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THE HOUSE-FLY AS A DISEASE CARRIER.

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I readily admit that the observations recorded and the arguments advanced in this paper are open to the objection that they afford but scanty data upon which to base so important a conclusion that the house-fly is frequently the intermediary and probably by far the most common intermediary, in the propagation of that *bête noire* of Indian sanitarians, enteric fever. Nevertheless, scanty though these data undoubtedly are, rough though the methods employed may be, and brief the period over which the observations extend, there is an isochronism shown in the appended charts between the advent of the house-fly in Poona and the seasonal prevalence of enteric fever, which is highly significant and at least suggests that a *prima facie* case has been established for further investigation. Ten years ago the theory that enteric fever was a water-borne disease was accepted by everyone, the policy of "the kettle and the cauldron" was a sanitary axiom, and many outbreaks were quoted, in America, Maidstone, and elsewhere, in support of the theory; yet in spite of the strong evidence then produced, in spite of an epidemiological relation apparently incontestable, the opinion has gained ground, year by year, that water is not a frequent carrier, and some even go so far as to say that it is never the carrier.

If water, then, is not the carrier, what is? Manifestly, it can only be one of three things, viz., an infected man or animal;

air-borne through contaminated dust; insect-borne, either by inoculation into the circulation by bites, or by direct deposit on foodstuffs.

I am not concerned, at present, with the two former, and will content myself by saying that there is so far no reliable evidence that domestic animals have anything to do with the propagation of enteric fever, except indirectly, *e.g.*, horse dung as a breeding medium for flies; neither is there any evidence forthcoming that the bites or stings of insects are a factor, though it has been suggested more than once that the bed-bug may possibly be the culprit.<sup>1</sup>

It appears to be clearly established that the human "bacillus carrier" is indubitably the infective focus, but how so is by no means clear. Is it by implanting the bacillus on foodstuffs with his hands soiled with his own excreta? Does he excrete the bacilli through his sweat-glands? Does he perchance cough them up? We do not know. All that we do know up to date is, that a cook, or a dairymaid, who is a bacillus carrier is a danger. And so also with the air-borne theory. Is the bacillus whirled broadcast in infected dust? Again the answer is—we do not know. It is possible, but not probable, and it is worthy of note, that in so far as Poona is concerned the seasonal prevalence of enteric fever is just at the time when dust is least in evidence, *i.e.*, in the middle of the monsoon.

Having thus, so to speak, cleared the ground, I proceed to discuss, as briefly as may be, the possibilities of the fly as a disease carrier and with special reference to the propagation of enteric fever. And, primarily, I would remark that there are a great many more cases of enteric fever amongst the natives than is usually conceded—for instance, out of ninety-two cases of enteric fever collected by me in Poona during the first ten months of 1908, no less than forty were genuine attacks in natives, from whose blood in many instances I isolated pure cultures of *Bacillus typhosus*. Now when the habits of the natives of India are considered, the danger of these cases to the general community cannot be over-estimated.

Notwithstanding the fact that much has been written of late regarding the life-history and habits of the common house-fly and

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<sup>1</sup> I am not unmindful of the evidence brought forward in favour of animal etiology by Major Statham in the October Journal, but to my thinking any such theory is hopelessly barred in that it fails to fit in with the proven fact of seasonal prevalence.

many suggestions made relative to its possibilities as a disease carrier, it is to be feared that the general tone of the medical profession with regard to the question is apathetic, if not actually antagonistic. The latter is distinctly in evidence in a rider to the recent reports of the Simla Enteric Fever Committee added by some members thereof, though why they should dissent so emphatically in face of rapidly accumulating proof is hard to understand. Attention has repeatedly been called to the prevalence of flies concurrently with epidemic outbreaks of enteric, and notably by Aldridge (Annual Sanitary Report, Eastern Command, 1904). Similarly, Dr. Snell, M.O.H., Coventry, in 1906, showed that 70 per cent. of the cases of infantile diarrhoea occurred in the north-east part of his district, close to a large collection of refuse where flies swarmed.

Reference to the annexed Table I. and Charts Nos. 1 to 16, which give the admissions for enteric fever for the last fifteen years, month by month, to the station hospitals, Poona and Kirkee, shows very remarkably the regularity of the seasonal prevalence of enteric in these two stations, which, for the purpose of this paper, are considered as one, they being close to each other, in constant daily communication and under exactly similar conditions.

