

between ourselves and the practitioners of the indigenous systems if we follow our own path and allow them to do the same. If there be any widespread demand for the restoration of the ancient systems the first step must be made by the adherents of the systems, they must produce evidence that they can supply a public need which cannot be supplied by the existing scheme, but they are in the dilemma of knowing that if they can demonstrate the superiority of any of their methods as compared with the methods of scientific medicine, we shall, without hesitation, adopt the improvement which they have brought to our notice. To do so is in the interests of humanity and is perfectly fair; we have published every detail of our knowledge to the world, so is it not only right that the treasures of the ancient systems should also be published for the use of humanity?

It may be suggested that we are prejudiced, our interests are at stake so that we cannot be accepted as reliable witnesses in this matter. If this argument is raised we must appeal to the opinion of the whole civilised world, this has already been expressed in favour of scientific medicine, so that if we ask for a verdict from educated humanity they would be faced by the hard fact that it is a case of the whole world against the systems. European practitioners have discarded their own ancient system in spite of centuries of hallowed tradition, they cannot be accused of blind prejudice when they equally discard the systems which have been given up by the whole mass of educated opinion in India.

Let the practitioners of the systems place their cards on the table as we have done, let them admit that existing knowledge is far from perfect and that science has yielded up secrets of the greatest importance, let them join us in the search for truth and knowledge, and in the application of that knowledge and we shall receive them with open arms. Under existing conditions fellowship with them in medical practice is inconceivable.

It is surprising to find that the advocates of the restoration of the systems include a small number of intelligent Indian medical men who profess the firmest belief in modern medicine. It is hard to believe that they can be actuated by any motives other than expediency. There has been a good deal of loose thinking on the subject of the indigenous systems; it is time that we came down to hard facts.

To them we would like to put two questions: "Do you believe that there are drugs or methods of treatment, used exclusively by the practitioners of the ancient systems, which are superior to those used in modern scientific medicine?"

We should expect their reply to be in the affirmative; their attitude would otherwise be inexplicable. Our second question would be: "Can you suggest any reason why those superior drugs or methods should not be adopted by practitioners of modern scientific medicine?"

J. W. D. M.

SPECIAL ARTICLE.

A CRITICAL REVIEW OF DR. C. A. BENTLEY'S "MALARIA AND IRRIGATION IN BENGAL."*

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THE purport of Dr. Bentley's work is the submission to Government of his opinion as to the causes of the malaria which afflicts the province of Bengal and to suggest a scheme for the amelioration of its condition.

The distinction of the author, the high place which he holds in the administration of Government and the magnitude of the issue, will ensure that what he says will receive most careful attention, and there is therefore no reason to apologise for the scrutiny of the paper which is here made in the hope that it may be helpful to those who wish to come to a right decision in the matter. All the more so as one of the theses submitted by the author is, as will be seen later, the basis of statements by laymen and politicians which have been used publicly as a rod wherewithal to beat the "Satanic Government."

Now that being the purport of the work, the title would suggest that the author has found the decline of agriculture to be the exciting cause of the trouble, but as one reads through the pages one finds that such has not been the case. The following passages show it, ".....the great increase of malaria disease..... is inextricably bound up with a coincident decline of agriculture owing to.....and....." (*vide* p. 65).

"The common origin of these associated evils is to be sought in....." (*ibid*). "The evidence incriminating.....as the cause of both agricultural decline and increase of malaria is so overwhelming that....." (p. 67). "A greatly increased prevalence of the disease almost invariably accompanies the decay of agriculture" (p. 1) "..... has caused serious damage alike to agriculture and the health of the people." These and many other statements of a like nature indicate that the author had no intention of incriminating the condition of agriculture with the incidence of malaria, but that both conditions are the result of some other factor. That being so, such references to agriculture, which take up a large proportion of the work, appear to be irrelevant to the discussion and to have no more justification or value than would have a coincident analysis of the growth of anarchical societies in the community or of any other consequences springing from the same root.

Now the author in analysing his data predicates that deltaic tracts are not prone to malaria, e.g., those of the Nile, the Mekong, the great rivers of China and many others. Some however are so, as the Mississippi and the Gangetic plain. Why should some be malarial and not others? One possible reason is not mentioned by the author, viz., that one locality may support a mosquito fauna different from another. *Anopheles ludlowi* for instance is found in Malayan deltas but not in Indo-China. Such an instance shews that deductions made concerning one country are absolutely of no value in another.

It is the ubiquitous embankment of the Bengal delta that Dr. Bentley blames for the woeful condition of the province to-day. He would premise that any locality which has not been embanked, if any such exist, is perfectly healthy because it is subject to the normal flood and flush of river inundations and it is only the works of man that have

* "Malaria and Agriculture in Bengal. How to reduce Malaria in Bengal by Irrigation." By Charles A. Bentley, Director of Public Health, Bengal. Calcutta: Bengal Secretariat Book Depôt, 1925. Price, Indian Rs. 2-2; English 4s.

