

MALARIA IN CHOTA NAGPUR ✓

By C. STRICKLAND, M.A., M.D.

(from the School of Tropical Medicine, Calcutta)

An outbreak of malaria at Hazaribagh on the Chota Nagpur plateau in Bihar in a certain segregated community has led to the following report on what appear to be the important factors in the matter.

Fry (1912 and 1914) approached the subject from another direction, and showed that villages on the plateau have a comparatively low spleen-index (7 per cent in 528 children): the following records by the writer confirm his figures:—

Village	Number of children examined	SPLENOMEGALY INCIDENCE	
		Number	Percentage
Tatisilwai ..	40	7	17.5
Mandu ..	33	6	18.0

On the other hand he found that villages along the ghats* cutting the face of the plateau escarpment were intensely infected and he noted that two particular villages, Angarah and Bundkhela, situated at the top of the ghats but otherwise apparently quite similar to villages on the plateau were as highly infected as any he had found at the foot of the scarp, and they are notoriously malarious.

His findings are instructive, relating as they do to two areas of observation one of which can be regarded as a control of the other. In the two areas, the plateau and the ghats, only the physiography of the terrain varies. In both there are terraced rice-fields, though on the ghats the terracing is steeper. Over the plateau the stream flows more gently, so that surface run-off of storm-water is slower, but, on the other hand, as the land is at a higher altitude, seepage is more rapid and the water 'table' is lower. The communities are the same in each case, so there is no justification for regarding malaria as a social disease. Only geographical factors differ.

As for differences in the climatic conditions, Fry's observations prove one very important point. This is, that upon the plateau, as at

* 'Ghat' may mean either the length of the scarp or the approach to the plateau up a steep valley.

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Friedman tests were positive and led to the revision of the clinical diagnosis. Eventually the woman gave birth to a live child.

REFERENCE

Browne, F. J. (1938). *The British Encyclopædia of Medical Practice*, Vol. X. Butterworth and Co. (Publishers), Ltd., London, p. 62.

Angarah, at an altitude of approximately 2,000 feet, the climatic conditions are not inhibitory to malariogenesis. One might of course have presumed this from the incidence of malaria in the Darjeeling foot-hills, where severe epidemics and a spleen index of 55 per cent and more have occurred at an altitude of about 2,500 feet, *i.e.*, in a region where foot for foot the climate is cooler than on this peninsula plateau. Climatic inhibition then does not account for the relative freedom from malaria of the plateau in general*.

If then on the plateau climate is no bar to malariogenesis and malaria comparatively speaking is slight, what can be the reason for this? What can be the explanation of the ghats being so malarious, the plateau so non-malarious? As stated, only the physiography varies and this considerably. The village tanks, and other hold-ups of the surface-water, and the wells, are the same in both tracts, but the rice-fields are more steeply terraced on the ghats, the stream instead of flowing slowly over the plateau now runs fast down its rocky channel, and the further one descends the longer the period during which the streams flow, and the greater the amount of the spring water cropping out on to the surface. Even in the fair-weather season the stream runs fast down the ghat, although there are now numerous shallow pools along its course, whereas on the plateau the stream bed is largely sandy and discrete pools on its bed are relatively infrequent.

During the rains, in neither the plateau streams nor ghat streams are there many anophelines; they are scoured away. It is in the fair season that they survive, but then the mosquito-breeding places on the sandy riverbeds of the plateau streams are few and far between, as compared with the innumerable rocky pools, ideal for mosquito larvæ, that mark the courses of the ghat streams. A factor of importance in this matter must be the equability of the flow in the two types of stream; those on the plateau maintain an equable flow, on the ghat they are torrential, *i.e.*, they swell with a storm and subside at its passing. Equability in the flow of a stream is an important factor in malariogenesis, a matter that will now be referred to, in relation to the influence of natural enemies.

The more equable and gentler the flow of water in a stream and the greater the accessibility

* One may note here that there is a difference in the seasonal incidence of malaria in the two regions. In the Himalayan foot-hills at an altitude of 2,500 feet, and indeed round 2,000 feet, the incidence of malaria is vernal; autumn is too cold for malariogenesis there, while on the Chota Nagpur plateau on the other hand the incidence of malaria tends to the common plains type, *i.e.*, autumnal, though it is definitely earlier than on the plains, as also is maximum mortality (Fry). That is what one would expect from the point of view of the cooler climate in its bearing upon the potential infectivity of the mosquito. At higher altitudes on the plateau, one should find an even earlier malarial incidence than in the villages recorded by Fry.

of the mosquito-breeding places to natural enemies, like fish, the greater will be the destruction of the mosquitoes. A torrent that is scoured out with great violence during a rain-storm and a little later is represented by a series of pools from which there is no surface flow at all is in an ideal condition for the production and full development of mosquitoes long before their natural enemies, such as fish, can be established therein.