We find then, year by year, that in Poona and Kirkee enteric fever begins in July, reaches its maximum in August, maintains a high level in September, dies down in October, and nearly disappears in November and December. The admissions for the two months, August and September, are considerably higher than those for all the other ten months put together, and for the four months, July, August, September and October, rather more than two and a half times greater than the sum of the other eight months. This is a very striking fact, and points unmistakably to a regularly recurrent cause. Now these four months are the monsoon months, and at first it would seem to afford proof positive that the germs are water-borne; but, apart from the fact that there is a pipe supply from a distant catchment area, not very liable to contamination, and that analyses, both chemical and bacteriological, exonerate the water, it is practically certain that if water were the agent the first outburst would follow the break of the monsoon in the average incubation period, say fourteen days, and the maximum intensity would be reached within the month, as the accumulated filth of the antecedent dry days would be washed down by the first floods. But this is not so, as reference to the annexed charts will show; on the contrary, the

monsoon breaks invariably in the middle of June, and enteric does not become epidemic until August. But heat and moisture, combined with suitable breeding media, will of a certainty produce flies. Unfortunately, I can only speak of this one season, which local residents did not consider to be a very bad year for flies, and yet in July, 1908, the flies were simply appalling, and one medical officer, who is most particular in regard to the sanitation of his bungalow and compound, told me that in two days with six large glass traps he filled a stable bucket with dead flies caught in his own kitchen and back verandah. This will give some idea of their prevalence. Now Poona is a great racing centre, and the racing goes on during the monsoon months. Scores of horses are brought into the station just before the monsoon and stabled anywhere and everywhere. I am credibly informed that over 500 racehorses were in training during the 1908 season, and little or no supervision was, or could be, exercised over the disposal of their litter. Moreover the race authorities, breaking a promise given, covered the course with a fairly lavish top dressing of horse manure. I have hatched out many hundreds of flies from very small quantities of stable litter. Aldridge hatched out over 4,000 from one-sixth of a cubic foot of night soil, and Smith produced them with ease from the soil beneath all sorts of excrement. A very curious circumstance was told me a few months ago by a well-known Indian cavalry officer. He was proceeding with his regiment to China, the stable management was of the best and cleanliness was strictly maintained, yet on the high seas, many miles from land, the ship, all of a sudden, was swarming with flies. I only relate the incident to show how intimately associated the fly and the horse are. Now study the charts numbered 18 and 19; the former shows the triple relationship of rainfall, flies, and enteric fever cases admitted to the Station Hospital, Poona; the latter embraces all the cases of enteric fever which occurred in Poona and Kirkee, and includes, as far as possible, cases known to have occurred among the native population.

Granted that I only had the opportunity of carrying on my observations for one season, yet the coincidence is so striking that, as I have already said, there appear to be ample grounds for further enquiry. Add to this tabulated statement—the result of careful experiment—the general observations made by many medical officers that fly prevalence means probably an outbreak of enteric in the near future, and I think that many will arrive

at the conclusion that the fly is the intermediary between the "bacillus carrier" on the one hand and the susceptible individual upon the other:

A word or two as to how the fly prevalence was estimated: A half sheet of tanglefoot was placed in three different kitchens and changed every twenty-four hours; a count was thereafter made and a daily average struck—a rough and ready method, no doubt, but sufficiently accurate for practical purposes, especially when I add that, at the height of the fly plague, over 700 were caught on a half sheet of paper. Incidentally also, two facts may be quoted, first, that the kitchens used were supposed to be fly-proof, being elaborately protected with gauze; and second, that the daily average of flies caught in the kitchen of the Station Hospital, Poona, during the period the observations were carried out (May to October) was thirty, whilst in the worst of the three experimental kitchens it was just 200.

Look now for a moment at charts Nos. 17 and 20, admitting, unconditionally, that the cases are far too few to afford reliable data upon which to base any sound deductions, still bearing in mind the shorter incubation period of infantile diarrhoea, it may at least be said that, so far as they go, they support Dr. Snell's conclusions above quoted, and go to prove that this exceedingly prevalent and fatal disease is probably fly-borne. And if we concede the point that the fly may be the culprit, or, short of that, the accomplice, in the spread of enteric fever and infantile diarrhoea, where are we going to draw the line of demarcation? Is there any connection between the fly and the well-known fact that residence near a small-pox hospital is dangerous? May diphtheria not be communicable through its intermediation? Are we quite sure that we may not have to revise, anyhow in part, our accepted theory that cholera is entirely water-borne?