Note.—The italics all through this paper are the reviewer's.

made it unhealthy. Thus, "there has been a great extension of malaria.....since the construction of several hundred miles of railway." "The indiscriminate embanking of vast tracts primarily for flood prevention and for the construction of the network of railways and roads that now covers the country, has caused serious damage.....to the health of the people." Then (p. 21 *et seq.*) he gives correlated statistics of the malaria and the mileage of embankments in the four great divisions of the province to support his hypothesis. He also cites (p. 34 *et seq.*) several instances where the construction of embankments for public works has been accompanied by epidemics; and another piece of evidence, culled from Stewart and Proctor, is that certain *thanas* in Murshidabad District outside the protection of an embankment have a lower spleen index than others inside it.

More generally, the author says that the deltaic area is potentially malarious if the rivers are disorganised by human interference, which usually lies in the form of works for improved communications or zemindary* bunding; and that there is reason to believe that many of the changes in the Bengal rivers during the last sixty years have followed the embankment of the country. He is clearly of the opinion then that embankments are the exciting cause of the trouble.

Dr. Bentley explains why embankments should have led to an increase of malaria. They have prevented the normal flood and flush of the land; no silt-bearing water has deposited its burden to level up the inequalities of the surface which are so favourable to mosquito-breeding, and the reduction of lineage of dangerous "edge" in the breeding places has not ensued. Further, he says, river inundation water seems *per se* to be inimical to anophelines, while rain-water is favourable.

Now, in reading the author's evidence in favour of his hypothesis, one is struck by one very salient fact. Although Eastern Bengal may not be so well provided with roads and railways as the other divisions, yet it has 163 miles per 1,000 square miles of area; moreover what it lacks compared to the other divisions in roads and railways probably owing to the land lying lower and more subject to inundation, it makes up with a greater number of zemindary bunds. Yet in spite of this degree of embankment the health is notoriously good. Dr. Bentley himself refers to it in these sentences "the delta tracts at present largely exempt from the disease," and "the future welfare of the country depends on its continued good health."

Then again, although Northern and Western Bengal have about the same mileage of rail and road embankments (about 300 per 1,000 sq. miles) yet Northern Bengal is very much more healthy, its increase of population in 1901-1911 being as 8.0 per cent. to 28 per cent. in Western Bengal.

If one then turns to the data afforded by the separate districts in any one Division there is the very important fact noted by Fry that Howrah District and the southern part of Hooghly District are strikingly non-malarious as compared with the adjoining Burdwan District, yet those districts are perhaps more embanked than any in the province.

Finally, if one turns[†] with the author to other countries and Lower Egypt be compared with the Presidency Division of Bengal, both are of about the same area; Lower Egypt has 3,600 miles of embanked roads and rails, and is, practically speaking, non-malarious, while the Presidency Division with about 4,000 of embanked works is very malarious.

It is justifiable then to conclude that notwithstanding the evidence cited to the contrary embankments *per se* are not dangerous, or at any rate not to any "economic" extent. Indeed, Dr. Bentley himself in one passage says that that is so, that they are only dangerous when the embanked land is not irrigated, and that irrigation schemes should always

include the embanking of rivers and improved means of communication. In this one sentence the author himself refutes the unqualified assertions of paragraph after paragraph and chapter after chapter.

Now if embanking the delta is not to be blamed for the state of affairs, can any alternative hypothesis be submitted? The reviewer reiterates that if there were not an embankment in Bengal except such as be naturally thrown up by the rivers the distribution of malaria would be precisely as it now is: and that the explanation lies in the existence of local variations in the natural physiography of the delta. One need not go into any detail concerning the structure of a delta—which has been fascinatingly portrayed by Ferguson (1912)— suffice it that the varying elements in the picture can be considered to be responsible for all that has been observed in the local incidence of the disease. Thus the great ill health of the Western Districts as compared to the Eastern may be due to the fact that the Western side of the delta has been raised and the rivers, having thus done their duty, have migrated to the East, leaving the "decayed" channels behind; these provide no flood or flush and that has brought malaria. Whether the land has been embanked or not has made no difference. Dr. Bentley himself in one passage says that in these decayed tracts the old river-beds become but local storm water chutes and that this decay of the river systems "has been responsible."

To summarise then up to this point, Dr. Bentley would explain the malaria in Bengal as due primarily to the embanking of the land, which prevents the natural flood and flush by river inundations. The reviewer, on the other hand, suggests that whether or not there be an embankment in the province, the incidence of malaria would to-day be as it is and that this is wholly a function of the existing state of growth of the different parts of the delta.

The second part of the author's paper is devoted to the schemes which he advocates for the amelioration of the state of affairs. They are classified according to whether they have any coincident economic value or not. The former are called, after the Italian, "bonification" The others are the "specific" anti-malarial measures.

The specific anti-malarial measures are in general dismissed as impracticable on the score of expense or that they have been tried and failed. If they were to be carried out on the name scale as at Panama they would cost from 18 to 27 crores per annum. *Drainage schemes*, he says, are in general out of the question as in the flood season the level of the rivers is too high. *Flooding* without aiming at any economic advantage (therefore not 'bonifying') has been successful in a few places. The information given regarding the administration of "State quinine" is very valuable and should, it seems, be reprinted for the benefit of all governments who make use of it.

