CLINICAL STUDY.

Fever.

With a view to indicating the type of fever met in actual practice, I give an analysis of 100 consecutive cases from the 1926 British series, classified according to the temperatures recorded whilst in hospital.

*Group I.*—"Typical cases" (i.e., those showing the stages of initial fever, remission and terminal fever). Total, forty-one cases. A number of these showed very characteristic saddle-back charts. The initial fever generally fell by lysis, and only in one-third did the temperature reach normal in the interval, and that for a very short period. The terminal fever rose gradually or rapidly, and terminated more frequently by lysis than by crisis. In only four cases was the terminal fever higher than the initial fever. A few cases, notably those ending by lysis, lasted eight or nine days, but the most typical ones ended on the seventh day.

*Group II.*—"Terminal cases" (i.e., those not showing the stages of initial fever, remission and terminal fever). Total, fifty-nine cases. For descriptive purposes these may be subdivided as below, into four classes, the type mainly depending on the day on which the case came under observation:—

Group II.1. 5 cases:
Group II.2. 22 cases:
Group II.3. 25 cases:
Group II.4. 17 cases:
Dengue in Aden: A Clinical and Statistical Survey

Class (a).—A short fever ending by lysis and simulating "three-day" fever.

Class (b).—An intermediate type—a low continued fever ending by crisis.

Class (c).—A longer type, of approximately five days' duration, showing a prolonged lysis.

Class (d).—A limited number of cases of step-like rise and fall, lasting about one week, and suggesting a short paratyphoid fever.

Pulse.—With the exception of some acceleration at the onset, the pulse-rate was typically slow throughout the series, not infrequently falling to below sixty per minute.

Blood Changes.—An average of twenty-four consecutive counts gave the following results: Total leucocytes, 4,637 per cubic millimetre; polymorphonuclears, 52.3 per cent; lymphocytes, 40.2 per cent; large mononuclears, 4.5 per cent; eosinophils, 3.0 per cent.

The lowest total leucocyte count was 3,125 per cubic millimetre; polymorphonuclears, 50 per cent; lymphocytes, 47 per cent; large mononuclears, 2 per cent; eosinophils, 1 per cent. The lowest polymorphonuclear percentage recorded was 41, and the highest lymphocyte and large mononuclear, 55.5 and 14 respectively. The fall in the polymorphonuclear total was thus characteristic and general.

Rash.—Owing to the universal existence of extensive and severe sudaminal rashes, it was impossible to state whether the characteristic terminal eruption of dengue was present or not. At the European General Hospital, and amongst Indian troops during this period, I have seen the characteristic rash, and from the confusion between rubella and dengue in the British records for 1922, it is to be surmised that an eruption was a prominent feature in that year.

Adenitis.—Enlargement of the lymphatic glands, particularly the cervical, was quite common and served as a useful adjunct to diagnosis—its presence may have helped the confusion of these cases with rubella.

Urine.—With a view to excluding "seven-day fever" a series of urines was examined for the Leptospira hebdomidis with negative results.

Diagnosis.—The diagnosis of these cases depended on:

1. Epidemiological factors, including the presence of the vector Aëdes argenteus.
2. Clinical features as outlined above.
3. Exclusion of other diseases.

In previous years it would seem that in Aden the following diseases have been commonly confounded with dengue:—Influenza, rubella, sandfly fever, malaria and catarrhal conditions of the nasopharynx and bronchi.

Treatment.—The cases were all mild and rarely required more than a
routine diaphoretic mixture. Pains were not often sufficiently severe to call for anodynes.

Cases amongst Indian Troops (1926).—The febrile course of these cases corresponds very closely with that seen in British troops. In May and June rashes of various types were common, and in September I saw some characteristic terminal eruptions. The absence of sweat rashes facilitated observation. Epistaxis was present in a number of the May and June cases and occurred just before the temperature fell—in September it was only observed on one occasion.

Statistical.

With a view to elucidating the position as regards infectious diseases in Aden I compiled composite charts for the years 1922-26 (to end of September) inclusive, showing the incidence of the chief fevers, less malaria, on the one curve.

As regards British troops, it was at once evident that there was each year a definite seasonal rise in April, May, June and July with a maximum in June, the annual curves being almost identical.

This was attributed in successive years to the following causes: 1922, influenza and rubella; 1923, sandfly fever; 1924, dengue; 1925, dengue; 1926, dengue.

So accurate was the correspondence of the curves that I had but little doubt that the annual incidence was due to one and the same cause.

Fortunately I was later able to find a large number of temperature charts, duly labelled with a "diagnosis," for the years in question, and a study of these made it abundantly clear that one disease, and one disease only, was present, viz., dengue.