Lastly there is the argument from analogy—a weak one, I allow; we do not know why malaria, yellow fever, or plague exist, but we do know that the anopheles, the stegomyia and the *Pulex cheopis* are guarantors that they shall not die out for want of adequate support. Nature has a reason for everything, and we may rest assured that the rôle of the fly is not merely that of an irritating nuisance.

What of the remedy? One thing is certain that wire gauze protection to kitchens, alone, is sheer waste of money—money which might be spent to much greater advantage in other directions. Even if wire gauze did keep flies out of kitchens—which it

does not and never will—it would be useless; for it is self-evident that there is much more danger of fly contamination without than within, let alone that thorough cooking will destroy any germ, and that even after cooking there is less likelihood of infection in the kitchen than in the dining-room by reason of the food being hot. The problem is a difficult one—I might, with justice, say a stupendous one; and were it not for the marked success attained by General Leonard Wood and Colonel Gorgas in Cuba and Panama, of which an interesting account is given in the September Journal by Lieutenant-Colonel Macpherson, we might almost be tempted to abandon it in despair.

TABLE I.—ADMISSIONS OF CASES OF ENTERIC FEVER TO STATION HOSPITALS, POONA AND KIRKEE, BY MONTHS FROM JANUARY 1ST, 1894, TO THE END OF OCTOBER, 1908.

	Jan.	Feb.	March	April	May	June	July	Aug.	Sept.	Oct.	Nov.	Dec.
1894	1	—	3	1	2	4	11	3	13	4	3	1
1895	1	4	12	17	3	1	5	12	7	3	—	1
1896	1	—	8	6	10	4	8	20	7	6	1	1
1897	1	2	5	2	3	—	6	11	16	2	1	—
1898	1	1	3	5	2	1	6	19	15	1	2	1
1899	7	4	3	3	5	7	4	6	3	4	3	—
1900	2	1	2	—	1	2	4	9	25	11	2	—
1901	2	3	2	2	2	3	3	11	6	—	—	1
1902	3	2	2	6	4	3	14	23	20	11	2	—
1903	—	1	3	2	1	1	6	9	37	14	2	3
1904	—	2	1	4	3	3	5	52	18	3	1	—
1905	2	2	—	2	2	2	3	42	36	17	1	1
1906	—	2	—	1	—	—	4	29	24	4	1	1
1907	4	1	2	2	2	1	4	6	5	2	4	3
1908	—	—	2	—	2	2	4	20	5	1	—	—
Total	25	25	48	53	42	34	87	272	237	83	23	13

Clearly, just as with the mosquito, we must attack the fly in the larval stage, and to do that successfully we must know more of its life-history than we do at present. We must, for example, know why it is that in one year flies abound and in another why they are comparatively scarce. Armed with this and similar knowledge we may then hope to approach the problem with a reasonable prospect of a successful solution.

It seems to me that enteric prevention naturally groups itself under five headings, viz:—

- (1) Isolation of the human carrier, failing
- (2) Elimination of the bacillus by means of some drug as yet undiscovered.
- (3) Rendering excreta innocuous, by disinfection, water-carriage and similar sanitary measures.

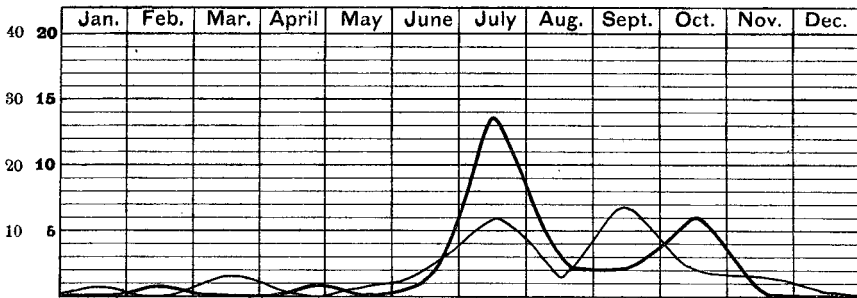
- (4) The establishment of immunity.
- (5) The destruction of the go-between, to wit, the fly.

I cannot conclude these remarks without reference to the great help I have received from Colonel Forman. He has always been a staunch advocate of the rôle of the house-fly in spreading disease, and whilst Principal Medical Officer of the 5th Division his sympathy with these opinions greatly simplified my work, in addition to which he very kindly revised the letterpress for this paper.

