

'BACKDOOR DRAINAGE', AN ANTI-MALARIAL MEASURE DESIGNED TO MEET A PARTICULAR PHYSIOGRAPHICAL SITUATION IN SYLHET DISTRICT, ASSAM

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*Physiography of Sancherra garden*

A RIVER has a regimen like that of a pendulum; in its course it oscillates from side to side, and the consequence is that it moves in a series of curves, these having an amplitude depending on the gradient and a wave-length depending on the width of the river. The phenomenon however is influenced in its manifestations by such static factors as the heterogeneity of the earth—for instance if the banks of a stream that would naturally swing in curves be rigidly protected it is compelled to follow a straight course—or it is biased by such a dynamic matter as the deposition of alluvium by another stream approaching it—and so when one observes that two streams pursue independent courses for some distance down a valley plain, one may be sure that the oscillation of each has been biased by the resistance offered by the alluviation of the other, the resultant course of the streams being the state of equilibrium between the opposing forces.\*

An example on a grand scale of the influence of a stream on the course of a second one, even when the latter is the greater of the two, is seen in the Ganges Valley, where the great river has been for various reasons pushed over to the south against the peninsula by the deposits of its tributaries the Gogra, Gandak, and others; while on a small scale such factors doubtless have determined the courses of the Dholoi River and the Legata River in the Dholoi Valley of South Sylhet, the scene of this report, the two rivers running down the valley independently for some distance before joining (see map 1).

Now not only do two opposing streams influence the oscillation of each other, but the

(Continued from previous page)

any fungous elements, possibly owing to defective technique.

The exfoliation of the epithelial lining definitely suggests ringworm, but on the other hand, the treatment used may increase this.

I believe that a certain proportion of the cases diagnosed as furunculosis of the meatus belong to this category.

\* Actual junction of two streams will be effected if the bigger stream when swinging can overcome the resistance due to deposition of alluvium by the other.

result may even proceed to the length of the larger stream choking, as it were, the smaller, if this indeed cannot escape elsewhere, for it stands to reason that if the alluviation of a stream be powerful enough to influence another in its course, the deposit may go so far as to invade the latter grossly, the first effect of the choking of the lesser stream\* by the deposition of silt in its bed being that the stream is raised, thus reducing the gradient of its course behind the obstruction. Consequently the stream swings more from side to side and its valley is thereby further widened by erosion: while it more readily overflows its banks, and a permanent swamp, or even a broad expanse of water may be the result. The stream at the obstruction meanwhile becomes more exiguous as it is choked by the deposit, so that the outflow from the lake or swamp that may have been formed behind it becomes a mere trickle, and indeed if the outflow be no more than can get away by percolating through the barrier of silt it entirely disappears underground.

Such a strangulation of a stream emerging from a valley in the hills, and the physical consequences as described above, were observed by us in 1923† in the Sancherra garden of the Ali-nugger Tea Company in the Dholoi Valley of Sylhet in Assam. Here the 'lines' of the tea-garden labourers had been built on a spur of hilly ground to the south of a shallow *bhil*, or lake, which had originated in the way described and been deepened by the local fishermen who had erected a bund for this purpose. The valley in which the *bhil* was confined had been naturally widened by the swinging of the stream in its attempt to escape from the obstruction at its mouth and the area provided a sump for the local rainfall, from which at the height of the rains there was only a very exiguous outlet, or spill (see map 2); over higher ground‡ to the west, a high bank of alluvium deposited by the Sancherra River (see levels in map 2 and figure 1): while during the drier months the only outlet for the lake was by percolation through this bank of deposit. The *bhil* was shallow, covered with aquatic plants, and bred innumerable mosquitoes, of which *Anopheles funestus (minimus)*, *aconitus* and *philippinensis* may be mentioned.

*Malaria in Sancherra garden*

In 1923 the spleen-indices were as follows:—

'Lines'	Spleen-index
East	58.8
Bazar	52.5

\* The choking may even completely block up the mouth of a tributary valley.

