The later history of spirillum fever at Bombay, 1882-83 : memoir based upon cases read before the Medical and Physical Society / by H.V. Carter.

THE LATER HISTORY OF SPIRILLUM FEVER AT BOMBAY, 1882-83.

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Memoir based upon Cases read before the Medical and Physical Society.

By H. V. CARTER, M.D., Lond., President of the Society.

The following observations comprise the material collected after my return to India, in April 1882; and they are here grouped together in order to illustrate the further course of the great epidemic of 1877-78, which is fully described in my work on "Spirillum Fever," Churchills, London, 1882.

Being much occupied subsequently to May 1882, it was only in a casual way that this material could be acquired; and probably the total is but a sample of what might have been gathered, through means of a completer enquiry. All the cases described below were seen by me, and so alone the blood-examinations made; and hence, the responsibility of interpretation also is mine.

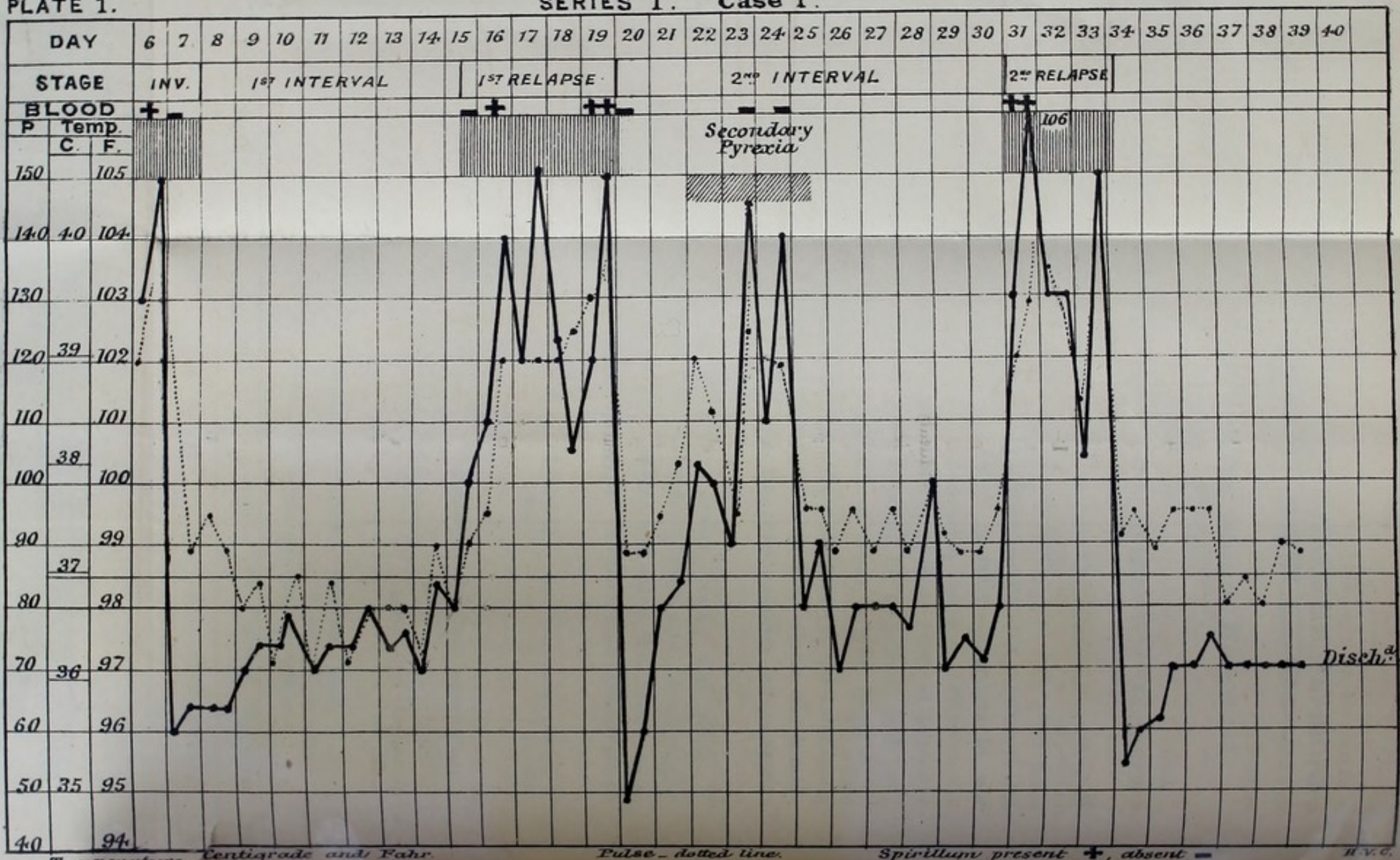
Subjects, with two exceptions males, young and adult, of different castes, resident in the native town and usually near the harbour side; season both before and after the rains, with no peculiar meteorological features. Number and arrangement of cases thus:—

Series 1. Sporadic cases.	2 Examples ...	Relapsing form.	Spirillum seen..	April. August.
Series 2. Tenement-epidemics.				
Sub-series 1.	4 Cases	Relapsing.	Spirillum seen thrice.	May. June.
,, 2.	6 Cases	3 Relapsing.	Spirillum seen in five.....	July.
Series 3. Attacks in Foreigners.				
Sub-series 1.	8 Arabs	5 Relapsing.	Spirillum seen in six.....	April.
,, 2.	10 Muleteers ...	1 Relapsing.	Spirillum seen in four.....	October.

Total 30 cases. Relapses seen in 15; in some others probable. Spirillum detected in 20.

PLATE 1.

SERIES 1. Case 1.



Temperature Centigrade and Fahr. Pulse _ dotted line. Spirillum present +, absent –

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Analysis of the data, and concluding remarks to follow; and if these should appear somewhat elaborated, I would plead in extenuation the novelty and importance of the subject, as regards Western India.

Description of the Cases.

Series 1.—*Sporadic Cases.*—No. 1.—M., æt. 20; Hindoo, resident in Bombay 6 years; watchman of a much frequented temple, situated in a crowded locality (Paidhoni); admitted 6th April 1882 into the G. T. Hospital. Well-nourished; unmarried; one of a party of four engaged in similar duty, but the rest (seen) all well. Has had continuous high fever for 5 days, setting in suddenly; temperature 103; pulse 120; spleen enlarged and tender; other signs of spirillum fever present, and the blood parasite abundantly detected the evening after his admission on 6th day of illness; repeated epistaxis occurred, at midnight of 6th day, temperature 105°, when the crisis came on, and next morning, temperature 96°; an eruption of pink spots seen on the chest and limbs. The spirillum had then disappeared; some fresh spots were seen a day later, but convalescence was prompt as usual, and the temperature continued rather subnormal for seven days.

On the evening of the 8th day of first apyretic interval, the first relapse promptly set in; there was some epistaxis, which was repeated: spirillum not clearly seen at first, but found next morning. This attack lasted about 5 days, and was of remittent form; maximum temperature noted 105·2°, on 3rd day. Spirillum seen twice on last day (evening temperature 105°), disappearing next morning with critical defervescence, temperature 96°. The temperature still further declined to 94·8°, with great exhaustion, and more bleeding from the same left nostril as before, needing the tampon; slight iritis of the left eye followed (? embolus); a few pink spots in the skin.

Smart secondary fever ensued on the 3—5 day, maximum temperature 104·6, with no apparent complication, spleen not enlarged; no spirillum in the blood; subsequently rallying was quick and complete.

On the 12th day after the end of the first true relapse, fever again returned suddenly, lasting three days, during two of which it was sustained; temperature at acme 105°, pulse 140, at critical fall 95·4°, pulse 92. Reaction was slow, and the patient left hospital five days later. During this second relapse the blood-spirillum was again found scantily, slight epistaxis from the right nostril took place, and a few spots were seen at the close.

Full notes of this typical case are kept. The source of contagion could not be traced, and no other fever case from the

same locality was seen; but the temple in question was visited by mendicants amongst others, and no local enquiry was instituted. Chart subjoined as evidence of some characteristic clinical features, entirely corresponding to experience at height of the late epidemic.