Another factor in the matter may be more frequent, 'deviation' by domestic animals, on the plateau.

It is not along the sandy-bedded streams of the Chota Nagpur plateau only that one finds a comparative freedom from malaria. On the plains of Bengal too one notices along all the sandy-bedded rivers that one can recall to mind, e.g., the Damodar in Burdwan District, the Ajay and the Barakar also, the Subarnarekha in Midnapur, that they are characterized by healthy communities living along their banks.

Other things being equal one need not perhaps look for any other reason for the differential malaria incidence in the plateau villages and the ghat villages than those differential physical characters in the streams. When the rains stop, mosquito breeding starts, but to a much greater extent along the ghat streams, and that causes the autumnal epidemic.

From the cessation of the rains onwards more and more of the streamlets dry up as one ascends the ghats, so that by the end of the 'hot-weather' there is very little surface-water at all on the plateau and high up the ghats; there is much more in the streams and swamps at the foot of the hills. If then there is a high malaria rate in the villages at the top of the ghats it can only be derived from the stream in autumn and perhaps winter. Now if the fair-weather streamlets at the foot of the ghats run for such a longer period than those upon the ghats, then the villages in the former situation should be the more malarious, but, as was narrated above, that is not the case, and the reason for this is that in the lower situation the climate is too hot for the development of the malaria parasites, and, moreover as Fry says, the mosquitoes then die out*.

Different factors operate in the two zones to control infection in either during the hot weather. The autumn is the only season when there are mosquito-breeding places and mosquito production in both tracts, and a

*In the hot weather in the plains although the mosquito dies out because of the heat, and at the head of the ghats never comes into being because there is no water, yet it will be observed that in both tracts by the autumn it becomes prevalent enough to produce the annual epidemic. One has seen stated that in certain parts of Bengal pathogenic mosquitoes only start to breed in the autumn but then it is too late for malariogenesis. The above narrated facts, however, show that that argument is fallacious,

suitable temperature for development of the parasite.

With regard to the plateau itself one must repeat that, while the autumnal temperature is suitable for infection, culicidigenesis is too scanty for it to be of any importance and that is the state of affairs that also pertains to all the big river-beds in Bengal.

One must consider, however, the possibility that the different physiography of the ghat streams leads them to support a different anopheline fauna, perhaps the streams having a more rapid surface run-off carry sweeter water and yield a different and perhaps more malariogenic anopheline fauna.

From this point of view Senior White and Das' (1938) observation in the Singhbhum District that the *funestus* group was perhaps solely responsible for the malaria there makes one suspect that it also occurs on the Chota Nagpur ghats, though here one goes to considerably higher altitudes than those observed by Senior White. Nevertheless, the writer has never found this species* in Chota Nagpur and Fry mentions that he did not find the adults of *funestus* ('listoni') in the highly-infected villages, when *culicifacies* and *jeyporiensis* were swarming, nor could he find larvæ of 'listoni' on combing out the water of the rice-fields. The possibility of *funestus* races being responsible in the ghat villages is indeed quite hypothetical, and as it also has not been recorded from the streams on the plateau no differentiation in respect of this species or in fact of any other has been established.

At the same time Fry, like Senior White in Singhbhum, could not find those putatively infective species, *culicifacies* and *jeyporiensis*, infected. He examined 76, a sufficient number in a hyperendemic village to have yielded something positive if they had been culpable, unless the season was rather too early. The writer found *culicifacies* and *jeyporiensis* plentiful at Hazaribagh.

It may be noted that where the plateau and the ghats merge into one another intermediate grades of spleen-index are found, and whereas at Ramgarh the profile of the ghat stream (figure 1) flattens out, which, torrential though it be, does not partake of the full character of a ghat stream, the spleen-index is also intermediate in magnitude.