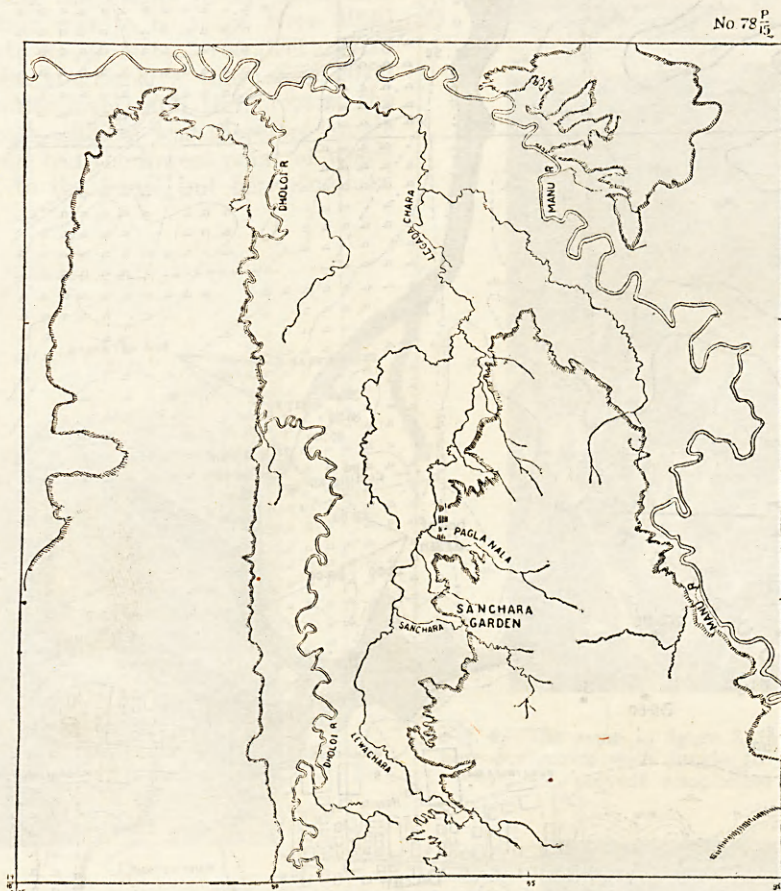
† When one of us (C. S.) surveyed this garden in connection with a general malaria survey of the Assam Tea Estates.

‡ A very common phenomenon in South Sylhet.

In 1926 Messrs. Duncan Brothers of Calcutta accepted a scheme for the amplification of the survey of 1923 and allowed us to organize some anti-malarial work on this garden with others in their agency, to see whether measures based on the findings of the survey would be effective.

with it. Careful consideration of the sequence of events resulting in the formation of the *bhil* indicated that its artificial drainage by cutting through the bank of silt obstructing the outflow was not feasible, as more silt from the original source would immediately dominate the drain

MAP 1



The Dholoi River Valley (taken from the Survey of India sheet, 1 mile to the inch scale).

As it had been concluded that the *bhil* was an undesirable feature in the malariageny of the place, discussion arose as to what to do

and fill it up. It would be comparable to expecting a prick in the skin to remain open. Among various alternatives it was ultimately

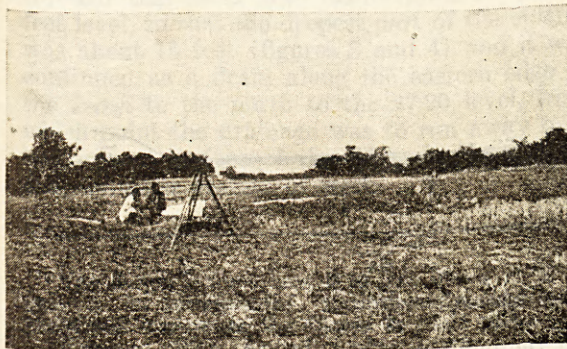


Fig. 1.—A high bank of alluvium deposited by the Sancherra River planted with paddy.