No. 2.—M., æt. 30; Mussulman, resident, living at Kamatipura (a quarter of Bombay different to any of the others' residence); a labourer out of work, though well-fed in aspect; of intemperate habits, and had been drinking when he was suddenly seized with fever. Admitted 17th August 1883, on reputed 8th day of illness, temperature 102°, pulse 128, respiration 48; critically declining the following day to temperature 95°, pulse 80, with profuse sweats. There was pulmonary congestion, cough with reddish sputum; jaundice; the urine then contained albumin; much emaciation; some diarrhœa. He rallied slowly, the cough and tinged sputum persisting for some days. Nine days after first crisis fever suddenly returned, evening temperature 105°, pulse 120: this relapse lasted three days, at the acme epistaxis, and at crisis a fall of temperature to 96°, pulse 76, respiration 18. Rallying was prompt, but an abscess formed on the nates, and he was considerably reduced: no second relapse was noticed. The temperature chart of this man is quite characteristic of relapsing fever; and on examining the blood during the recurrent attack, I noted an occasionally twitching of the red discs (not however seen by others), which by suitable preparing of the dried specimen was proved to be due to the presence of several fully developed spirillar organisms. Evidence, therefore, complete.

This case was admitted under care of Dr. Hojel, who seeing its probable character, obligingly drew my attention to the patient. It is one of the latest examples met with (February 1884), though a few other fever cases later seen at the J. J. Hospital have, to my knowledge, presented clinical features indicative of the spirillum infection; and at the G. T. Hospital, also, I have been recently allowed to inspect some patients whose temperature charts strongly resembled those of relapsing fever persisting sporadically in the town. The two instances above detailed, were strictly of such dispersed character; being to all appearance quite isolated, and occurring at a long interval apart of both time and place. In neither, was the probable source of contagion ascertained; and yet the symptoms in both were as characteristic as ever seen in examples undoubtedly contagious, at height of the late epidemic.

Series 2. *Tenement Epidemics.—Sub-Series* 1.—The first example given below occurred at the G. T. Hospital, where I was kindly allowed to see the patients and examine their blood. These instances having been fully described by the late Surgeon-Major Cody in *Transactions Medical and Physical Society of Bombay*, New Series, No. II., p. 1, 1883, a brief summary of them will here suffice. Dr. Cody prefaces his account with a significant remark—"The following three cases are the most typical of a considerable number that have been admitted during the past year into the G. T. Hospital, all of which were strongly suspected as being relapsing fever. The majority of them, however, might be open to doubt, or they showed but one fall of temperature, or rather one of either period—pyrexial and apyrexial, and I have therefore excluded them for these three."

Nos. 1—3.—A mother and two children, brought by the Police, 13th May 1882; found on the road-side at Mody Bay, houseless and destitute, and apparently ill. On admission the mother was in a semi-comatose state, collapsed, with temperature 97°; in a few days she rallied, and could then state that in the 'chall' (tenement) where her room was, a man had been previously ill with fever, from whom this woman considers she contracted her fever; also that the family subsisted on charity, and had been ill-fed lately. I saw this patient, and considered her case one of spirillum-fever at the close of specific pyrexia; since no relapse took place in hospital, verification by blood-analysis was impracticable.

The next case described is that of the boy, 10, admitted on 2nd day of invasion or first attack. The chart shows critical defervescence on 6th day of illness; 7 days apyretic interval; and then an entire relapse of 3 days' duration, maximum temperature at acme 106·6°, crisis and decline to 96°, and no further return for fourteen days. Details given are, in the main, characteristic. I saw the patient myself, and found the blood spirillum during the sharp febrile relapse.

Sister of the above, 8, admitted on reputed 4th day of invasion, with high fever which promptly subsided two days later; 6 days of apyretic interval followed, and then a pronounced relapse of 3 days' duration, maximum temperature 105·4, minumim temperature at crisis 96·2°; again after 6 days apyrexia, a second relapse of about 36 hours' duration (maximum temperature 104·2°, minimum temperature 96°); thenceforward progressing convalescence while in hospital. This patient, too, I visited, and in her blood, during fever, found the parasite: besides, the general features of the illness were unmistakeably those of genuine relapsing fever.

The above were Hindus, of the same low-caste as those in the series below: the locality they were brought from—Mody Bay—being also not far distant from Bori Bunder, and hence a possibility of inter-communication. Family epidemics were frequent in 1877-78 (*loc. cit.*, p. 378), and strangers coming within their range did not escape, as the following instance, also narrated by Dr. Cody, would serve to show:—

No. 4.—M., 25, Marathi, grass-cutter, living in a 'chall' near Mody Bay; admitted 25th June 1882, with high fever, of 4 days' duration. On 6th day epistaxis with dyspnœa and loud bronchial râles over right lung; at midnight temperature 105°, and crisis after with sweats, temperature 96° at 4 p. m.: prostration persisted, and the temperature was subnormal during the next 7 days' apyretic interval. The relapse next evening was pronounced, lasting full 3 days; at acme 2 p. m. temperature 106°, and at crisis (7 p. m.) temperature 96°, still further declining during the night. The symptoms at acme are specially alluded to by Dr. Cody as being remarkable, though not at all peculiar to this case. Convalescence was gradual and steady, during the remaining eight days of patient's stay in hospital. I examined the blood during the relapse, and found in it the spirillum.

This patient was one of three men brought to hospital from the same locality—but being the only instance in which fever ran a typical course while under observation, it alone was published (remark by Dr. Cody). I may add that the patient was an immigrant from the Deccan famine districts, and belonged to the same class of men so largely affected in 1877-78: this circumstance further illustrating the tendency of spirillum fever to linger long amongst once-infected communities.

Sub-Series 2.—Six men of ages ranging from 16 to 35 years, belonging to a colony of low-caste Mahars, living together in the same hut; working as town-scavengers and resident in Bombay for varying periods, were admitted at near dates into the J. J. Hospital during July 1882. The first man seen, displayed a full ordinary attack with marked relapse; of the others, two coming a fortnight later gave a history of prior attack, one showed a suppressed relapse, one had no recurrence; and one, recently affected, died shortly after admission. Judging from their history, Nos. 1, 2, and 6 below may have been first attacked about the same date, Nos. 3 and 4 also simultaneously

about a week later, and No. 5 also after another week. The physical condition of all was fairly good.

Special enquiry was at the time made into the circumstances of this localised outbreak, and my informant learnt as follows:—

The patients occupied one of six mud huts, clustered together under the walls of Fort George but open to the sea-breeze: they came hither three months ago. The larger huts are square shaped, measure 24 feet by 10 feet, are placed on a damp soil, having wattle and dab walls and palm-leaf roofs; and being sub-divided by cane partitions into five compartments, each lodging a family: the doors low, and darkness and dirt within abounding. Near at hand are large cow sheds, and pools of foul water have collected since the rains began last month. Fever is said to be entirely limited to one of the huts (in which 45 people lodged), and to have speedily affected 15 persons, of whom 3 died (men 2 and 1 woman); when, becoming alarmed, some of the sick came to hospital, whilst others decamped; and shortly afterwards, this particular hut was pulled down.

As to the origin of the "fever" one of the patients stated that two men with "fever" came to them from Matharpakady, Mazagaon (about a mile distant); when a week later, the disease broke out in the rest. This would indicate both importation of illness, and spread by contagion; certainly the man whose case is No. 5 below, may have become infected from a comrade.

As to the nature of the "fever," there is absolutely no room for doubting that it was genuine relapsing fever, characterised by the presence of the blood-spirillum. The whole incident entirely corresponds with ordinary experience of famine-fever, both here and in Europe; and it is noteworthy that during 1877-78, the same group of men, Mahars, living in nearly the same locality of Bori Bunder, were most of all the population of Bombay severely affected by the epidemic of that date.

No. 1.—Male, æt 20, and in fair condition; first seen on reputed 3rd day of illness, with high and persistent fever. Temperature 103°, pulse 140, respiration 36, there was prostration and some incoherence;

the spleen became enlarged next day, when, too, slight jaundice appeared: the fever was continuous for two days longer, and then abruptly subsided with copious sweats, much depression, and the advent of very restless delirium; temperature 97°, pulse 80. The urine near acme of the attack was plentiful, specific gravity 1017, of albumin and bile a trace. Neither early history nor symptoms at first were very peculiar, and the diagnosis was "remittent fever": blood not examined microscopically. On account of the remarkable depression attending the febrile crisis, a suspicion, however, arose that the attack was due to spirillar infection; and the patient was detained in hospital. Sodium salicylate had been freely exhibited without any very marked effect in reducing the high temperature; rallying was tolerably prompt, the body-heat soon resuming a normal level; and though the pulse declined for two days longer, apparent convalescence gradually ensued. On the seventh day after crisis there was a slight evening rise of temperature, which on the following day was more decided; and then the relapse became manifest, lasting three other days and showing fever of remittent character, the successive evening temperature being 105°, 104·8,° and finally 105·8°F., with a pulse rising to 136 per minute just after the crisis; the respiration also quickened to 30 per minute; and there was some distress at the acme. During this recurrence the symptoms were those of relapsing fever; and the blood displayed scantily the spirillar organism, though not distinctly so till after dessication and staining. The critical defervescence was pronounced, the temperature sinking from 105°, pulse 136 (at 11° p. m.) to 100° next morning, 96° at evening, and about midnight so low as 92° F., pulse 50: depression was then great, yet without delirium; and a reaction soon began (temperature 97°, pulse 70 next day), which was followed by prompt convalescence in the course of the thirteen days longer the patient could be induced to stay in hospital. There were some slight indications of a second relapse at about the tenth day of the period: emaciation was persistent.

