

A FACT BEARING ON THE ETIOLOGY OF CHOLERA.

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THE Yerrowda Central Gaol is situated in the Deccan, some 1865 feet above the level of the sea, and distant some four miles N.N.W. of the town and camp of Poona. The slightly undulated plateau on which the gaol is built consists mainly of trap rock; the country around is bare, a few mimosæ and euphorbiacæ alone cast their scanty shade over the bleak and exposed locality. It is naturally well drained, the nearest village is a mile distant, and from the central tower of the gaol the Moola river can be seen winding right and left about a mile on each side, and marking with its blue line the limits of the peninsula on which the gaol has been erected.

Some large wells and tanks (former quarries) exist in the vicinity of the gaol, but they are used only for agricultural and building purposes. Quite recently water was brought to the gaol by iron pipes from a lake near Poona; before that the drinking water for the prisoners was obtained from the Moola river before its southerly curve—i.e., before it became polluted by the towns of Kirkee and Poona, around which it flows.

The heat during our last hot season was excessive and unusual, at the same time the diurnal range was considerable. During the month of May, in the shade, the maximum varied between 100° and 106° Fahr., and in the sun from 115° to 126°. The nights and mornings were relatively cool, the minimum in the shade being 72° to 75°. The weather was remarkably dry, the rainfall during March, April, and May being 1 inch and 72 cents., and the number of days on which rain fell during three months only three.

The season did not, however, prove unhealthy, and the admissions into hospital fell below the average; cases of febricula due to exposure to the sun, and slight surgical cases, formed the large majority of admissions, and diarrhoea did not prevail above the average of former years at that season.

At 2 A.M. on the morning of the 27th of May a case of cholera, the patient being in a state of collapse, was taken to the gaol hospital; and by noon on the following day twenty cases had been admitted. These cases came from both circles then occupied, and from nine different barracks, and to all appearance this sudden outbreak was general; but a searching inquiry soon made it evident that the epidemic was as yet limited to a certain number of prisoners who had lately been employed in making a new road from the gaol towards the Moola river, there to join the Poona road; and the first impression of a general outbreak was due to these men being quartered in different circles and distributed among the several barracks.

I do not intend mentioning here the steps taken to arrest the progress of the disease, as I wish to limit myself to the cause of this outbreak; it will be sufficient to state that they were vigorous and carefully carried out, and attended with such success that only two cases occurred from among prisoners who did not belong to the gang of men mentioned above.

The following table will show the principal features of the outbreak of cholera we are considering:—

Date.	Number of cases.	Number of deaths.	Number of recoveries.	How employed.	
				Road gang.	Otherwise employed.
May 27th ...	7	5	2	7	—
„ 28th ...	13	2	11	13	—
„ 29th ...	2	1	1	1	1
„ 30th ...	1	—	1	1	—
June 1st ...	1	—	1	—	1
Total ...	24	8	16	22	2

A few words on the two cases that occurred inside the gaol before examining the interesting and important question of the appearance of cholera among the road gang.

The first case of cholera that occurred among prisoners “otherwise employed” was on the 29th of May. This man was sleeping on the night of the 26th–27th near one of the cases that occurred on that night. The suddenness of the outbreak took everyone by surprise, and much time was required before the cholera cases could be removed. It is not improbable that this man may have been infected by the choleraic discharges, as the patient not only vomited in his vicinity, but passed before him each time he had to resort to the night privy. The second of these cases occurred in a prisoner who had been attending on cholera patients. Contrary to orders, this man took his meals inside the cholera ward, and drank of water that had been standing there. In his case direct infection cannot be doubted.

These two secondary cases disposed of, I will now describe the conditions under which cholera made its appearance among the prisoners who had been working on a certain road during the previous days.

The subjoined tables show the occupation of the prisoners on the days preceding the outbreak:—

A.—Prisoners engaged in intra-mural labour.

Date.	Excused from labour.	Gaol servants.	Factory.	Miscellaneous.	Total.
May 24th	59	172	301	16	548
„ 25th	53	172	304	12	541
„ 26th	57	174	310	13	554

B.—Prisoners engaged in extra-mural labour or in out-door labour in Gaol enclosure.

