pfeiffer's bacillus frequently in the expectoration in the later stages of the disease, in large numbers, and he formed the opinion that this bacillus is the true cause of influenza, or, if not of influenza, of its more serious complications. He did not find pneumococci so frequently as they have been found in other parts of India. In this connexion it should be remembered that Madras escaped comparatively lightly from the more serious manifestations of the disease. Streptococci, so commonly found in England, were as rarely found in Madras as elsewhere in India.

Very early in the second virulent epidemic wave, it was considered that, though the causal relationship of Pfeiffer's bacillus and influenza was not definitely proved, the evidence was sufficient to justify an attempt to introduce a vaccine. On obtaining from South Africa information by cable regarding the constitution of the vaccine*, which, according to Reuter, had been used with good effect in that country, the Central Research Institute at Kasauli commenced its manufacture and issued it for use to the Military authorities.

	Millions.
*Influenza bacillus	70
Pneumococcus	200
Streptococcus	350

First dose: a similar dose repeated after an interval of seven days.

Later the formula adopted by the War Office conference of bacteriologists was cabled out to India. A vaccine of this constitution† was also prepared at Kasauli, except that the Streptococcus element was excluded: Indian experience had decided that this organism played no important part in India in the production of influenza, or of its complications. The vaccine issued from Kasauli was issued for preventive purposes only as in the opinion of the laboratory the pneumococcus element was not free from danger for general use as a curative.

	Millions.
†Influenza bacillus	30
Pneumococcus	100
Streptococcus	40

Second dose double the first.

Meanwhile Lieutenant-Colonel Liston, I.M.S., Director of the Parel Laboratory, Bombay, had prepared a vaccine consisting of influenza bacilli only (250 millions). This was issued for use in selected communities, where its efficacy

might be observed with scientific controls. Major Greig in Karachi was using an influenza vaccine in doses of from 150 to 300 millions without producing the least harmful reaction.

From the middle of November onwards Captain Knowles, the Director of the Assam Pasteur Institute, prepared and issued a mixed vaccine containing the influenza bacillus, *Pneumococcus*, *M. catarrhalis*, *Streptococcus* and *Staphylococcus*. This vaccine was intended to immunize influenza patients against the common serious complications of influenza, not to prevent the disease itself. By January 1919 65,000 persons had been inoculated with this vaccine.

Early steps were taken to secure the full time services of a trained bacteriologist to study the bacteriology of the disease as it occurred in India, with special reference to the production of a vaccine. Captain Malone, who had made a special study of the hæmolytic group of cocci under Professor Adami, was deputed to work under the Indian Research Fund Association. He is at present prosecuting his inquiry in Calcutta.

At an informal meeting of bacteriologists held in Delhi in December, the following constitution of a vaccine suitable for use as a prophylactic in India was decided upon. It is being prepared at the Bombay and Kasauli laboratories; it has the following constitution:—influenza bacilli five hundred millions, Pneumococcus one hundred million, for the first dose; the second dose to be double the first. It was decided that 300,000 doses of such a vaccine should be kept as a reserve, so as to be available should a reappearance of the epidemic declare itself. It must be realised, however, that in the event of a recrudescence of the epidemic, in a form in any way comparable to the last, inoculation would be little likely to confer any appreciable benefit on India as a whole. Epidemics of influenza are as brief as they are severe; they give no timely warning of their coming, and even if we had innumerable doctors ready to start inoculation at the first warning, the epidemic would run its course before we should be able to reach a tithe of the population. In relatively small communities such as the army, jails, labour forces and the like, inoculation with a suitable vaccine might be of very considerable value. Inoculation on a wholesale scale, in anticipation of a recrudescence, would not commend itself as a reasonable proposition even were the chances of a recrudescence greater than they appear to be. At present nothing is known regarding the degree or duration of the immunity conferred by inoculation. *A priori* it is little likely that inoculation with a vaccine would confer greater immunity than an attack of the disease. At the present time it can be stated without fear of exaggeration that from 50 to 80 per cent of the total population of India have recently suffered from influenza.

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A

PRELIMINARY REPORT

ON

THE INFLUENZA PAND NI

THE SANITARY COMMISSION RN OF

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PRELIMINARY REPORT
ON
THE INFLUENZA PANDEMIC OF 1918 IN INDIA
BY
THE SANITARY COMMISSIONER WITH THE GOVERNMENT OF I

The pandemic of influenza, from which India, in common with most oth tries in the world, has been suffering, was more widespread and more virul any recorded in the history of disease. No other outbreak hitherto experie approached it in intensity and it is doubtful whether any epidemic disea world's history has ever devastated such large areas of the globe in so shor and to such a degree, as did influen in 1918. The virulence of the outl exceeded that of the influenza pand 189 were the five years of out-standing ry over, in respect to the frequency o tb exceptional in most of the affecte ila many countries the epidemic assu l This was certainly the case in India , a available, it would appear that no di the last quarter of 1918. Altoget ea approximately five millions, in Brit n the incidence of the disease in Nati of but it is unlikely that the influen one Without fear of exaggeration, it ca hs was responsible for six million dea an mortality attributable to plague i pl prevailed in epidemic form in this

2. The world had grown accu a " influenza " in its midst. Partly to that nearly 30 years had gone by, di come to be regarded as a not ver ue complicated is certainly not a ver ta never again will its presence in bu serious menace to the public healt

3. In the earliest stages of th er affected, the disease ran a mild wa insignificant. With the onset of the second epidemic wave from chiefly affecting the lungs and respiratory tract became very prevalent responsible for mortality rates which in many cases were without para disease spread with lightening rapidity and very few sections of the p escaped. Town and village alike suffered, but, on the whole, the mort distress was greater in rural than in urban areas.

4. With the rapid increase in mortality, which accompanied the se demic wave, wild rumours as to the nature and causation of the disea little or no foundation in fact, became extremely prevalent and it would clear the air of some of these, should such false ideas still prevail.

There is not the least evidence that the disease was any other than i it was in no sense a new disease. It was not an unusual manifestation the two diseases are completely separate and distinct. There is no evide directly connects the epidemic with the war; influenza is not a " war-dis it prevailed more virulently in countries remote from the war areas tha those which were the scene of military operations. There is no evidence disease originates in malnutrition; it prevailed in virulent form in coun as the United States of America, where food was by no means scarce; the