The temperature chart of this man is characteristic of ordinary relapsing fever, and it was recognised by an experienced medical officer acquainted with 'country' fever in N. India, as being similar to what he had often seen there: this identification appeared to me suggestive.

No. 2.—M., æt. 16, in reduced health, was admitted with high fever of four days' duration, which next day culminated at 104·8°, pulse 148, respiration 36; there was then some jaundice and delirium, much splenic and hepatic tenderness with enlargement; a small amount of albumin in the urine. Defervescence on the ensuing day (temperature 100·2°, pulse 128, respiration 28, much sweating), and next day,

temperature 96°, pulse 68; relief to all the urgent symptoms ensued; and at the close of fourteen days, convalescence seemed established. No relapse took place; the blood furnished negative signs during this apyretic period, and the daily amount of urea excreted sank from 507 grs. (weight of body 87½ lbs.) at crisis, to 198 grs. (weight 89 lbs.): upon enquiry, it was learnt that the febrile attack seen on admission had not been the first one.

No. 3.—M., æt. 28, admitted with high fever of six days' duration; evening temperature 105·8°, pulse 132; next morning temperature 97·2°, pulse 76, there was copious sweating, with restlessness and pain in the hepatic region. Rallying was prompt, and in the course of thirteen days convalescence proceeded without interruption.

The blood of Nos. 2 and 3 did not, in the fresh state, show the spirillum; but on drying and staining, the presence of this organism was clearly demonstrated.

No. 4.—M., æt. 35, admitted at the close of six days' fever, in a state of deep collapse; the trunk supine, the limbs, however, flexed as in *rigor mortis*: temperature 96·5°, pulse 92, and distinctly perceptible, respiration 21 per minute, shallow; pupils said to be contracted. Rallying was not delayed, and it was uninterrupted during the next fortnight. This patient had no fever in hospital, being admitted just after the critical defervescence of a preceding attack; the blood therefore furnished negative evidence only.

No. 5.—M., æt. 25, had been seen at hospital in attendance on No. 1 three days before himself being admitted, and was then in good health. Fever had set in the day previously to his admission: now the temperature 103·8, pulse 132, respiration 40; distress and drowsiness. As a experiment *resorcine* was freely and frequently administered; it afforded no relief in the course of twenty-four hours, and other treatment was then adopted. This attack of fever proved fatal in less than forty-eight hours after the patient's entry into the ward; the temperature at the axilla was continously high, rising to 106·4° (pulse 140—150 per minute and respiration 30—40): there was distress, restlessness, coldness of the limbs, and vomiting, some cough, and sweats without relief; finally spasmodic twitching and exhaustion; the urine contained a trace of albumin. Slight indications of the spirillum in the fresh blood were noted, and several organisms were found in the same specimen after drying, and staining; hence the nature of the case was undoubted. Autopsy not available.

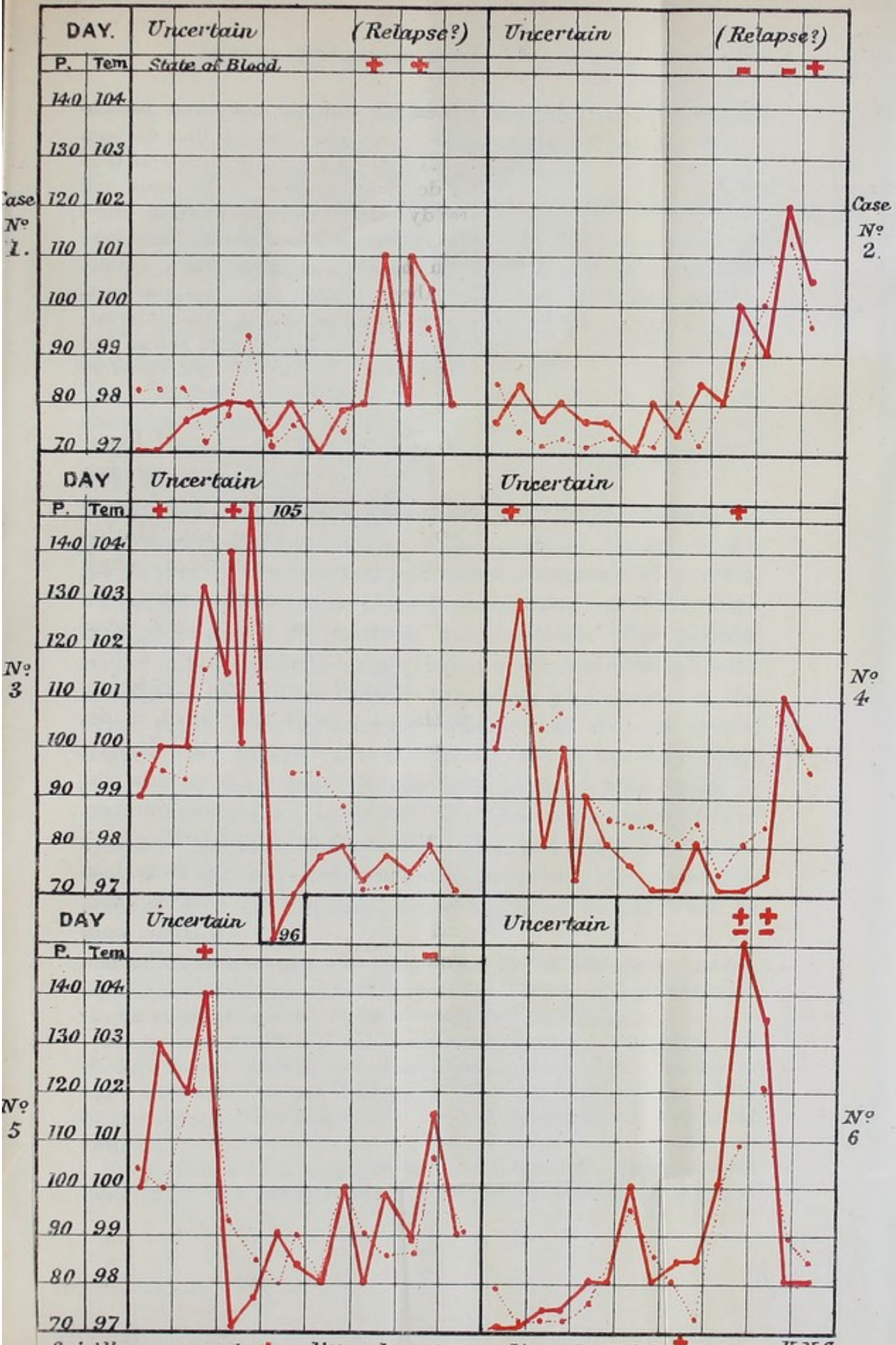
No. 6.—M., æt. 28, later admitted in another ward with high fever; temperature 103·4°, pulse 145, which two days subsequently rapidly declined (temperature 97°2, pulse 120): two days after crisis upon rallying somewhat, there occurred a first and then a second febrile paroxysm, the

pulse continuing very rapid. Thenceforward the body-heat became natural, and very slowly the pulse declined. The blood-spirillum was seen (in dried specimens only) on admission: the general symptoms were then marked with much exhaustion; delirium occurred at the crisis, and hepatic uneasiness with diarrhœa (dysenteric) shortly afterwards, when the temperature again rose; convalescence was protracted. There were no signs of a true relapse while in hospital; but there was a distinct history of a prior attack of fever about 15 days before his admission, which lasted a week and was followed by a prolonged apyretic interval; and during that period he went to work. The present illness had begun about a week before his coming to hospital, and therefore appeared to be the first relapse.

Series 3.—*First Sub-series. Relapsing Fever amongst Immigants from Arabia.*—Eight Arabs, male, of ages ranging from 10 to 45 years, arrived in Bombay 10 days previous to admission into the G. T. Hospital; having come from Murbat (near to Muscat on the Persian Gulf), in a native boat, which took 19 days to make the passage. All of the same caste, and five related: they came from the same town, where much fever prevails. Their own illness (termed "fever") began in that town, some of their large party having been ill three days before embarking. On the voyage they all had fever, which is described as lasting for about a week (more or less), then leaving for a similiar period, and again returning. These recurrent attacks are strongly insisted on, without the precise duration of illness and interval being always remembered. The kind of fever (with much headache, pains and distress) is said to have been always the same. Three had fever on admission, 4th April 1882, two in marked degree, one slightly; four were apyretic, and one at home was too ill to come out. The men are petty dealers, have left their town on account of public sickness, coming for medicine to Bombay; they paid one rupee each for the passage, bringing their own food. On landing at the wharf, they went to one house; they did not resort to hospital immediately, partly from being too ill and also because of not knowing of the hospital. (Personal statement.)