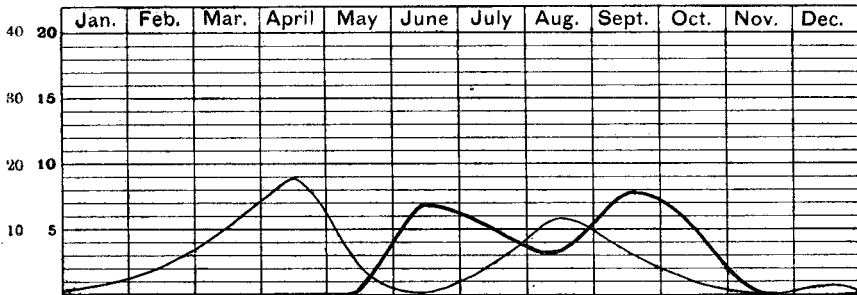
TO SHOW SEASONAL PREVALENCE OF ENTERIC FEVER. ADMISSIONS OF ENTERIC FEVER SHOWN BY A THIN LINE, RAINFALL BY A THICK LINE.

SHOWING THE ADMISSIONS OF CASES OF ENTERIC FEVER TO THE STATION HOSPITALS, POONA AND KIRKEE, BY MONTHS, FROM JANUARY 1ST, 1894, TO END OF OCTOBER, 1898, AND THE RAINFALL IN POONA FOR THE SAME PERIODS.

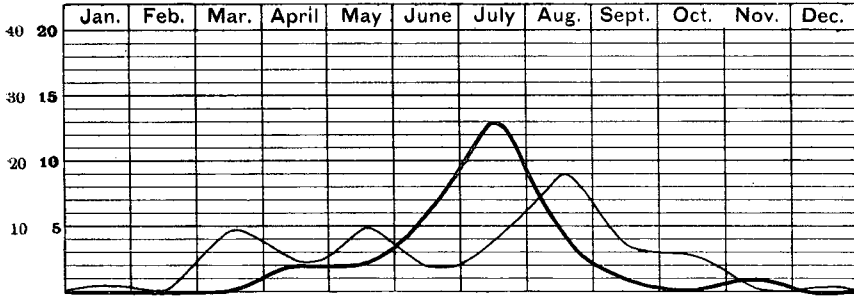
1894. CHART 1.



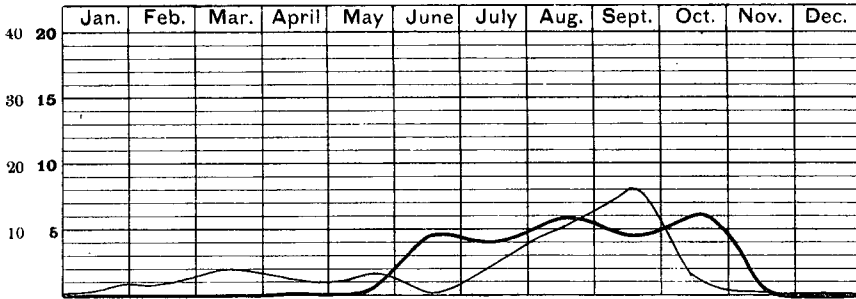
1895. CHART 2.



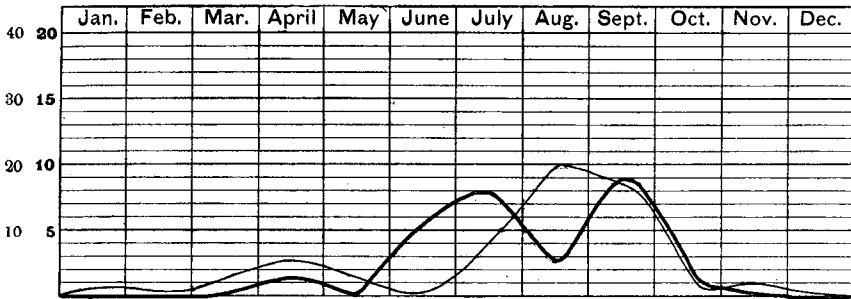
1896. CHART 3.