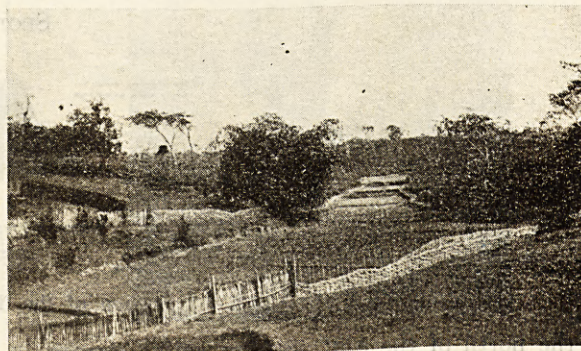
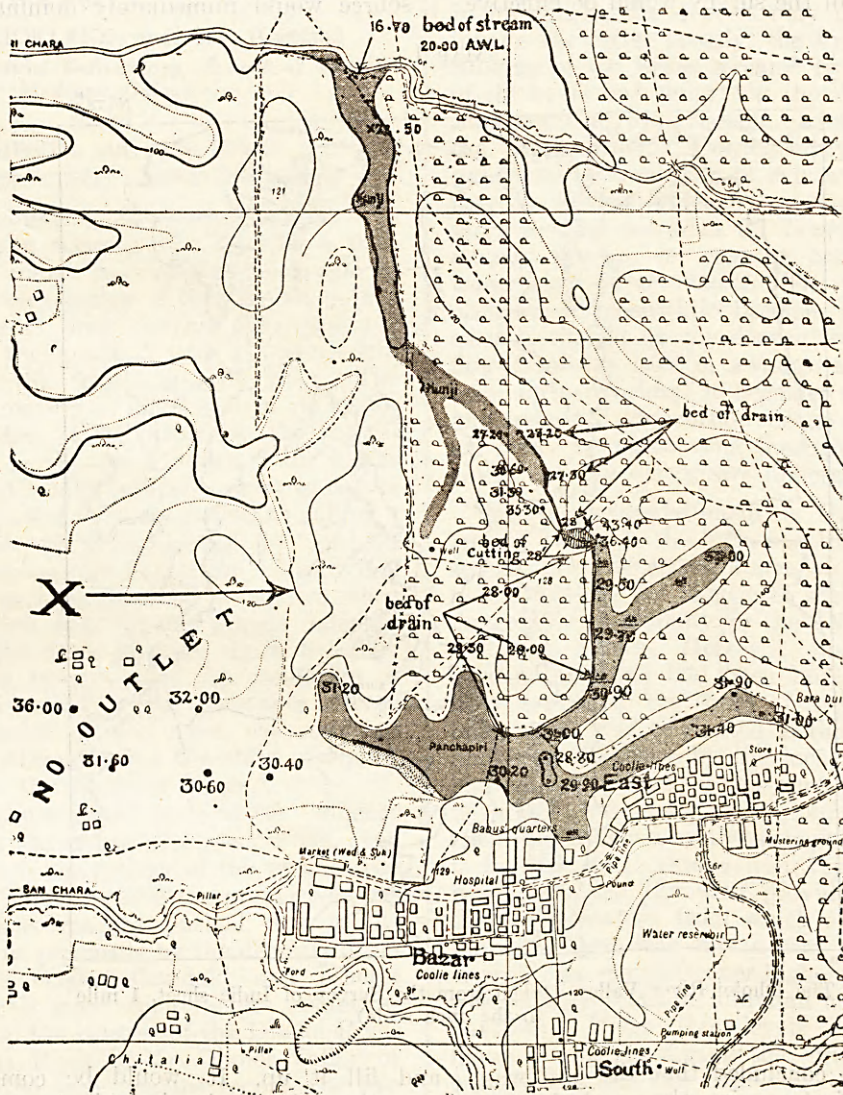


Fig. 2.—A *kunji*, an exiguous valley the bed of which has been levelled off by years of paddy planting.

decided that if the levels were found suitable a channel from the bed of the *bhil* should be cut through the high bank of the tea garden lying

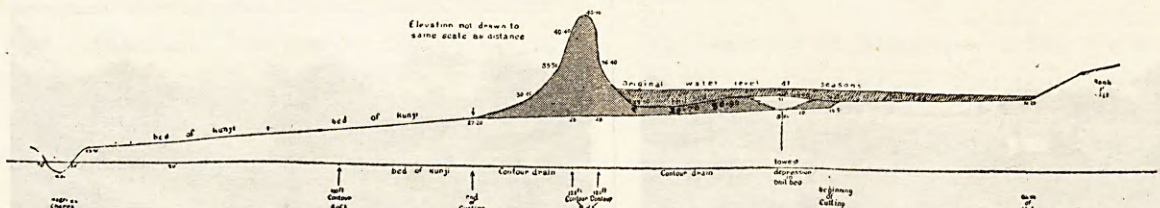
another stream. There was no particular virtue in the proposal to open out north rather than south into another stream, the Sancherra, except

MAP 2



Big scale survey showing levels (16 inches = 1 mile).

SECTION



Section of the drainage scheme.

to the north of the *bhil*, into an active stream, the Hagricherra (see map 2), which showed no signs of deterioration due to any conflict with

that the bank on the north side that would have to be cut through would probably not be so formidable. As far as the eye could see it was

indeed possible that on taking levels the northern route would be found to be unsuitable and the southern suitable.