My assistant visited the house in Bombay, whence these men

CHARTS of Temp.(Fahr.) Pulse and Blood. Series 3. Sub-series 1.



Spirillum present +: ditto absent -: ditto doubtful ±.

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were brought direct to hospital: it is a Musafir-khana (travellers' house), two-storied. There are 20 occupants on the first floor, and 12 on the second; the house-keeper lives on the ground-floor. In each room from 6—12 men sleep: 22 men arrived from Murbat about a fortnight before this visit was made, of whom 20 lodged in this house, and eight came to hospital sick; two are ailing, one is blind, and the other nine are now in health. These men occupy the second story: the first story is occupied by seven travellers from Hyderabad, who are all in good health. The Murbat men left their country because they were starving, there being a famine from want of rain during three years. The house is not clean, but it is fairly ventilated. (Mr. Mirza's notes.)

Brief notes of these eight cases are the following:—As general features of the series, is the common history of all; the frequently little marked and varied occurrence of pyrexia, with scantiness of visible blood-contamination—probably indicating late stages of recurrent auto-infection. The patients stayed in hospital little longer than a week, and although some symptoms were characteristic (including pink spots on the skin), yet it is in high degree probable that without special enquiry, the nature of the "fever" would not have been recognised; there was certainly little to attract attention in some of these cases, while yet the blood-contamination was present. Doubless, the actual duration and severity of illness were not identical in every case; and most likely the commencement of fever not the same, seeing the variation met with on their admission.

No. 1.—The father, æt. 45: temperature 97° on admission, and five days later suddenly rising to 101°, next day 100·4°; on both occasions the blood spirillum seen. Spots were detected on the skin.

No. 2.—Son, æt. 15: also sub-normal temperature on admission, and six days later a prompt rise of temperature, increasing next day to 102°, after which he was discharged. The blood parasite not seen during apyrexia, but detected on the last morning: a few spots of eruption.

No. 3.—Son, æt. 10: temperature, on admission, 99°, rising on third day to 105°; then falling suddenly to 96°, and continuing low the next

four days of his stay. During this marked relapse, the spirillum found on two successive mornings: a few spots noted at the crisis.

No. 4.—Uncle, æt. 25: on evening of admission a sudden rise of temperature to 103° (spirillum seen), then a decline to 98°, a second slight rise and subsidence to 97°: in six days after the first crisis fever returned, temperature 101° (spirillum seen), the patient then left. A few spots were seen at the first crisis.

No. 5.—Relative, æt. 40: on evening of admission temperature 103° (spirillum seen), next day temperature 104°, then critical decline to 97°, hence a gradual ascent to 100°, on the 5th day of apyrexia, when he left. The *facies* on admission was striking, and depression at crisis marked; then a few spots.

No, 6.—M., 19: temperature sub-normal on admission: six days later it rose to 103·4° for about 24 hours, the attack resembling a prolonged ague fit: some appearance of the spirillum in the prepared blood. This man had right *iritis* on admission.

No. 7.—M., 16: two paroxysmal ague-like attacks on third and fourth days after admission: no abnormal appearances in the blood. Spleen enlarged, and unusual depression after the fever.

No. 8.—The sick man at home (æt. 30 *circa*) came to the hospital later, his fever having suddenly left with profuse sweats: general aspect like the rest.

Charts of the temperature, pulse and state of blood of the first six cases above are hereto appended: they are taken from the records, and my note-book.

Sub-series 2.—*Relapsing Fever amongst Muleteers arriving from Egypt.—Cases at the J. J. Hospital and G. T. Hospital, October* 1882.—My attention being drawn to the characteristic symptoms of Case No. 1 below, and hearing of other fever cases elsewhere, I visited the camp on the Esplanade where men and animals landing after the voyage from Egypt were located, on the 17th October and following days. In one of the 'lines' whence patients had come, I found about 50 men, with several sick among them; and one man, recently taken ill, was at once despatched to hospital (Case No. 5 below). If the other 'lines' had been equally affected, at least 50 fever patients would have been found. Many men had suffered from diverse minor complaints, and one died from injury inflicted by a mule. These 'batches' belonging to the Transport Department had arrived by different steamers,

at near but various dates. Some of the men had landed at Suez, and then re-embarked; batch No. 5 (that furnishing the earlier hospital cases) had come direct from the Suez Canal —duration of voyage probably upwards of a fortnight. The men were well-fed on board ship, had fair wages, and did not show any signs of mere 'want.' The weather at Bombay was open, though sultry, and the ground tolerably dry on which the small tents were pitched: conservancy seemed fairly good. The landing-place was the Prince's Dock, about 1½ miles distant; and on enquiry made for me by a senior student, no 'fever' seemed to be prevalent around the dock itself. Popularly, this fever was attributed to careless exposure, change of diet, and a climate new to these Punjabi muleteers. In a few days later the encampment was broken up, and the men and animals dispersed in various directions—some inland and others to Karachi: and immediately afterwards, Artillery arrived at the same ground. I was not in a position to ascertain if 'fever' persisted amongst the men dispersed; or if the new-comers were attacked.

As the result of my enquiries, it appeared that relapsing fever either might have been caught in Bombay, or possibly it was imported (see Case No. 6 below). If acquired on the spot where it was detected, then this must have been through infection (no starvation prevailing here) very promptly acquired; *e.g.*, in some cases where the history showed an incubation-period of not more than 4—6 days. In other instances, the fever appeared 10 to 14 days after landing, and may have been caught locally, from the earlier cases in the camp.

If this view be adopted, here was evidence of great susceptibility to contagion amongst these newly-arrived muleteers, and a very speedy acquirement of disease—seeing that the ordinary period of incubation after infection, is in relapsing fever usually seven days. Infection might have come from labourers at the dock, or from places nearer the camp, where it is possible this disease was prevalent; but no evidence to such effect appeared upon enquiry.

On the other hand, the 'fever' may, not impossibly, have

been brought by the men themselves from Egypt: such event being 'clinically' even not unlikely; so far as can be judged from the histories of actual illness, and from other known instances of long conveyance of relapsing fever by successive infections amongst an associated body of men. Nothing, however, is known of the medical condition of the muleteers on board ship, or of fever in Egypt; though, if the history of No. 6 below be correct, infection must certainly, according to present knowledge of relapsing fever, have been acquired aboard ship.

Fevers were termed 'Remittent' and 'Intermittent' in about equal number, in a total of ten whose cases are with me; doubtless there were some other instances I did not see. One case of complicated spirillar infection (fatal) is entered as "Double pneumonia." These came first to notice on 13th to 17th October, and on the 29th about a dozen miscellaneous sick were brought to hospital from the S. S. *Avoca*, just arrived from Egypt with sick details under medical charge. There were five cases of dysentery and diarrhœa, four of ulcer and injury, one of dropsy, one of gangrene of lung, and one of keratitis: illness in some of them dating back to near the beginning of the month, when the troops were still in Egypt. It seemed to me probable that the two fatally-ending cases of lung inflammation and dropsy with debility, were sequelar to 'fever,' and also some at least of the bowel affections: such fever might have been of the relapsing form, but there were no details in evidence. Within my experience, spirillar pyrexia has often been designated remittent and intermittent fever, or ague; and its complications or sequelæ entered alone as pneumonia, bowel affections or other local disease. I am, therefore, sceptical at times concerning the propriety of such designations, when applied to cases cotemporary and mingled with the demonstrated specific fever, as occurred in the present series. And rather confirming the view of importation of relapsing fever from Egypt, is the evident fact that from the very character of this complaint, affirmative testimony of the kind now offered by these series, is the only kind that could be looked for; apart from examination of the men prior to their

landing. The question is like that of 'contagion in hospital,' which I have discussed elsewhere (*loc. cit.*, p. 392).

The following is a summary of all the cases of 'fever' I had the opportunity of seeing :—

No. 1.—M., 25: six days in Bombay when attacked, and two days later sent to hospital; where for four days longer he had continuous high temperature (103°–105°, pulse 110–120), and on the seventh morning of fever critical defervescence (temperature 96·4°). Severe headache and pains in the calves and joints, with splenic and hepatic implication: a critical perturbation with profuse sweats following, and prompt relief of suffering were duly noted. The man was discharged from the G. T. Hospital seven days later, or about the usual date of relapse: wanting this feature, the case was still recorded (and I think correctly) as one of relapsing fever.