*The types of breeding places examined by the writer on the plateau and their mosquito fauna may be stated as follows, for record:—

Rice-fields under seepage water	<i>jeyporiensis</i> <i>nigerrimus</i> <i>pallidus</i> <i>annularis</i> <i>splendidus</i>
Stream-beds (nullahs)	.. <i>pallidus</i> <i>culicifacies</i> <i>jeyporiensis</i>
Bandhs (reservoirs)	.. <i>annularis</i>

The influence of *bandhs* (figures 2 and 3), as are called the reservoirs produced by damming up a line of surface drainage, may be here



Fig. 1.—Showing the Damodar river at Ramgarh.

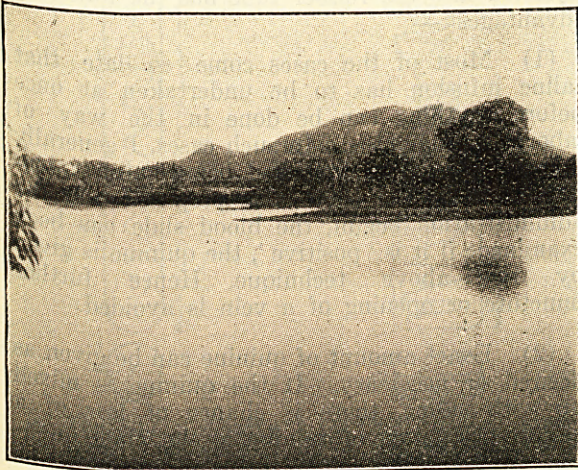


Fig. 2.

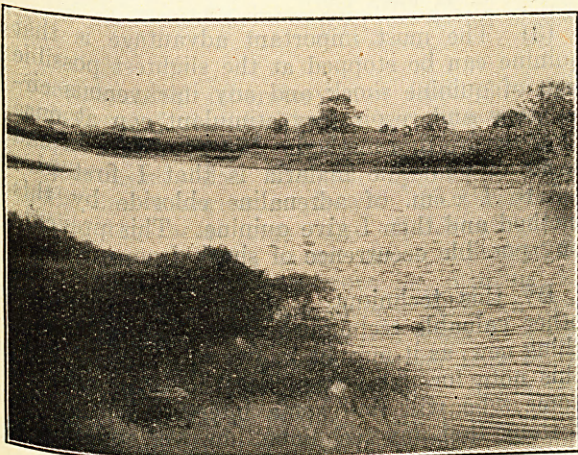


Fig. 3.

also mentioned. At Mandu there are two such *bandhs* overgrown with aquatic vegetation (figure 3), such as would in certain other

parts of India make the politicians talk vociferously about the iniquity of a Government allowing such a thing and call to the colours every able-bodied citizen to clear the nuisance. Yet the spleen-index of this place was about 18 per cent, and that it was as high as this was possibly due to it not being very far from a small ghat stream. Mosquito larvæ were not easily found in these *bandhs*.

They hold perennial water and if the non-perennial stream at the head of a ghat be highly malariagenic in the autumn, why should not these perennial *bandhs* be highly malariagenic?

If there be no difference in the species of anophelines they support, the reason may be ascribed to the existence of 'natural enemies' in these collections of water.

Finally, it is interesting to note that in this part of the country, man for the purposes of his livelihood has sometimes unwittingly carried out anti-malarial measures. Where a stream has not too high a gradient, it has been in many places filled in up to the level of the adjoining *padi* fields so as to afford a slightly larger area of rice-growing land. Powerful *bandhs* of rock across the stream *nullah* are necessary where this is done, otherwise the subsoil flux rapidly washes away the earth-filling. While this lasts it certainly minimizes the dangers that lie in the streams. Except for this sort of thing, the conclusions reached above indicate for permanent control work the training of the hill streams, or better still the damming up of lines of drainage to form permanent reservoirs, such as are shown in figures 2 and 3.

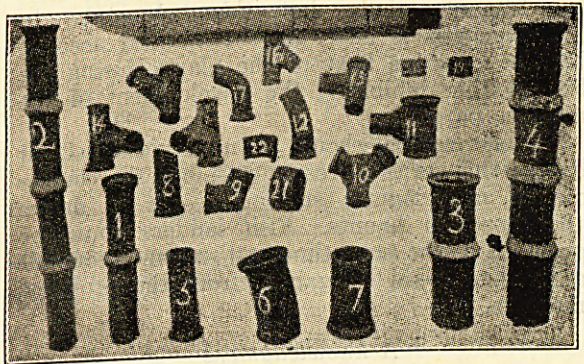


Fig. 4.—The potter, helped by two coolies, turns out 200 pipes daily.