The following were the relative levels at important points. The average water-level in the *bhil* was 31.40 feet\* with soundings of the bottom everywhere of less than 3 feet. The levels taken along the *kunji*† to the north into which the cutting was to be made were 40.40 feet; 35.30 feet; 31.30 feet; 30.60 feet; 27.20 feet; and at the Hagrigherra they were 20.00 feet (average water-level) and 16.70 feet at the bed of the stream. There was therefore ample fall from the *bhil* bed the lowest point of which was 28.80 feet, to the *kunji*, but between these



Fig. 3.—The cutting looking east toward the *bhil*, in 1930.

two points the bank of the tea garden, on which tea was being grown and which would have to be cut through, rose to 43.10 feet at the datum level. In the end the necessary cutting‡ through this bank was made down to the 28 feet level, so that the deepest part of the cutting was about 15 feet (figures 3 and 4) and it was continued as a drain along the eastern edge of the *kunji* to the north to the 27.20 level, from which point the drainage was to run away over the general surface of the land, see Section for diagrammatic section of work.

\* The datum utilized was 43.10 feet shown at X on map 2. It corresponded approximately with the 123.10 feet contour in the Survey of India maps.

† Exiguous valley, the bed of which has been levelled off by years of paddy planting (see figure 2). This *kunji* is to be called the Johnstone *kunji*.

‡ Named the *Wilson Cutting*.

*Physical results*

The effect of this earthwork was to dry up almost completely the great expanse of water in the *bhil* (figures 5 and 6). Mr. Aitken's and



Fig. 4.—The same as figure 3, in 1934, well settled and now overgrown with jungle to support the sides and prevent anopheline breeding.



Fig. 5.—The *bhil* near the cutting before completion; water at the cold-weather level: the line of bushes delimits the rains level.

Mr. Wilson's notes on results are appended. A few depressions remained, but the garden labourers filled most of them in and levelled them off for the purposes of paddy cultivation (figures 7, 8 and 9). No deleterious effects on the Hagricheria have since been noted. A



Fig. 6.—The same as figure 5 after draining off the *bhil*: the 'nullah' was formed by the flow-off and has since been levelled away.

side-issue however has been that the ryots on the lands adjoining the *bhil* have entered a protest against their loss of fishing-'rights' on the estate land.

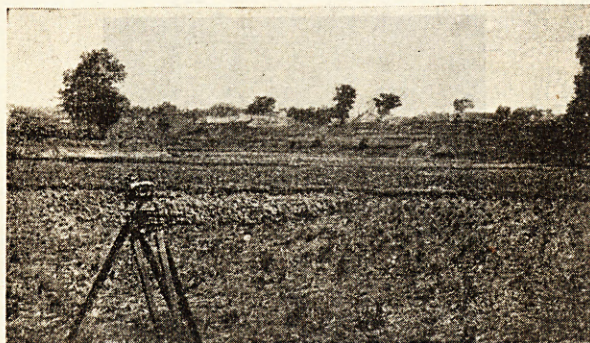


Fig. 7.—The bed of the *bhil* levelled up and planted with paddy.

The levels on the bed of the *bhil* after the main work was completed are shown in the map, the lowest point as already stated being 28.80, not too low for drainage through the cutting, but too low for rapid drainage. This and other such places have therefore been filled in, and further to facilitate drainage a contour-drain graded from 29.30 to the cutting at 28

feet has been dug on the western side of the *bhil* (figure 9).

#### Results to health

As for the result to the malaria endemicity, this as stated above was noted by one of us



Fig. 8.—The southernmost arm of the *bhil* below the bazar cooly lines: a contour-drain protects it, as seen on the left.



Fig. 9.—The arm of the *bhil*, at the apex of which the cutting was made: the contour-drain on the left is shown on map 2, on the west of the *bhil*.

(C. S.) in 1923 and has been recently taken again by him in 1934 as follows:—

'Lines'	East	Bazar	South	TOTAL
1923	58.8	52.5	..	..
1934	25.71	11.62	17.24	17.75

It is not within our purpose to discuss here the causes of the residual endemicity.

#### Conclusion

The lessons to be learnt from these observations are:—

(1) That it is essential to understand what Nature is doing, otherwise one may be tempted into measures opposed to her infinitely greater power: thus the common practice of the 'straightening out of rivers' by cutting by-passes is folly, because, as explained above, rivers are curved in their courses in obedience to dynamic laws:

(2) That in areas of great alluvial deposition one may commonly find big streams not

only influencing the course of lesser streams but actually blocking them with silt so that they cease to exist above ground and swamps and lakes are formed behind the obstruction:

(3) That on no account should open drainage through recent alluvium be resorted to, but such areas of deterioration may perhaps be drained out by the 'backdoor method', thus defeating Nature by a stratagem:

(4) This 'backdoor' drainage is very often impracticable, as a cutting to an active stream at a suitable level would be too costly:

(5) That Man, represented in this case by tea-garden labourers, may be, though unintentionally, an important factor in altering the physical features of the surface of the land by filling in depressions for the purpose of planting paddy.