1897. CHART 4.



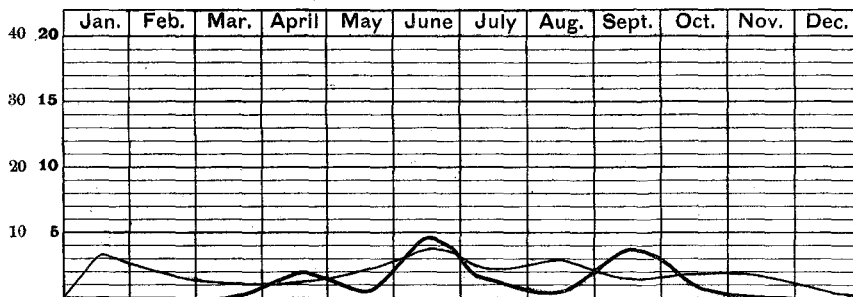
1898. CHART 5.



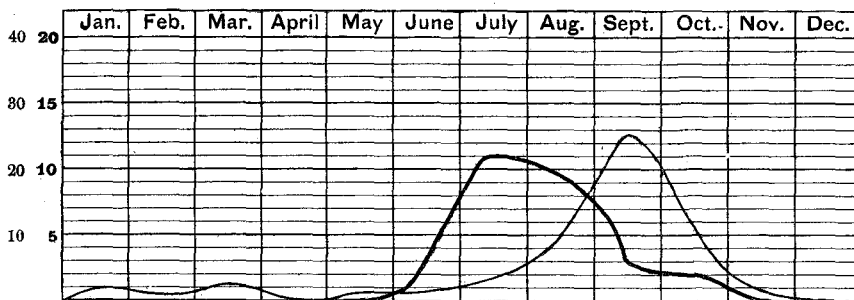


SHOWING ADMISSIONS FOR ENTERIC FEVER BY MONTHS BY THIN LINE, AND MONTHLY RAINFALL BY THICK LINE; TO SHOW SEASONAL PREVALENCE OF ENTERIC FEVER.

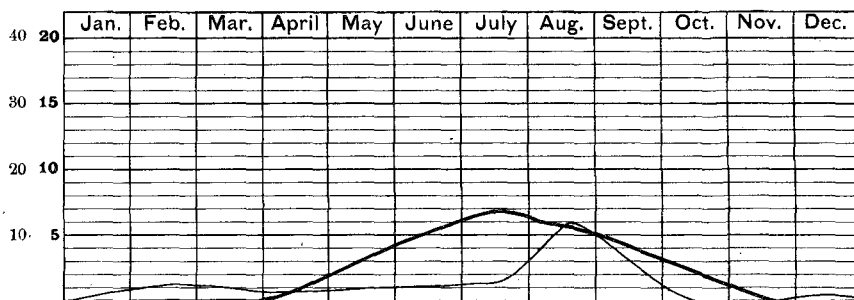
1899. CHART 6.