On land where selected communities are settled a comparatively low endemic-index may have serious consequences and therefore mention may be made here of the use of subsoil drainage by the Rev. Father Turkenburg at St. Stanislaus College, Hazaribagh. He has written an account of the material and technique employed (1938) and figure 4 illustrates the pottery produced by his workmen at such
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A SIMPLE TECHNIQUE OF GIVING INTRAVENOUS QUININE WITH SALINE

By R. K. DE, L.M.F., D.T.M.
Assistant Medical Officer, Talap Tea Estate,
Talap P. O., Assam

IN tea-garden practice, we frequently encounter algid cases of malaria, both in adults

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a low cost that this system of drainage is here brought within reach of a much wider circle of people than those whom it has been used to protect.

Summary

The Chota Nagpur plateau is mildly malarious. The villages at the head of the ghats, and also those along them and at their foot are severely malarious.

As the climate on the plateau is optimal for malaria-genesis, it is surmised that it is the physical conditions of the terrain, particularly the equability in the flow of the gentle streams and the operations of natural foes of the mosquitoes, or deviation by domestic animals, that inhibit a too dangerous culicidigenesis. This consideration also applies to certain communities living beside big river-beds in Bengal and to the Chota Nagpur villages in which *bandhs* or reservoirs of water have been made.

The streams at the head of the ghats mostly dry up in the hot weather and therefore the hyperendemicity there is due to mosquito breeding in the autumn.

The streams at the foot of the ghats flow for longer periods, but this advantage to culicidigenesis is offset on the malaria account by the excessive heat of the plains during the hot weather inhibiting the development of the malaria parasite.

Malaria control should be mainly carried out by creating series of reservoirs along the courses of the malariagenic streams so as to drown the mosquito haunts. Fish ladders could be provided at the same time and so some economic advantage could be gained from the proposed measure.

Acknowledgment

The writer is much obliged to the Rev. Father Turkenburg at Hazaribagh for his help in enabling him to carry out his investigations as far as Hazaribagh was concerned.

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and children. Every choleraic diarrhoea case that comes is looked upon with suspicion as to the possibility of the case being due to malaria. In such cases the microscope is the only thing that helps us in making a rapid diagnosis.

The technique.—When the case has been diagnosed as one of the choleraic type of malaria, saline infusion is begun, either by direct vein puncture or by opening a vein. Then I take in a syringe the desired amount of quinine dissolved in one or two cubic centimetres of distilled water and while the saline flows on, inject the quinine into the saline solution through the rubber tube that connects the saline funnel and the needle. The rubber tube is taken as a vein, sterilized with spirit and punctured. The quinine solution is given very slowly so that it is well diluted with saline, and this eliminates shock.

This method of giving intravenous quinine by injection into the rubber tube has the following advantages:—

(1) Most of the cases come so late that saline infusion has to be undertaken at once before anything can be done in the way of laboratory diagnosis. In such cases, I generally take a blood slide first and begin saline injection and, by the time it is prepared and the administration begun, the blood slide has been examined; if it is 'positive', the quinine is given by the above technique. Hence further puncture or opening of a vein is avoided.

(2) Exact amount of quinine can be given as desired or necessary. If the quinine is mixed up with saline, there is chance of loss of a certain percentage of quinine, as the whole quantity of saline taken for infusion may not be required and also some cases react badly after a few ounces of saline.

(3) The most important advantage is that quinine can be stopped at the slightest possible sign of quinine shock and any intravenous circulatory and respiratory stimulant can at once be given by this method. My procedure in bad cases of choleraic malaria is that I first give 0.5 to 1 c.cm. of adrenaline chloride by this method and then I give quinine. This prevents any possible occurrence of shock from quinine.

By this technique I do not deprecate the other valuable techniques nor do I claim something new, as it may be known to many. I send this note for publication because there may be some who will find some interest in it. Also I think that any technique, however simple and negligible it may be, should be recorded.

[Note.—We note what the writer says on this point, but we still consider that much the same result could be achieved by pouring the quinine into the tank with a small amount of saline and adding the rest of the saline when this is almost exhausted.—EDITOR, I. M. G.]