It may be noted that the officer responsible for the diagnosis in 1922 held a temporary commission and so presumably was meeting the condition without any previous training in tropical medicine. I append a summary of the diagnoses of thirty-four cases of undoubted dengue in 1922 whose temperature charts were available: influenza, 11 cases; rubella, 10 cases; sinusitis and naso-pharyngitis, 6 cases; various diagnoses, 7 cases.

In 1923 when all the cases were attributed to sandfly fever and none to dengue, a study of the temperature charts again shows that they were due in the main, if not entirely, to the latter disease.

Before finding the charts I had established some presumptive evidence in favour of this conclusion by averaging the stay in hospital of cases admitted during the endemic period with the following results: 1923 (eighty-three cases), average time in hospital 9·4 days; 1926 (seventy-three cases), average time in hospital 8·4 days.

Applying the same methods to cases amongst Indian troops, I found much confirmatory evidence and certain new factors. There was the same seasonal incidence in April, May, June and July, attributed in successive years to the following causes: 1922, sandfly fever; 1923, sandfly fever;
Dengue in Aden: A Clinical and Statistical Survey

1924, sandfly fever and dengue; 1925, sandfly fever and dengue; 1926, dengue.

Compared with the British records it will be seen that in 1922 sandfly fever replaced influenza and rubella, and that in both cases dengue has gradually ousted sandfly fever.

Unfortunately I have been unable to find any charts of Indian cases prior to 1925, but a study of those available shows that many recorded as sandfly fever, pharyngitis and bronchitis, were really cases of dengue.

It is interesting to note in this year, as in 1926, how catarrhal symptoms were prominent in Indian troops, whilst certainly in 1926 this was not the case to any degree in British troops. The diagnosis of influenza and nasopharyngeal conditions in British troops in 1922 suggests that the reverse was the case in that year.

A special factor is very noticeable in Indian troops, viz., a second febrile wave in the latter months of the year attributed in 1922 to sandfly fever, in 1924 to dengue, and certainly due in 1926 to the latter disease.

The clinical notes on Indian cases already given are from this 1926 series, and it is very striking how largely the September cases were confined to the one company that had been absent from Aden during the normal dengue season (May to July). This company had been free from infectious disease during its absence from Aden, and had only been back a few weeks before dengue had developed in a large proportion of the men.

The same explanation would appear to be valid for 1922 and 1924, an added reason for attributing this second febrile wave in all three years to dengue. The absence of this second wave in 1923 and 1925 is dealt with later.

The factors governing the seasonal incidence of dengue in Aden may be summarized as below:

British Troops.—Whether the battalion arrives at Aden in December, February, March, or April, the annual epidemic begins in April, reaches a maximum in June and subsides in July. Except for sporadic cases in varying degree in other months the disease is now over until a new battalion arrives. A very high degree of immunity results in respect of those attacked.

Indian Troops.—As with British troops there is an epidemic period, April to July, and, as before, troops exposed during this period appear to be largely immune for the remainder of the same year and considerably so for the ensuing year.

This early wave of incidence is most marked in the alternate years in which the new battalion arrives, the relief taking place in the first quarter.

An additional epidemic period occurs in some years in September (possibly continued into October and November, but here the normal seasonal incidence of malaria may have caused confusion)—it is dependent on the presence during this period of troops who have not been exposed to the disease earlier in the year or in the preceding year.
This second wave appeared in 1922, 1924 and 1926, in the early part of which years the Indian battalion arrived at Aden for the biennial relief—a portion of these units proceeding to outstations would not be subject to infection until their return to Aden later in the year.

In the years 1923 and 1925 when there was no relief there was no second wave, the whole battalion having already been exposed to infection, either in the same or in the preceding year. And in these years the total incidence was much less.

In the case of British troops, where companies are stationed both at Steamer Point and Crater, the incidence is much higher at the latter where there are greater facilities for mosquito breeding. The Indian battalion is stationed at the Crater and mosquito breeding grounds adjoin.

As stated earlier in this section malaria cases were excluded, and as regards figures for British troops this exclusion, except perhaps in 1922, is unimportant. In that year there was a considerable and sharp increase in the malaria incidence in June, the normal maximal period for dengue, and it was evident from the charts examined that some at least of these cases were not malaria but dengue.

Moreover, there was an abnormally high percentage of cases diagnosed malaria without demonstration of the parasite.