1900. CHART 7.

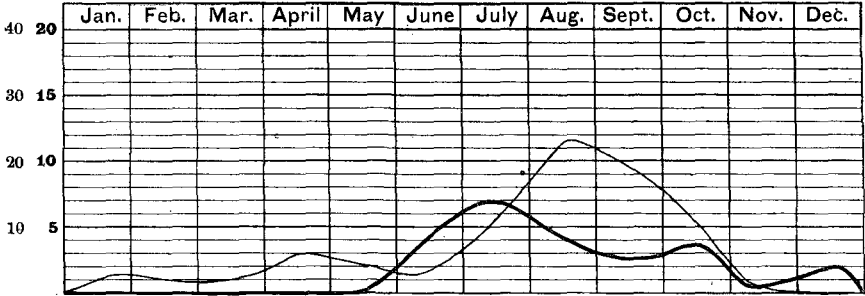


1901. CHART 8.

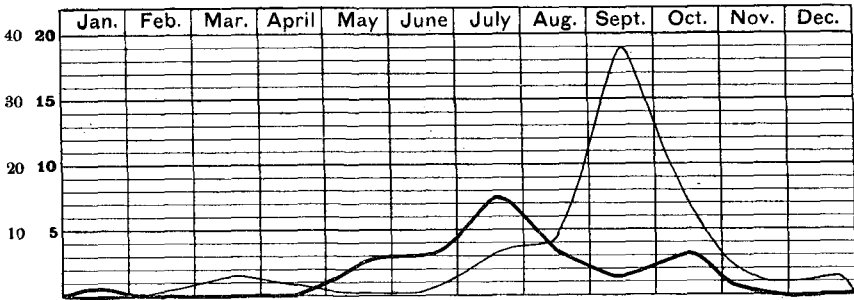


*The House-fly as a Disease Carrier*

1902. CHART 9.

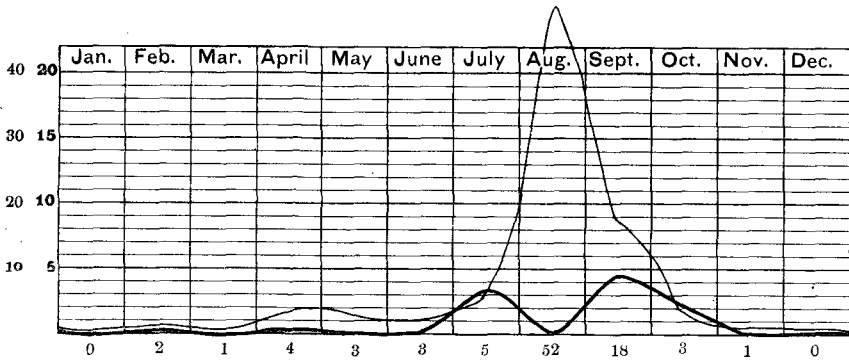


1903. CHART 10.

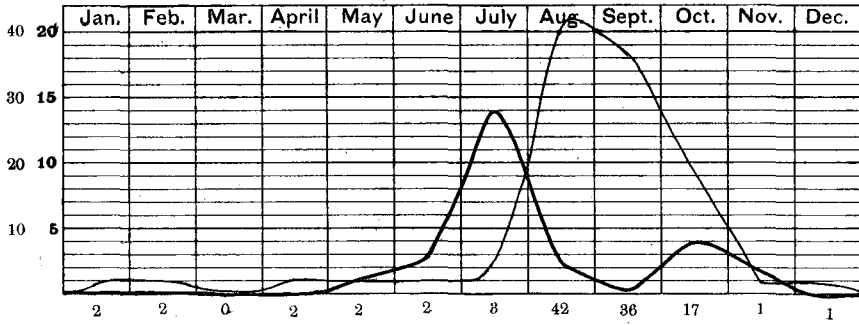


TO SHOW SEASONAL PREVALENCE OF ENTERIC FEVER.  
 SHOWING ADMISSIONS OF ENTERIC FEVER BY MONTHS BY THIN LINE AND MONTHLY  
 RAINFALL BY THICK LINE.

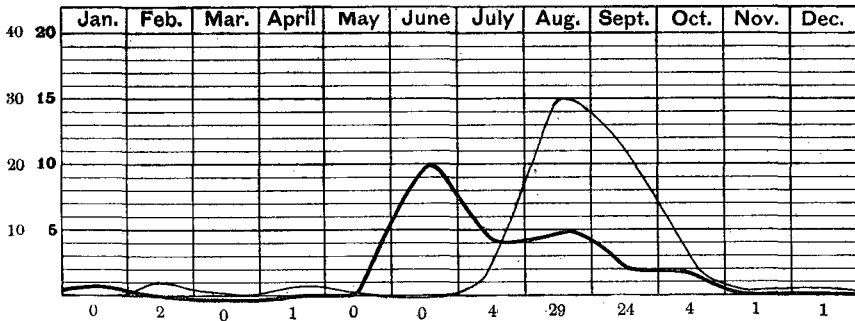
1904. CHART 11.



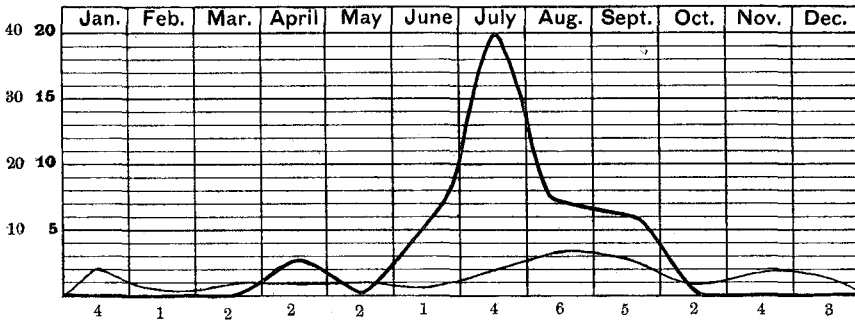
1905. CHART 12.