No. 2.—M., 30: four days in Bombay, when he caught fever, and six days later was seen at the close of the attack. No paroxysm witnessed in hospital, and the entry is 'intermittent' fever; probably from the patient's statement of alternate chills and sweats, such statement being equally made in case No. 1, and others of undoubted spirillum fever.

No. 3.—M., 35: seven days in Bombay, when he got fever, and five days later was admitted: then temperature 100°, next day rising to the same, and then becoming sub-normal. Aching pains and debility were prominent. Designation 'ague,' and discharge in seven days.

No. 4.—M., 25: six days in Bombay, when he was seized with fever, and four days later was admitted with temperature 104°, pulse 110, signs of pulmonary congestion and hepatic implication. The sputum is described as thin and frothy. Dyspnœa became urgent, with much headache, pain in joints and vomiting, On the second day pyrexia subsided to 101°—102°, but pulse rose to 128, and the bases of the lungs became more implicated; on the third evening temperature 101°, pulse 120, respiration 44; and he sank with great apnœa. No autopsy. The case was entered as one of 'double pneumonia.' I visited the man, and being impressed with the urgency of dyspnœa and general symptoms, as contrasted with signs of local lesion and degrees of pyrexia, took specimens of the blood for microscopic examination: these clearly displayed the spirillum, and so demonstrated the real nature of the illness. Instances of like nature were met with here in 1877-78, and such are highly significant in many obvious respects.

The following is the J. J. Hospital series :—

No. 5.—M., 20: about ten days in Bombay when seized with fever, and two days later admitted: temperature 104,° pulse 100, respiration 32. For six days more the pyrexia was high and remarkably sustained (not-

withstanding large doses of sodium salicylate, &c.), yet the pulse did not quicken in proportion, and general distress was only moderate. At the acme (estimated seventh evening) a decided perturbation, temperature 104°, falling to 94° within about 12 hours; pulse then 60. Next day, I wrote, "the body is like that of a corpse, yet he sits up and even moves about, breath cold, tongue shrunken, no cramps or delirium; urine 20 ozs, high-coloured, clear, 1012, neutral, albumin a trace, chlorides scanty, phosphates abundant, bile-pigment present." Rallying was prompt, and eight days later the patient decamped; returning however next morning with signs of ophthalmia, and there then occurred a smart proxysm of fever (temperatur 104°), with splenic enlargement and marked crisis (temperature 95, pulse 58); no permanent collapse or complication, and two days later the man left hospital for duty.

The day after his first entry, I examined the blood and found the spirillum; so that if any doubt as to the nature of the fever were likely, it would be dissipated.

No. 6.—M., 30: admitted for fever on the 13th October, having arrived, it was said, five days previously from Egypt, and having been ill four days, the fever coming on the day of his landing at Bombay. As the febrile state lasted only two days longer, this attack might have been a relapse; all the clinical symptoms were distinct, including critical perturbation and ensuing fall of temperature from 104° to 95·6° with the delirium of collapse, deafness and eruption of pink spots. The man was scorbutic, and slight dysentery appeared during the apyretic period; no decided relapse followed, but only a slight rise, temperature 100°, six days after the crisis (no spirillum seen): rallying was prompt, and the patient was discharged convalescent a few days later.

If the history of this case can be relied upon, the fever must have been acquired before landing; unless, indeed, infection had operated instantaneously, and of such prompt operation I have never met with an example in man.

No. 7.—M., 18: had been in Bombay fourteen days before he was seized with fever, and the day after came to hospital; when fever of a remitting course was seen; lasting seven days, on the third of which I found in the blood indications of the spirillum. No marked crisis, but scorbutic dysentery was present, and might possibly have led to depression of temperature. Four days later he left for Ambala.

No. 8.—M., 21: arrived in Bombay with the last named patient: had fever the day before admission, but while in hospital for two days only feverishness of 100°, declining to 98·5°. Nature of illness not obvious.

No. 9.—M., 30: belonged to the same batch of men: was admitted eleven day later than the last, having had fever for three days. In hospital he showed four days of sustained pyrexia, temperature (101°—103) declining on 8—9 days: then he left. Spleen enlarged; some cough and defective resonance at apices of lungs, and a disproportionate amount of dyspnœa; depression and general distress. Convalescence, however, prompt on defervescence. The blood seemed free from contamination. It was unknown if there had been a previous attack.

No. 10.—M., 40: from a later batch, seems to have had 'fever' four days before admission. In hospital, a subnormal temperature, with much weakness; convalescence slow. All these men were observed under identical conditions; and according to recognised methods of inference, were affected with identical disease. Such inference would be entirely supported by the clinical testimony presented.

Remarks on the above Cases.

Arranged under the headings of semeiology (*a*), diagnosis (*b*), and epidemicity (*c*).

(*a.*) So faithful, in general, have been the late examples seen of spirillum or relapsing fever, that by one having prior experience, a tolerably complete description of this disease might be drawn up from these recent records; and in the more detailed instances, correspondence of symptoms with earlier records was even precise. Not least typical were the two 'sporadic' cases, in Series 1; and this noteworthy fact shows that seemingly isolated cases are not necessarily 'abortive' in character, or unsuited (judging by inference) to propagate the disease. Grouped cases (Series 2) were also characteristic. Fever amongst new-comers, or possibly imported by sea, appeared less regular and pronounced; but here the conditions of observation were comparatively unfavourable, though such as must alone commonly be met with. For example, from the details furnished in Plate 2 (Arab series), it will be seen that the patients were only seven or eight days under observation; so that not more than one febrile attack could be witnessed throughout, and hence the term 'relapsing' fever might not always strictly apply: further, only once or twice was the course of pyrexia striking enough to attract special attention (as con-

trasting, that is, with paroxysmal malarious fever); and lastly, it happens that other frequent signs were not very pronounced. The Muleteer series following was also comparatively unimpressive in several instances, and of all ten cases, only two are registered as 'relapsing fever,' the remaining eight being designated 'remittent' or 'intermittent' fever, as not rarely happened in 1877. To avoid prolixity, I have not given the full notes of instances most of all carefully watched; and it must therefore suffice to state that in such best known cases, there is evidence of identity of disease as regards not only subjects attacked, stages and repetition of illness, and ordinary symptoms, but also frequency of eruption and local complications: exceptional features were also now reproduced; and my earlier conviction affirmed, that the clinical manifestations of spirillar infection are liable to divergency wider than is often supposed.

Nothing new, however, was clinically observed; nor fresh evidence of 'blending' of fevers, or of alteration of type: so that at Bombay, at least, this affection has maintained its specific characters essentially unchanged.

With the subsidence of peculiar famine conditions here, other typhus-like fevers (either cerebro-spinal, or spotted,) have seemingly also lessened; though examples are still to be met with, of severe, low type, whose real character is not quite clear.

Amongst the cases above recorded, the known mortality was at the rate of 6·6 per cent. only; but some deaths were heard of outside hospital, and the entire course of many instances seen remains unknown. The two casualties witnessed, took place near acme of first or invasion attack; as formerly was frequent here (*loc. cit.*, p. 242).

As to treatment by drugs, nothing more favourable was learnt; both sodium salicylate and resorcine in large repeated doses, failed even to control the high pyrexia. Kairin had not been introduced (1882); but I may add that in Germany of late it, too, has been found to operate mainly as an anti-pyretic and not as anti-periodic. (*Lond. Med. Rec.*, 1883. Vol. 2, p. 468.)

(*b.*) *Diagnosis.*—Since the year 1877, from both clinical and sanitary points of view, the early detection of so-called relapsing fever has become increasingly important; and when doubts of its presence arise, I must still hold there is but one sure mode of avoiding possible error. Even if origin, causation and symptoms seem tolerably clear, it is a satisfaction to verify diagnosis; and by repetition with improved processes, the blood-test may come to teach far more than the single stage yet shown of the spirillar blood-contamination.