*Acknowledgments*

We are indebted to Messrs. Duncan Brothers and Company in the first instance for their kindly placing this estate at our disposal for the conduct of this sanitary experiment, and, as for the executive work, we have received a great deal of assistance from Mr. H. Aitken, the consulting engineer, who after confirming the survey levels concurred in the scheme, Mr. John Forbes, general manager of the Ali-nugger Tea Company gardens, whose influence was a great inspiration for success, Mr. Wilson, the manager of the Sancherra garden, who discovered the best line for drainage and carried out the main scheme, for which reason we would like the big cutting to be named the Wilson Cutting, and finally Mr. Johnstone, who more lately has taken out the levels again to enable us to see what changes there have been.

We would also wish to thank our assistant Dr. Paul for his careful malariological data enabling us to control the scheme.

APPENDIX

Details of executive work, and cost supplied by Mr. Wilson.

	WORK	
Total length of cutting through bank and the <i>kunji</i> on the north .. ..	690 ft.	
of which the cutting through bank may be taken to be .. ..	350 ft.	
and the outlet drain .. ..	340 ft.	
<i>Cutting</i> —		
greatest depth .. ..	15.10 ft.	
greatest width at top .. ..	15 ft.	
greatest width at bottom .. ..	3 ft.	
<i>Outlet drain</i> —		
width .. ..	3½ ft.	
depth .. ..	1½ ft.	
<i>Inlet contour-drain (on west of <i>bhil</i>)</i> —		
length .. ..	1,320 ft.	
width .. ..	1½ ft.	
depth .. ..	2 ft.	

A day's rainfall of 3.52 inches took 18 hours to drain off.

(Continued at foot of next column)

ANTI-MALARIAL WORK ON A GROUP OF TEA ESTATES IN SOUTH SYLHET

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 Medical Officer, Luskerpore Valley Medical Association,  
 South Sylhet

THE anti-malarial work here reported upon was initiated in 1926 under the auspices of Messrs. Duncan Brothers of Calcutta, the agents for three of the tea gardens in the group of which I was in medical charge. Later on, other companies decided to adopt the same measures, so that in the end the estates of the Amo, Deundi, Chandpore, Teliapara, Luskerpore, and the Imperial Tea Companies were included in the scheme of work, the results of which are reported below.

In 1926 practically no anti-malarial work had been attempted in the tea districts in India, so that the scheme—which was based mainly on the findings of Dr. C. Strickland of the Calcutta School of Tropical Medicine during an extensive malarial survey of the tea districts in 1922 and 1923 and was carried out in collaboration with him—was really an experiment in sanitation.

The results of the initial work in the gardens of Messrs. Duncan Brothers' agency have been

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COST

The capital cost of the executive work for 1930-31 was as follows:—

	Rs.	As.	P.
1930. The big cutting cost .. ..	347	4	6
Infilling depressions .. ..	149	7	9
	<hr/>		
	496	12	3
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1931. Contour-drain dug round <i>bhil</i> , big cutting deepened .. ..	60	0	0
Infilling holes .. ..	160	0	0
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GRAND TOTAL 1930-31 .. ..	716	12	3

APPENDIX

Note by Mr. H. Aitken, Consulting Engineer to Messrs. Duncan Brothers and Co., on the executive work, dated 29th March, 1934:—

I inspect the *bhil* annually and can assure you the works are a complete success.

I take this opportunity of letting you know, in connection with contour seepage drains round the foot of *tillahs*, that during the past three cold weathers I have had miles of these drains cut and existing ones deepened resulting in most effective drainage in low narrow *kunjis* under tea cultivation, most profitable work.

Note by Mr. Wilson, 23rd August, 1933:—

What was previously waste *bhil* land is now excellent *khet* land while outside our boundary a greater area is being cultivated by *bustee* people.

To the garden coolies every acre under cultivation means anything from Rs. 100 to 175 *per annum*, and this for a capital cost to the garden of about Rs. 100 an acre, plus a little for necessary upkeep.....

(Sd.) D WILSON.