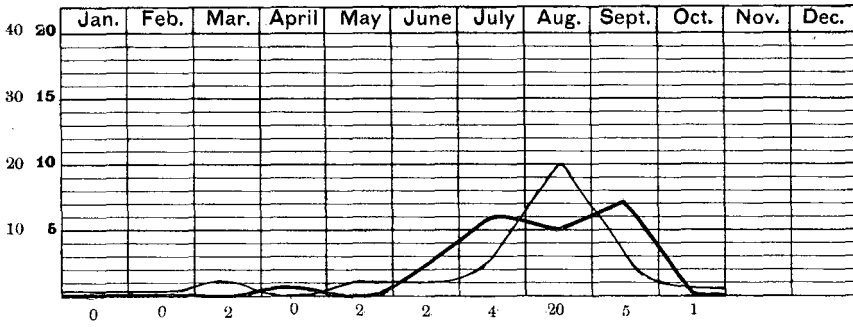
1906. CHART 13.



1907. CHART 14.

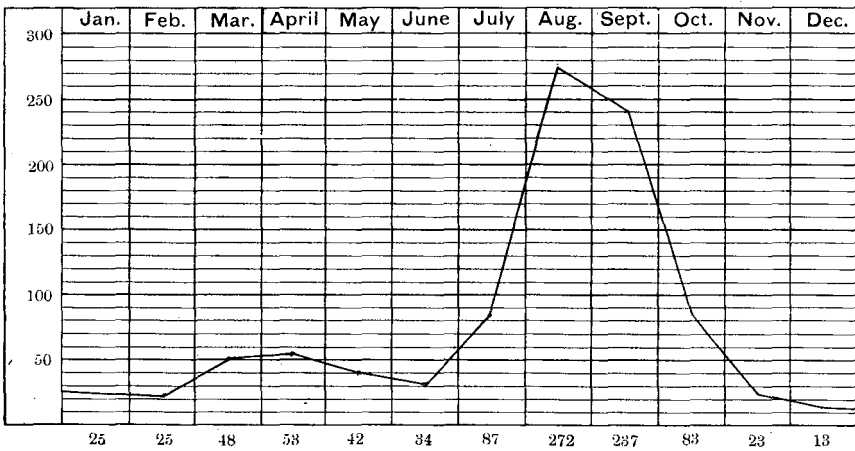


1908. CHART 15.



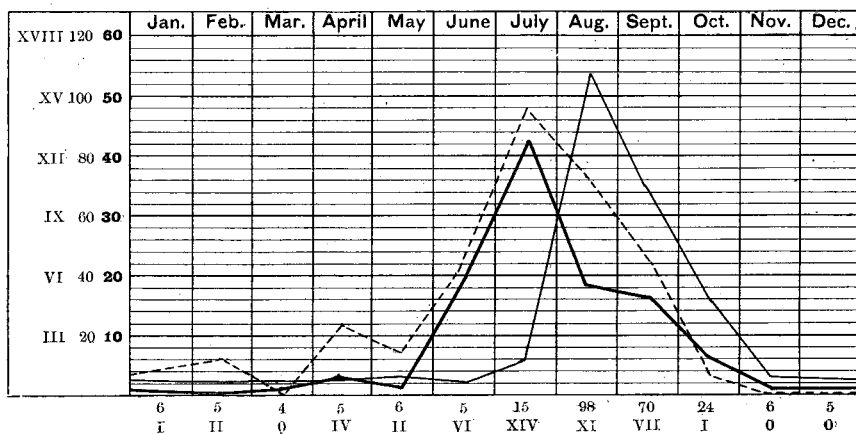
SHOWING THE TOTAL NUMBER OF ADMISSIONS OF ENTERIC FEVER TO THE STATION HOSPITALS, POONA AND KIRKEE, FROM JANUARY 1ST, 1894, TO THE END OF OCTOBER, 1908.

CHART 16.



SHOWING THE TOTAL NUMBER OF ADMISSIONS TO THE STATION FAMILY HOSPITALS, POONA AND KIRKEE, OF ALL CASES OF INFANTILE DIARRHŒA; ALL CASES OF ENTERIC FEVER ADMITTED TO THE STATION HOSPITALS, POONA AND KIRKEE, AND THE TOTAL RAINFALL, FROM JANUARY 1ST, 1905, TO THE END OF OCTOBER, 1908.

CHART 17.