As elsewhere stated (*loc. cit.*, p. 309), several contingencies and precautions attend the application of this test; but these conditions being complied with, I am so convinced of its clinical utility as regards spirillum fever in every phase, that (such phases being both many and varied) I cannot but recommend the adoption of such test in all outbreaks of epidemic or endemic fever of doubtful character, occurring in the districts and jails of this country. It is true that at Bombay, in 1877, the detection of the blood-spirillum was not to all men convincing evidence of the nature of the then prevalent epidemic; and possibly some of the cases narrated above will appear to many to be of dubious nature, whether or not spirillar-contamination could be found in the blood. Until, however, directly opposing testimony be brought forward of the absolute disconnection of relapsing fever (in all its phases) from such contamination, the inference, according to my experience, must be that this sign is pathognomonic: and if so in 'typical' cases, then also in the obscurer, where a guide is more to be appreciated. It would not, I add, be enough to show that the blood-spirillum is present when the 'fever' is slight or does not present relapsing features, because, as I have shown elsewhere (*loc. cit.*, p. 128), in ordinary clinical practice a recurrence is neither by any means invariably noted, nor when seen (alone it may be) s it always of prominent character. In point of fact, the wider the acquaintance with this infection, the wider its clinical features will be seen to range (*loc. cit.*, pp. 34 and 312). Since the blood test is applicable at only certain dates of illness, and its use may call for some care and dexterity, a positive

datum here carries more weight than the negative; and if once the spirillar organism be clearly detected, diagnosis becomes sure; having in my experience always been satisfactorily confirmed by other available evidence, besides that furnished by the visible blood-state. The most puzzling cases, to me, were those in which I failed in search, under conditions otherwise at first sight promising; yet even here the reason of failure either was, or soon became, conceivable—commonly being an insufficient application of the microscopic test. Many times it was only the dried and stained blood-specimens, which furnished clear evidence; fresh blood giving either negative or dubious indications. Like all instruments of precision, this newer means of investigation calls for special attention in its use; and the spirillar test is, I feel sure, but a sample of clinical aids that will presently become essential to accurate diagnosis. Such aid is greatly needed, *e.g*, for the sure detection of the typhus, typhoid and malarial infections; and until it be obtained, present doubts often prevailing must abide, to the perplexity of both physician and sanitarian.

Adverting to the several instances under review, I observe that diagnosis by the ordinary means, if sometimes clear, would at least equally often have been doubtful; and that it actually proved to be insufficient, may be inferred from some remarks of Dr. Cody quoted above (in the first Sub-series, Series 1), and was seen as regards the fatal case of 'double pneumonia'—several other instances being wrongly designated, if the validity of the blood-test be allowable. Satisfactory clinical diagnosis of the obscurer fever cases, may fail—(1) when there is neither famine nor epidemic, and no history of contagion, as causative influence; (2) on clinical grounds, when a relapse is not witnessed from not occurring either absolutely or during the short time the patient may haply be detained under observation; or when only a late relapse takes place in hospital, so transitory and mild as to attract but little notice—as was frequently experienced during the epidemic of 1877, as well as at this post epidemic date of 1882; and (3), when other symptoms regarded as characteristic, are either wanting or undistinguishable

from the co-existence of local complications and secondary fever; the patient coming in late, dying early, or insisting on his discharge before the whole course of illness be ascertained.

Doubts and difficulties from these several contingencies, I have very often known to arise; all of which were promptly and finally dispelled, by an adequate employment of the microscope: and apart from such technical method, I am not acquainted with any means of avoiding undesirable hesitation or misinterpretations. Whatever were the decisions of former years (when relapsing fever doubtless prevailed), it is allowable to insist upon the value of the present improved aids to diagnosis; especially in India, where there universally prevails the malarious infection, with pyrexial manifestations so vagarious as popularly to embrace all kinds of 'fever.' Thus during 1877 and later, all mild recurrent or irregular pyrexia was attributed to 'ague'; and to 'remittent' fever, the more prolonged attacks seen—'with spirillum' being affixed to the designation of certain cases examined microscopically. There is reason to hope such a confusing nomenclature might not again be resorted to; but the remark is still quoted, that in 'ague' the blood-spirillum is to be found. I am also acquainted with occasions where recurring agueish attacks were put down to (so-called) relapsing fever; although in support of such identification no evidence has been procurable from previous history, clinical characters, or special blood-state. Obviously, therefore, the risks in diagnosis here are two-fold; namely, first that of disregarding the spirillar infection, and next that of attributing to it pyrexial attacks of different nature. (*Loc. cit.*, p. 313.)

Lastly, as regards the more general subject of identity of disease, in a closely-allied group of cases presenting some non-concordant symptoms. Here the question may arise, if such group be not of composite character—ordinary malarious fever mingling with the relapsing form. In England, similar groups of fever—typhus or enteric—would commonly be regarded as all of one character, despite some absence of clinical concord. But in India, where ague and remittent fever are freely recog-

nised as the prevailing kinds of fever, it might be urged that a mingling of those kinds with phases of relapsing fever is both possible and likely; and such event would be proved if every instance seen did offer suitable opportunities for use of the blood-test, and a divergence of character were established thereby. Otherwise, my experience leads me to infer that the groups of fever-cases, however seemingly non-concordant in the mass, will usually be of a uniform character, represented by the better-marked individual instances; and the finding of the blood-spirillum in a single instance has so frequently been followed by affirmative evidence regarding the remainder, that I am disposed to reply upon the European citerion of a community of origin meaning also a common character. For perfect accuracy, however, the greater pains cannot ever be spared.

Another interesting collateral topic is the employment of dates of periodic disease-stages, for estimating the probable total duration of an illness seen only towards its close. And according to my experience of 'relapsing fever' in man, there obtains such a uniformity in date of the successive incubation-periods (including the first) and febrile manifestations, as is close enough to warrant reliable inference regarding both previous unseen illness and future likely course. This question concerns the validity of average and mean dates like those given at p. 128 of my work (see also p. 403 for the initial incubation-period); and the answer hereto conveys only probabilities, to be estimated at judgment of an experienced enquirer. Personally, I should regard average dates as practically valid, and as useful either alone or combined with other evidence. For an application of this method of reckoning, see remarks and Series 3 above.

Lastly, as regards the febrile complications of relapsing fever, which may be classed as either symptomatic of local lesion or secondary, reactive or residual pyrexias; some hope appears of their further diagnosis, from researches lately made in Europe. Thus, as regards pneumonia, which, with secondary fever, I was disposed to attribute to blood-contamination

sometimes attending the spirillar (*loc. cit.*, p. 240), it is now proved that croupous pneumonitis is a specific malady due to a *micrococcus* growing in the affected part and existing in the lymphatics, as well as in the blood of the animals experimented on (*Brit. Med. Jour.*, 26th Jan. 1884, p. 174). Moreover, Dr. R. Koch some time since furnished excellent photographs of a *micrococcus* present in the inflamed lung of pneumonia accompanying relapsing fever (*Mittheil. d. Kaiserlich Gesund. Amt.* Bd. I., Berlin, 1881, Tab. X.); and this observation amounts to actual proof of an infection, superadded to the spirillar.

It seems, indeed, that much (if not all) pronounced and well-defined pyrexia—not solar or nervous in origin, is due to a blood-contamination, which now or eventually may be made visible or otherwise apparent. Whatever organic chemistry shall reveal, that encouragement exists to persist in microscopic research, is shown by the clinical results already obtained in spirillum-fever; and the blood-tests now known should be commonly and assiduously employed, if only because febrile epidemics in India may be due to relapsing fever oftener than is supposed. There are, besides, other outbreaks of sickness in which this means of investigation seems to be called for, *e.g.*, 'beri-beri' 'or acute œdema,' of which a late epidemic occurred in the jail at Thayetmyo in British Burmah (*Ind. Med. Gaz.*, March 1884, p. 88); it would be well worth ascertaining if such sickness be related to the so-called 'malignant œdema' of Europe—a form of 'anthrax,' I believe—as could readily be done.

(*c.*) *Decline of Epidemic.*—In continuation of the Chart at p. 30 of my work (*q. v.*), I present the following Table founded on the same authentic data; namely, the Bombay Municipal Fever death Returns, A.; Total Remittent Fever cases treated at the J. J. Hospital, Bombay, B.; and C., Fever deaths in the Southern Deccan country-districts, lately the seat of famine in this Presidency (Rep. Sanit. Com. 1882). The excess over normal here represents superadded (probably famine-) fever, not otherwise distinguished in the Returns:—

Late Progress of 'Fever,' Bombay Presidency.

	Normal.	Famine Epoch.		Gradual return to Normal times.				
Years.	1876	1877	1878	1879	1880	1881	1882	1883
A	5,867	12,832	9,944	8,445	7,513	6,437	5,453	5,903
B	189	1,095	672	285	244	266	234	176
C	52,658	137,985	98,686	68,382	57,720	52,145	45,887	...