Date.	Gaol servants	Public Work Department.	Gaol re-pairs.	Garden.	Thatching roofs.	Road gang.	Total.
May 24th	161	370	10	42	87	61	731
„ 25th	161	373	10	42	18	134	738
„ 26th	163	376	10	42	18	116	725

These 1279 prisoners, as a body of men, can in many respects be considered as a unit; they have the same diet, the same clothing, dwell in the same locality, are exposed to the same meteorological influences, &c.; they differ, and that slightly, but in one respect, according to the labour in which they are engaged.

From the tables given above it will be perceived that of the total number of prisoners about 554 worked under cover. But cholera broke out among those who had been working in the sun, and as this cause might be deemed to have had some influence on the development of the disease, this group of 554 men will be eliminated, and the inquiry limited to the second group of 724 men, who were all of them equally exposed.

Some of the men belonging to our second group were engaged on masonry; some in dragging heavy water-carts along a bad road, and supplying the jail with water; others were engaged in ploughing, or in garden work, or conveyed the night-soil outside the gaol, &c.; and some in watering and rolling a new road. None of these occupations are one more than the other “cholera-producing,” and when we find that among this group of men only a certain number contract the disease, we must seek for an explanation beyond telluric influences, cholera waves, absence of ozone, &c.

Now if the men among whom cholera appeared were on no single point differently placed from the other, with but one remarkable exception, this fact must necessarily carry great weight with us, and assist us in solving the arduous question of the etiology of cholera. All the prisoners, whether engaged in intra- or extra-mural labour, were supplied with water taken from the Moola river before it reaches Poona; “the only exception occurred among the

prisoners engaged in road work, who drank water taken from the bed of the Moola river below the dam."

It will be observed by a reference to the table of employment that the road gang was considerably increased on the 25th and 26th May; the road had already been metalled, and the extra hands were required to water and roll the road, so that it might not be damaged by the daily expected heavy rains. It should be here stated that a certain number of barrels for storing water and water-carts were sent with the road gang, and that water for drinking purposes was brought to them from above the dam. Five water-carts had been also sent with these men for the purpose of watering the road whilst it was being rolled by others; these carts were filled from the nearest water obtainable—that is, from pools in the nearly dry bed of the river, opposite to the Poona end of the road under construction. The prisoners admitted that they had drunk freely of that water, not only when they filled the carts, but also when they were made to wash before returning to the gaol after their day's task was over. The cholera patients to whom this query was put all unhesitatingly declared that they had partaken freely of it; moreover the warder who was in charge of the carts for supplying them with drinking water corroborated the fact in a remarkable manner; he stated that on the 25th and 26th of May he had conveyed to them less water than on the previous days, although the number of prisoners at work on the road was nearly three times as great. "The fact of the road gang drinking water taken from a source different to the one used by the remainder of the prisoners is placed beyond any doubt."

Was cholera communicated to these prisoners through the water they drank? This is the question I will now endeavour to solve.

On the morning of the 29th May Mr. Taylor (the gaoler) and myself visited the locality from which water for watering the road had been taken. The identical spot was shown to us by the warders on duty on the 25th and 26th, and their testimony was corroborated by our finding there several pieces of gaol clothing. Some 600 or 700 yards above this spot the river is barred; a dam was erected there some years ago for the purpose of securing a constant water-supply to the city of Poona, the river generally running nearly dry during the hot weather. The bed of the river from the dam downwards contained but little water; where we were standing we saw several large semi-stagnant pools, separated from similar small expanses by high boulders and moss-covered islets of volcanic rocks; slowly flowing streamlets connected these pools one with another, but on our side of the river-bed the current was so weak that we almost doubted its existence. Between the locality on which we were standing and the dam a number of washermen were at work; men and women were seen here and there performing their morning ablutions, &c.; cattle were roaming about; and a glance showed that the bed of the river between the dam and the place from which water had been taken for watering the road must be contaminated by excreta of all kinds. The river was not overflowing the dam on that day, and from inquiries we learnt that it had not done so for several days: one of the sluices was open, but on the opposite (Poona) side of the river. Water was taken from the pools above mentioned and forwarded to Dr. Gray, the chemical analyst to Government.\*

Cholera existed at the time throughout the province, in Poona, and in the neighbouring villages. In India the bed of a river in the vicinity of a large city is the usual place selected by travellers before entering the town to perform their ablutions, &c.; washermen are constantly at work in the same locality; in fact, we could hardly expect to find anywhere so many agencies united to contaminate drinking water by means of choleraic discharges, and, irrespective of what the inquiry had already allowed us to surmise, we would have already strong grounds for accepting the outbreak as due to the propagation of cholera through drinking water. In this instance, however, we possess evidence still more direct and positive.