INFANTILE DIARRHŒA ADMISSIONS SHOWN BY BROKEN LINE, RAINFALL BY THICK LINE, ENTERIC ADMISSIONS SHOWN BY THIN LINE. I WAS ONLY ABLE TO OBTAIN THE RECORDS FOR THE LAST FOUR YEARS AS REGARDS THE ADMISSIONS OF INFANTILE DIARRHŒA.

CHART SHOWING CASES OF ENTERIC FEVER TREATED AT STATION HOSPITAL, POONA, FROM JANUARY 1ST TO END OF OCTOBER, 1908, BY BROKEN LINE. DAILY RECORD OF FLIES CAUGHT FROM MAY 23RD TO END OF OCTOBER SHOWN BY THIN LINE, AND DAILY RAINFALL BY THICK LINE.

CHART 18.

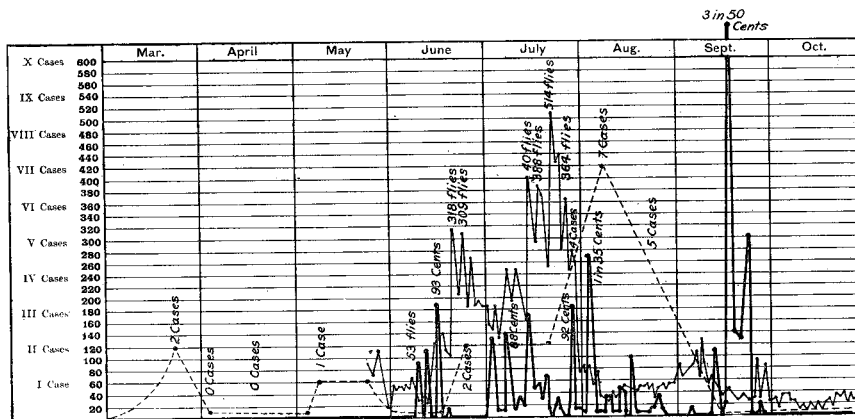


CHART SHOWING CASES OF ENTERIC FEVER UNDER TREATMENT IN POONA AND KIRKEE FROM MAY 23 TO THE END OF OCTOBER. ADMISSIONS ARE SHOWN FORTNIGHTLY BY BROKEN LINE. DAILY RECORD OF FLIES FOR SAME PERIOD SHOWN BY THIN LINE. ONLY NINE CASES OF ENTERIC FEVER WERE UNDER TREATMENT FOR FIRST FOUR AND A HALF MONTHS OF THE YEAR, VIZ., JANUARY 1ST TO MAY 15TH, 1908.

CHART 19.

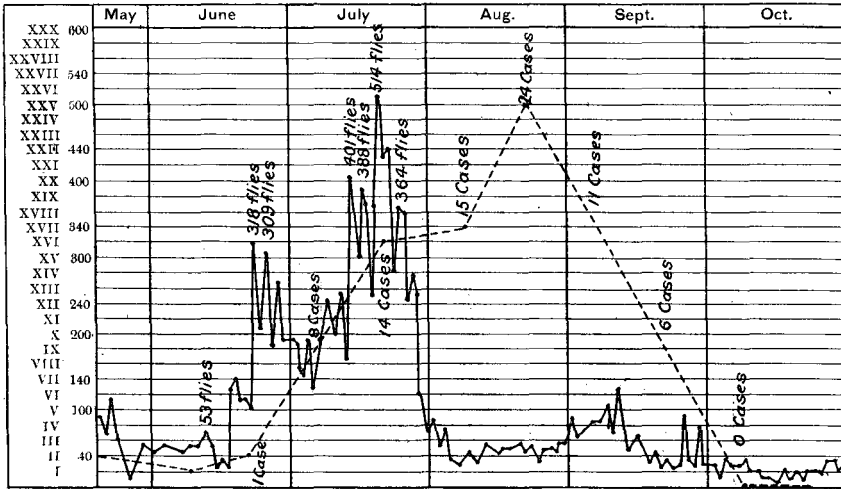


CHART SHOWING CONNECTION BETWEEN PREVALENCE OF FLIES AND INFANTILE DIARRHOEA. NUMBER OF FLIES CAUGHT SHOWN BY THIN LINE, NUMBER OF CASES OF INFANTILE DIARRHOEA SHOWN BY BROKEN LINE. PERIOD IN QUESTION FROM MAY 23RD TO END OF OCTOBER, 1908.

CHART 20.