The mortality of 1876 was at fairly normal amount. With felt stress of famine, fever-sickness and mortality suddenly rose (1877); and the dearth persisting though to less degree, they continued very high (1878). Distress then diminished, and so the mortality; which after the fourth year of the epidemic, had returned to normal amount or thereabouts. The whole course of the outbreak is therefore here shown, so far as revealed in these concurrent statistical data: its maximum was speedily attained; its decline more gradual; its duration 3—4 years. The maximum mortality was very high and rather greater in the country districts—260 per cent. above normal, than in Bombay —220 per cent. above normal: the hospital admissions were increased 525 per cent. The rates of subsequent decline were as follows:—Bombay city, excess in 1878 and three following years about 40 per cent., 30 per cent., 23 per cent., and 10 per cent, respectively: country districts, at corresponding dates, decline to 47 per cent., 24 per cent., 9 per cent., and *nil*, showing a prompter return to normal than in the city, where other persons suffered besides the starving immigrants. Excessive hospital sickness remained very high ($3\frac{1}{2}$ times above normal) during 1878, and did not wholly subside until the seventh year after the maximum; but this datum, perhaps, is less valid than the others.

Respecting the country data, it is interesting to note there happened a distinct radiation of fever-mortality around the above-named focus of famine, towards the North, North-West and the South; where the fever deaths attained their maxi-

mum a year or even two years later—namely, during 1878-79. Nothing is known regarding districts to the East; and towards the West is the low-lying Concan area, separated by a mountain range. According to my interpretation, famine-fever may have been conveyed by emigrants from the Southern Deccan, into the areas just indicated, which are continuous with it; and thus have given rise to their later augmented mortality (*loc. cit.*, p. 5).

Respecting the Bombay city *data*, a special point to note, is the fact of true relapsing fever still persisting five or six years after the era of distress; although no sign of its fatal operation is apparent in the lessened total fever-deaths of 1882-83. Such an event is comprehensible, because of the small death-rate usually attending this disease: yet not the less is to be remarked the important datum, that a highly contagious scourge may be present in *quasi*-latent degree, without general statistics furnishing any notice thereof.

The Hospital Returns point to similar result, showing that cases of relapsing fever may be admitted throughout the year; and no evidence of this be apparent in the 'remittent' or 'intermittent' fever returns, such cases may be included amongst.

I am unable to particularise further, since the special diagnosis of spirillum-fever is not—perhaps cannot be—attempted under existing circumstances. Yet it is this fact of an unnoticed prevalence of the disease, which would serve to explain the rise of epidemic outbreak, under a repetition of impaired public health-conditions comparable to those of 1877-78. The chief epidemiological features of the epoch under review, may be summed up as follows:—

1. Genuine relapsing fever, first detected at Bombay in 1877, still lingers here (1883); without any notable increase in prevalence or mortality of the 'fever,' to which it was relegated along with other forms. Owing to absence from March 1880 to March 1882, I could not estimate the number of cases detectible during that period; but the present Memorandum proves that without very much effort, from April to December

1882, about 30 instances were met with. And this number is large enough to demonstrate a tendency of the complaint to become 'endemic,' or 'naturalised,' after the fashion seen in some European cities (*loc. cit.*, p. 29). That only one case was noted at the J. J. Hospital during 1883, seems to show almost entire subsidence of the disease; but whether or not by active enquiry more cases could have been found there or elsewhere, it is impossible to say. A certain degree of effort is essential, for procuring data of valid significance; and a single example in a general hospital, doubtless stands for several outside unseen.

2. This long persistence has been independent of public distress, and commonly of personal destitution. Thus, both the above sporadic cases occurred in well nourished men; and of the associated series only a woman and her two children appear to have been ill-fed: no patients that I saw, were unusually emaciated. The conclusions before arrived at, are in general confirmed; the spirillar infection of man being essentially disconnected from primary wasting of the frame, whilst for collateral reasons being in the mass a *morbus pauperum* (*loc. cit.*, p. 369). The number of acknowledged mendicants in an Oriental city like Bombay, is very considerable (9,584 by Census of 1881, with 566 deaths); but judging from the wide prevalence of charitable customs, it may be doubted if instances of starvation or approach thereto, are so numerous as in corresponding European cities. Famine or general scarcity would, however, be more felt here.

3. In 28 of 30 cases, the operation of contagion was strongly suggested. Thus, these 28 cases occurred in groups of 3, 6, 8 and 10 persons; and how many other persons in each instance were infected and not seen, remains unknown. In fact, the difficulty here is to understand why the spread of infection is not usually more apparent than it happens to be; although, obviously enough, without special and prolonged enquiry, the whole truth in any one instance may not be learnt. The work of such an enquiry might be tedious, but would not be either misplaced or fruitless. Various forms of disease tend to work like the other noxious *feræ naturæ*, and a systematic hunting

down can alone dislodge either species. Inasmuch as positive data here necessarily outweigh the negative, so may contagion be inferred where likely though not demonstrated; and the occurrence of sporadic cases can often be understood, on this supposition of casual contagion in localities known to have been once affected.

4. Tenement-epidemics merit special notice: *e.g.*, that above described as No. 2, Series 2. The locality in question I visited, and saw that while all the huts were placed within a few feet of each other (say 6—10 feet apart), in only one of them had fever prevailed. Were it true that usually the contagion of spirillum fever is, or can be, conveyed by currents of air; in this instance it might be anticipated that a breeze from the South or East, would waft infection across the narrow interspaces of these clustered dwellings; and hence the fever spread at least in certain directions, when other favouring conditions were present, as they here were. But prior experience had indicated the need of actual contact, as a rule (*loc. cit.*, p. 384); and in the present Series 3, No. 1, is another illustration of narrow fever localisation—Mr. Banshaw, my assistant, finding the new fever to be confined to the one room alone occupied by the Arabs, in a large house where other strangers of different races, and not intermingling, also dwelt. I think, too, that here the successive dates of these illnesses—namely, at about a week's interval—is further sign of their non-dependence on a diffusible miasm (malaria), either endemically generated or epidemically wafted.

5. *Transport of Spirillum-Fever.*—For short distances such conveyance is common, for in associated groups of sick there is usually a history of personal introduction of the disease by some neighbour or near resident, or visitor from not far off. And for longer distances, instances are known of transport on land from distant localities; that narrated at p. 8 of my work, proving possible conveyance by railroad during half a day's journey (120 miles), and here unquestionably the same sick woman might have travelled very much further, *e.g.*, across the peninsula of India. Dr. Murchison mentions the case of a medical man infected in one town (in Germany) and developing

the fever at another 200 miles distant, after an interval which would have allowed of a far longer journey. And considering the facts ascertained (*loc. cit.*, p. 11), it is possible this disease may also be transported by one or more individuals during lengthened voyages by sea. In 1877 I had occasion to refer to the question of the importation of fever into Bombay, by ships carrying immigrants from Arabia and camp followers from Abyssinia; and during 1882, the cases narrated above under Series 3, seem to raise a similar query of importation from Arabia by immigrants, and from Egypt by muleteers of the Transport Department. Judgment here rests upon—(1) direct evidence of conveyed disease, which may fail; (2) antecedent history of events aboard ship, also liable to fail; and (3) clinical testimony of symptoms witnessed after landing of the patients, which alone was available, and if not convincing, was at least suggestive. The clinical dates in relapsing fever are commonly precise; and if any reliance can be placed upon the history of the cases in question, it seems permissible to infer that infection had sometimes been acquired at sea and before the landing in Bombay. For proof of importation, a single clear instance would suffice in each of the series; such, *e.g.*, as No. 6 among the Muleteers, and No. 1 in the Arab group; because under the circumstances, disease would be kept up aboard through a sucessive infection of individuals.

Counter-argument is two-fold:—First, that no reliance whatever should be placed upon statements of the sick, or results of local enquiry; and next, that admitting dates to be correct, the patients might have become infected immediately upon landing, and as promptly have shown febrile symptoms. To which the reply is, that the men's statements were not unconfirmed by either enquiry or symptoms witnessed; and next, that had prompt infection on shore occurred (which is an assumption), the immediate manifestation of fever is a phenomenon hitherto unproved in man.

I may add, it is well known that 'enteric fever' has not seldom been introduced by ship into Bombay; whether or not then spreading, I cannot say. And in Vol. 1 of these Transactions

(1882), Surgeon Major Arnott describes a case of fever closely resembling relapsing fever, in a newly-arrived European: there being a marked relapse after seven days' apyretic interval, and the other symptoms fully bearing out, in my opinion, the diagnosis suggested. Patient aged 16 years, employed on board a steamer coming from Trieste, and arriving in harbour on 31st October 1874: illness referred to 'about' the same day, and exposure to the sun being mentioned as its probable cause. I am informed that there was no other case of fever on board the ship on her arrival, or during her further stay in harbour; further particulars unknown. The explanation of this striking case, therefore, remains as obscure as that of the abovenamed series of 1882.