It is doubtful if in British troops in Aden proper there is any primary infection with malaria—relapse cases begin to appear with the advent of a new battalion, if this be infected prior to arrival, the maximum numbers occurring in May, June, July and August, without any sudden accession in any one month. With Indian troops the position is quite different. Here, owing to the very high incidence of anopheline mosquitoes in Habil, which is garrisoned by Indian troops, the number of primary infections is relatively high, and the annual malaria wave occurs typically in November, December and January. It would seem possible in some years that the "malaria" wave of April, May and June, dengue being "absent" during this period, was in part at all events wrongly attributed to the former disease.

The very large number of cases diagnosed in these years on clinical grounds (i.e., parasite not found) lends support to this view. This is particularly apparent in 1922 when dengue was "absent" and "malaria" rampant in April, May and June.

It is with regard to sandfly fever, however, that the chief doubts are raised—indeed it is very questionable if this disease has existed in Aden at any period during the years under review (1922-1926). The difficulty—if not the impossibility—of differentiation of sandfly fever from dengue is notorious, but here the one disease (dengue) is certain, the existence of the other (sandfly fever) doubtful and in some cases disproved, whilst the constancy of the seasonal incidence indicates that only one disease is present. This view is supported by the high degree of immunity from second attacks, which would hardly be so apparent were two distinct diseases present.
246  Dengue in Aden: A Clinical and Statistical Survey

The seasonal incidence of the disease corresponds with the seasonal incidence of the vector of dengue, this again corresponding with the period of greatest heat and moisture, April to September. There is a slight, but definite improvement in the physical conditions in July and August, when there is also a reduction of mosquitoes and dengue.

No cases have been seen in 1926, either amongst British or Indian troops, which could be diagnosed sandfly fever. Phlebotomus is said to be present in Aden (Crater), but so far I have been unable to obtain specimens for identification, and have had no report of the somewhat characteristic assaults of this insect.

The question is of some importance as regards protective measures. Should sandfly fever be endemic in Aden it is extremely doubtful whether, owing to climatic conditions, the use of sufficiently fine-mesh netting could be tolerated. Even the use of ordinary mosquito netting, as a protection against the vector of dengue is discounted for the same reason.

SUMMARY.

(1) Dengue is endemic in Aden.
(2) For troops arriving in the winter months infection will normally occur from April to July.
(3) For troops absent during this period (and not exposed in the previous year) there is another infective period reaching its height in September.
(4) Both these periods correspond with the optimum season for mosquito development.
(5) A considerable degree of immunity is conferred by one attack.
(6) Various diseases, such as influenza, rubella, sandfly fever, nasopharyngeal and bronchial catarrh and malaria, have been confounded with dengue.
(7) It is very doubtful if sandfly fever exists in Aden.

I am indebted to Captain J. M. Mitchell, I.M.S., for information concerning Indian cases in 1926 and to Mr. E. Cordeiro, I.M.D., and Mr. T. J. S. Lynch, I.M.D., for much assistance in assembling clinical and statistical data.

APPENDIX.—FEVERS IN ADEN.

The Memoranda on "Medical Diseases in Tropical and Subtropical Areas" (fourth edition) quotes from Smith and Loughnan some notes on undifferentiated fevers of Aden. These are dealt with in the same order and with the following conclusions:

(1) "A continuous fever lasting fourteen to twenty-one days or longer—common, endemic, and occurring throughout the year." I have not met any instances of this in which it was not possible to diagnose malaria or the enteric group. In any case they were few in number.
(2) "A six to eight-day type of fever, with either a regular fall of temperature or a chart of a saddle-back type. It prevails from May to October, when mosquitoes are abundant." The mosquito in question is the *Aedes argenteus* and the disease is dengue.

(3) "A low continued fever with few symptoms." These cases, not infrequent in 1926, were invariably associated with polyneuritis which in Aden appears to be a manifestation of beriberi.

(4) The existence of sandfly fever in Aden, at least since 1922, seems doubtful.

(5) Enteric fever and its allies are infrequent.

(6) Malaria has been dealt with previously. The introduction of anopheline mosquitoes into Aden from the immediate hinterland is always possible, and, in view of the large numbers of carriers of malaria commonly present in the station, would be fraught with the gravest consequences. At present malaria is absent (from Aden proper) except for imported cases. There is no doubt, however, that the climate of Aden will encourage relapse in a large proportion of the men infected prior to arrival in the station.

(7) Dysentery (clinical bacillary exudate) provides a certain number of cases of fever. Shiga infections occur, but the bulk appear on clinical grounds to be Flexner. The local form is particularly fatal to children.

(8) There remain a few cases of fever which it has been found impossible to differentiate. They are invariably short (one to three days' duration), and commonly associated with headache. Some are doubtless due to malaria and dengue. Others appearing after exposure, as on the march or after any sudden accentuation of the normal hot and moist conditions are probably minor manifestations of the effects of heat.