On the 22nd of May two fatal cases of cholera occurred in the village of Yerrowda, situate opposite the dam, and

we learnt that on the evening of the 22nd these bodies were washed and burnt, and the clothes worn during their fatal illness washed some twenty yards above the spot from which water had been drunk by most of the road gang, and which proved so poisonous and so deadly to many of them.

Poona, July 1st, 1875.

## REMARKS ON THE ANATOMY AND PATHOLOGICAL RELATIONS OF A NEW SPECIES OF LIVER-FLUKE.

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On the 9th of September, 1874, I made a post-mortem examination of the body of a Chinaman, and found in the liver, obstructing the bile-ducts, a large number of "flukes." A careful examination of these, and comparison with other known distomata, have convinced me that they not only differ from the ordinary liver-fluke (*Dist. hepaticum*), but constitute an entirely new species. I desire therefore to describe the salient anatomical characters of these flukes, then to give a brief account of the post-mortem examination alluded to, and lastly to make a few remarks upon the case.

The woodcuts which accompany this paper will facilitate the description. Fig. 1 represents a few of these flukes drawn to natural size. Fig. 2 is one specimen enlarged to about six times the natural size, showing the ventral surface. Fig. 3 represents the ova magnified 300 diameters.

FIG. 1. Ad. Nat.

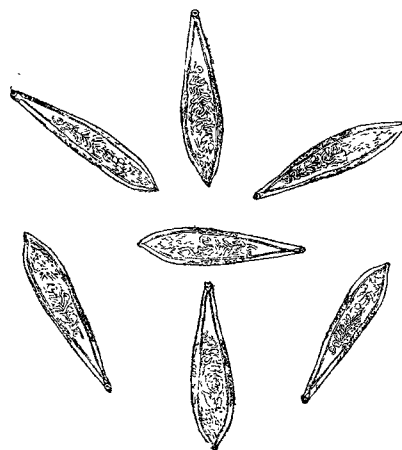


FIG. 2. × 6.

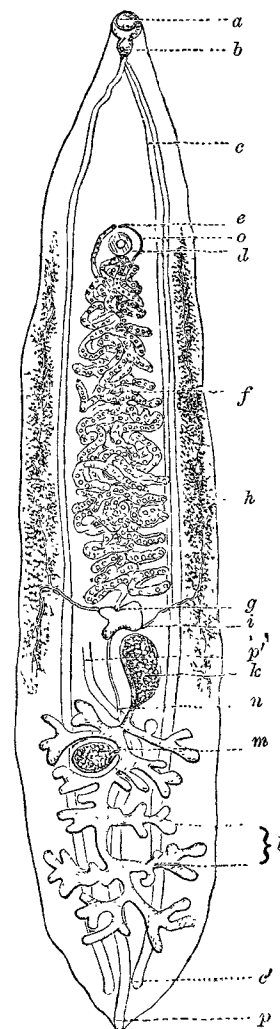


FIG. 3. × 300.

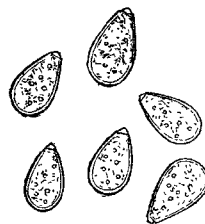


Fig. 2.—a. Oral sucker. b. Oesophagus. c, c'. Right alimentary canal. d. Ventral sucker. e. Genital orifice. f. Uterine folds. g. Ovary. h. Vitelline gland (right). i. Vitelline duct (right). k. Right testicle. l. Receptaculum seminis (?). m. Left testicle. n. Vas deferens. o. Termination of vas deferens. p. Pulsatile vesicle. p'. Water-vascular canal.

The body is narrow, flattened, lanceolate; the central portion being the broadest part of the animal, the anterior and posterior extremities tapering and pointed, the former, however, being much narrower than the latter, which is

\* Analysis of the water made by Dr. Gray, chemical analyst to Government:—Solid grains per gallon, 10.36; chlorine, .95; hardness, total, 6.30; hardness, permanent, 3.42; oxygen removed by readily oxidisable matter of water at 140° F., .072. Part per million of free ammonia, 0.32; of albuminoid ammonia, 0.22.