6. *Character and generation of Epidemics of Relapsing Fever.* —According to my apprehension, these outbreaks are in time occasional and not periodic. As regards locality, they are either primary when following a first importation of infected persons—one or more; or recurrent, when attributable to a re-kindling of prior endemic disease: examples of both forms being well known in Europe.

As to their origin and production, I know of no evidence proving the *de novo* origin of spirillum fever (*loc. cit.*, *p* 421); and at present, no valid analogical instance exists of a specific fever arising spontaneously. Infection may be kept up by sporadic cases, for prolonged intervals. A persisting series of isolated cases with minor groups of cases ensuing, constitutes the state of endemicity. From such state, the transition to epidemic prevalence is more or less graduated: epidemics being due to incidental favouring conditions, either personal (as the overcrowding of individuals) or circumjacent (as abject poverty states) which are usually, though not necessarily, concurrent together. New localities becoming the seat of an epidemic, must already offer favouring conditions prior to the introduction of infection from without; and recurrence of an epidemic in a formerly affected locality, with lingering disease prevalent, is due to some aggravation of overcrowding and want: hence will be seen the *rôle* of sanitation and of isolation, as regards the

public health. The commencement of an epidemic is more or less slow in rise; its progress and severity are contingent upon the abounding of unhealthy conditions and want of supervision; but always does the disease spread by the multiplication of pre-existing foci of infection, resulting in more and denser, wider-diffused centres of flourishing growth. When these latter become either exhausted of material or effectively separated from fresh areas, the epidemic forthwith subsides; commonly leaving behind it the endemic, or else sporadic, state above described: but whether in a once-infected place, a complete and permanent extinction of contagion does ever practically happen seems to me uncertain.

During the course of an epidemic, the clinical characters of disease do not materially change; that is to say, sporadic or endemic cases may be as severe as those seen at epidemic periods: and how far luxuriance of infection can lead to an alteration of virus properties, has not been evident to me at Bombay. It is true that the varying of intensity of epidemics is often attributed to corresponding changes in the infecting virus itself, which as proved by late experiments may be a real factor in disease; yet human experience rather indicates it is not the infection so much as the subjects and conditions of it, which are open to the variability in question. A little understood subject here, is the apparent special liability of new-comers into a locality, to be infected by a prevailing fever which spares many residents. This feature is said to belong, remarkably, to both enteric and malarious fevers; and if the above Series 3 be interpreted as of local origin, it would pertain to relapsing fever also. The explanation usually given as regards typhoid (namely, that a prior infection confers immunity), would not at all apply to ague, and but doubtfully to relapsing fever.

Lastly, the progress of an epidemic has often been intimately compared to that of an atmospheric current, vibration or *wave*; but according to my late experience of relapsing fever, the juster comparison would be with that of a *conflagration*— which begins, extends and becomes extinct proportionately to the amount, state and location of inflammable material encoun-

tered during its existance. Since the imagination influences sober conceptions, it is not unimportant to start with a right analogy; and that now suggested seems fairly explicable of similar small beginnings, spread by involving fresh units, localised intensities (where fuel abounds), and dying out (when fuel is spent); the scattered dispersions by individual carriers of contagion (as sparks fly), and fresh lightings up at a varying distance; also, the latency of contagion (as of the smouldering of hidden fire). Even further, the practical method of dealing with events by either removing the sick (putting out fire), or amending insanitary homes (equivalent to damping the fuel).

Although epidemic diseases *inter se* may differ in infection-characters, as they do in clinical signs; yet all display general resemblances, upon which sanitation ordinarily first proceeds. Small-pox is so far peculiar, that whilst it appears to spread as above (Dr. Edw. Seaton, late M. O. to the Local Government Board in *Medical Times and Gazette*, 23rd December 1882, p. 741); yet it alone is subject to a third means of effective treatment—that namely, of anticipating the natural by an artificial infection possessing much mitigated properties. (As if preventing a possible serious conflagration by a deliberate controllable ignition—prairie fires being so checked.) My inoculation experiments on monkeys with infected blood of man or their fellows, did not promise like advantages as regards spirillum fever; but much more detail has still to be learnt concerning virus culture and substitution, and the principle involved in vaccination may hereafter be found applicable to other infections during the periods of their epidemic prevalence.

Postscript.—Since the preceding pages were written, some other cases of relapsing fever have quite recently been met with at the J. J. Hospital. These later examples entirely conform to the earlier, and they equally well illustrate the value of blood-scrutiny as a means of prompt diagnosis. Once more, therefore, I would urge that difficulties attending the use of high optical powers or of conjoined staining processes,

ought not in these days to interfere with a due recognition of the clinical value of the microscope. In point of fact, this subject is one much too practical to be ignored with safety; and clinically, few topics are more interesting than the connection apparent between symptoms and visible blood-changes. Were the procedures I have recommended more generally adopted, it is probable that this additional series of cases would be a longer one.

No. 1.—During March 1884, a low-caste adult male was admitted into my clinical ward on the 6th day of fever—a first attack; evening temperature 106°, pulse 120, respiration 32, but no distress evident (he sits up and denies any sense of discomfort even): the spleen, however, was enlarged and tender. Diagnosis somewhat uncertain, the symptoms being possibly due to malarial infection. Next morning, the pyrexia had disappeared by crisis with profuse sweats (temp. 96°, p. 70, resp. 18); the splenic turgescence promptly subsided, and except some depression of the system and emaciation, there soon remained but few signs of illness. No relapse took place during the fifteen days longer the patient was detained in hospital.

A minute drop of blood taken from a finger on the first evening, showed under $\frac{1}{8}$ in. lens some occasional twitchings of the red discs; and after drying and staining with methyl-violet, the same material displayed numerous large spirilla.

Further enquiry at the house this patient came from, elicited the fact of other fever cases there, and one with a history of recurrent attacks; but more could not be learnt: there were no signs of unusual poverty or destitution.

Nos. 2 and 3, two youths from a large establishment, the residence of many others living under common conditions, were the only ones known to be attacked.

No. 2.—On 2nd April last it was intimated to me that J. A., æt. 21, one of the student-apprentices attached to the J. J. Hospital, had strong fever, and could not attend to duty. The illness was of four days' duration, and had not been checked by either quinine or kairin. Noting an aspect of distress in the patient, I was induced to examine his blood on the spot; and finding the spirillum present, had the sufferer remove to separate quarters. Fever persisted as was foretold, and during the eighth night of illness the temperature rose to 106·6°, delirium attending; a critical defervescence next morning ensuing, with decline to 97°. Convalescence then began, but on the ninth day later was in-

terrupted by a febrile relapse; continuing for three days, on the second of which a pseudo-crisis happened (min. temp. 95·8°) with prompt rise to 107·2° sixteen hours later, and then a final decline to 96·6°. The young man's sufferings at this time were great; but he was carefully tended by fellow-students, who also kept accurate notes of the case. I found the blood-spirillum present during the last acute exacerbation, and could therefore say the first and greatest decline of fever was not the final one. Convalescence again set in, and proceeded satisfactorily without any known interruption.

It is worthy of note that a brother of J. A. was the earliest victim of spirillar infection amongst the J. J. Hospital staff, during the great epidemic of 1877; contracting the disease at the Fever Camp, and dying with typhus-symptoms. (*Vide* 'Spirillum-Fever,' p. 390, case 1.)

No. 3.—M. H., low-caste Hindoo, a domestic servant at the residence of the student apprentices, was seized with fever simultaneously with J. A. (or possibly a day later); but continued, it is said, to wait at table two days longer after the fever began. Admitted to hospital on sixth day of illness; on the eighth day, the critical exacerbation (temp. 105·8°, pulse 120, with delirium), and then prompt decline of pyrexia, temp. 96°, p. 82): after which a slight brief febrile movement, and thenceforward rapid convalescence without any evident sign of relapse during the fifteen days he was kept under observation.

The blood-spirillum was seen on the day of his admission into hospital; and although no 'relapse' occurred, the case was seemingly of identical origin and character as that of J. A. There was no evidence of any special intimacy between this patient and J. A. The apprentices live together in small groups, each group occupying a separate room in the house; meals are taken in common, and the large sitting-room is open to all. There are six servants in attendance on over fifty young men.

Respecting the possible source of infection here, it is to be remarked that 'relapsing fever' in Bombay was known still to persist amongst some of the low-caste communities; and the above Mhar lad may have been in contact with some such sick persons, outside his dwelling. Is appears, however, as if these two patients had been infected from the same source; and as usually happens in retrospective enquiries of the kind, nothing definite regarding such primary source could be learnt, and the truth remained hidden for want of some prior information.