The author says that all these measures are so comparatively inefficient or costly that they should only be tried to allay malaria in a lightly-infected community, when they might be partially effective.

The measures called "bonification" imply a much more fundamental policy and are needed in a highly infected decadent community. The particular measure of bonification indicated for Bengal is irrigation.

Examples are cited where attempts at bonification have been successful in other countries, particularly in Holland, the English Fens, and the Italian Val da Chiana; in Egypt irrigation should not strictly be described under bonification for it was not instituted for the purpose of allaying malaria. But as pointed out above malaria is so local in the mechanism of its incidence that the experience of one country is by no means repeated in another, nor even in the same, for some of the Italian schemes have failed.

Coming nearer home, however, the Tanjore (Cauvery), Godaveri and Kistna delta irrigation schemes covering in all some 4,000 square miles of Madras Province, are recounted as examples of what has been done by irrigation (*plus* embankment). The

* Zemindar = landlord.

† Although, as shewn above, one should not do this.

results have certainly in every way been magnificent. In Bengal itself several comparatively minor schemes have been instituted: some have been in some degree successful, e.g., the Dankuni Jelah Project and the Howrah and Rajapur schemes; others have failed, e.g., the Manikhali Khal and Magraghat drainage. The Bengal schemes were mostly put in hand for only drainage purposes but in practice the drainage outlets have been used as irrigation inlets, so that the schemes come properly under the heading of irrigation.

Apparently the author thinks that irrigation schemes for the afflicted tracts of the country will neutralise all the harm that embankments have done in preventing flood and flush, but in addition he favours the statutory prohibition of further embanking. He, moreover, considers that these schemes would have a desirable effect in the direction of improving the navigability of the rivers and so making the need for roads and railways less clamant.

Now before embarking on great irrigation schemes primarily with a view to reducing malaria, the evidence adduced by the author which bears on the problem must, as he will allow, be specially considered. In the first place, presuming such schemes to be technically practicable,* is it likely that they will be successful? Most of the irrigation schemes which have been tried certainly suggest that such would not make matters worse than they now are, even if they would not improve the situation. Projects on a big scale, however, like those in the Madras Province deltas might succeed where smaller ones have failed. On the other hand, if the malarious parts of the province are malarious only because they have been elevated, then whether watered with rain-water or irrigation water they might be equally unhealthy. It is a most striking fact that *A. aconitus*, one of the worst of malaria carriers, delights in the fast-flowing water of grass-edged irrigating channels (see plate 1), and in the Brahmaputra delta it is in the irri-



gating channels of the land above the *pathar* level that one chiefly finds *A. funestus* (= *minimus*). Moreover, irrigation water does not carry the silt which Dr. Bentley says is such an important factor. The situation might, it appears to the reviewer, be exactly comparable to what one sees in that very district of Assam where Dr. Bent-

* The laymen in these matters may be permitted to ask whether the amount of water available for irrigating—*qua* flooding-and-flushing in the more elevated malarious parts of the delta will be sufficient for the purpose without so reducing that which now provides the flood and flush of the more fortunate parts that the condition of these will be rendered similar to that of the raised area. Indeed, Dr. Bentley himself says “more water might be temporarily diverted down a moribund water-way, but this result can only be obtained at the expense of other channels and may therefore do as much harm as good.”

ley was medical officer; the non-malarious “*pathar* level” subject to inundations from the Brahmaputra, and the elevated “red-bank” alluvium (see plate 2), very



malarious, where the rice-fields are intersected with little irrigation channels teeming with *A. funestus*.

Such facts are warnings that Dr. Bentley's conclusions, based mainly on the theoretical assumption that “flood and flush” is necessary to prevent malaria, may, if put into practice by irrigation not have any result. There is need for caution. Nevertheless, an irrigation scheme must necessarily have an economic value, so that not much would be lost if it failed from a health point of view. And the proceeds might, following the very good Italian custom, be earmarked for later and better anti-malarial schemes. The reviewer on this account would beg to support Dr. Bentley's proposals to Government.

On the other hand, the possibilities of drainage schemes might be reconsidered, though the reviewer admits that *a priori* not much can be hoped from them because the worse malaria carriers, like *A. funestus*, are more at home in drains than in the pools and swamps which they drain. Most of the so-called drainage schemes which have been instituted in the past have worked out as irrigation *plus* drainage schemes. The Saraswati scheme, however, was successful (see p. 118)? There should at any rate be no difficulty about providing for gravity drainage in the more malarious parts of the delta, as they are the highest parts and the old river-beds and river-bhils are at the highest points of them.

Needless to say there is very much more, which is very valuable, in the author's paper than has been touched upon in this review, but the essential points have been carefully considered. The arguments submitted against the acceptance of some of the author's conclusions as to the causes of malaria in the Province suggest the advisability of proceeding with proper caution, but have not traversed the main object of the work,—the recommendation to Government that the irrigation of the malarious tracts should be taken in hand.

Dr. Bentley's work is testimony to his Napoleonic vision and Government should be grateful to him for his spirit. No such gigantic piece of sanitary philosophy has ever before been perpetrated. The author would make a gargantuan feast of Gorgases.

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