THE CONTROL OF *ANOPHELES MINIMUS* BY 'SHADE' AND RELATED METHODS

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DURING the last ten or fifteen years there have been rapid advances in the control of *A. minimus* in Assam and North Bengal, and one of the most interesting features of this campaign has been the widespread and increasing use of 'shade' as a control measure in the tea districts (Ramsay, 1930; Ramsay and Macdonald, 1936). Although the efficiency of this simple method was well established, there was some doubt as to the exact way in which it worked, and accordingly an investigation was started in 1938 the main object of which was to find out the principles underlying control by 'shade', and if possible to put this and related methods of control on a firmer scientific basis. In order to tackle this problem it was necessary to study the reactions of *A. minimus* and its larvæ to different components of the environment in turn, such as light and shade, water movement, temperature, organic pollution, etc., and the reports on these separate aspects of the work have been published from time to time in the *Journal of the Malaria Institute of India* (Thomson, 1940, 1941). As these published results contain full details of all laboratory and field experiments on which the following conclusions are based, the reader might encounter difficulty in selecting from all that material those findings which lend themselves to direct practical application in control work. When the investigation came to an end in 1941 it was therefore felt that the time had come to review the work of the previous 3½ years and to discuss its practical possibilities. As the question of 'shade' is the one that claims first attention, it seems advisable to publish a preliminary communication to clear up some points which might previously have lent themselves to misinterpretation. One of the first points is that in the following account the system of control known as 'shade' will be printed in inverted commas in order to avoid confusion with shade as distinct from light, and it will soon become evident why this distinction is necessary.

If we select a grassy edged garden drain where *A. minimus* is breeding, and shade a section with bamboo matting or thatch, *A. minimus* continues to breed in the dense shade as long as the grassy edge remains. Dense shade by itself will not kill the larvæ, nor prevent the female mosquito from laying its eggs. When the grassy edge under the bamboo matting dies after a few weeks, in the same way as it does under 'shade' hedges of lantana, eupatorium, titapat, etc., *A. minimus* disappears.

Now if we clean weed a stretch of the same garden drain, to produce bare earth edges exposed to light, *A. minimus* is again eliminated. It appears therefore that the breeding place becomes unsuitable for *A. minimus* under 'shade' not because of low illumination but because of the ultimate disappearance of the grassy edge.

Our experiments also showed that the female *A. minimus* lays its eggs in the still water among the grass at the edge of the stream. When the grassy edge is clean weeded or removed by the action of 'shade', the increased water movement makes it unattractive to the female. Similarly, the larvæ of this mosquito are really very susceptible to water movement. Normally they are well protected by the still water among the grass at the very edge of the stream. When the grassy edge is removed, the increased flow makes it difficult for existing larvæ to maintain their position, and they are very liable to be washed away.

It appears therefore that the absence of *A. minimus* from streams under 'shade', and also its absence from streams whose edges have been clean weeded and exposed to light, is really due

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(*b*) G. D., male, *æt.* 35, admitted into hospital at 2-40 p.m. on 17th April, 1942, unconscious, cyanosed, cold and clammy. Pupils dilated and fixed. Jerks sluggish. Pulse 85, feeble, and regular. Respiration gasping. Temperature rose to 103. Urine examined on 18th April—albumin traces, sugar 0.5 per cent, bile present, casts granular, a few.

18th April. Patient's condition same, intensely cyanosed and frothing at the mouth. Temperature came down to 100. Pulse—volume good and regular. Patient catheterized, 28 oz. urine of deep yellow colour resulting.

20th April. Condition same. Temperature rose to 105 in the evening and patient died at 8-30 p.m.

(*c*) The lorry driver against whom the powder was thrown suffered from giddiness and twitching of the limbs in the evening. He was treated in a private hospital and discharged.

Conclusion.—The incidence of industrial poisoning though not high is increasing in India. It is likely that in the near future, when industrialization is speeded up, industrial diseases will occur much more frequently than heretofore.

Though such diseases are usually dealt with in the larger textbooks used by medical students, very little attention is paid to them in our colleges. Hence no importance is attached to industrial toxicology, a highly interesting branch of medicine.

The first five cases of paranitraniline poisoning occurred in December 1941. Three months later, three more workers were poisoned by the same dye, two of whom died of the effects of the poison. The latter accident would certainly have been avoided if warning had been given and precautions taken in time.

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to the same cause, namely, the removal of the grassy edge and the resulting increased water movement.*

We have noted above that the shade or low illumination itself is not repellent to *A. minimus*. In fact when the female mosquito is looking for a place to lay its eggs, it is attracted by a certain amount of shade, such as exists in among a thick grassy edge, or a shaded pool or pocket of water at the edge of the stream. In some parts of Assam *A. minimus* is found breeding in little dark pits or 'crab-holes' in the bank of the stream, and it is obvious that the low illumination itself has no harmful or deterrent effect. In streams, the attraction of *A. minimus* to a shaded spot is overruled by the repellent effect of moving water at the edges, but in the still water of *katcha* wells, where *A. minimus* also breeds, the reactions of the female to shade have a direct bearing on control. If we remove the vegetation from the well there is no increase in water movement such as occurs when the grassy edge of a stream is destroyed by 'shade' or by clean weeding. In the deeper wells, where the edges are shaded by the vertical or overhanging earth walls, breeding of *A. minimus* will still continue. But if the clean-weeded edges are fully exposed to light by converting vertical walls into smooth sloping ones, *A. minimus* is no longer attracted, and effective control is brought about.

If these fundamental facts about the influence of light, shade, and water movement are borne in mind, it will be seen that there is nothing incongruous about the fact that streams can be controlled equally well by 'shade' and by clean weeding, and that the two methods of control are really due to the same causes. Clean weeding is merely a subsidiary method which has been evolved during the course of experiments directed towards an explanation of control by 'shade'. The removal of the grassy edges of a stream and exposure of the bare edges to light is a sound and simple control measure, recommended as a temporary method to be applied in places where 'shade' does not exist or where it would be impracticable to plant it. It should be a particularly useful control measure at the edges of broad streams and perennial rivers, and in rural areas where it is difficult to establish and maintain good 'shade'.

The studies on the behaviour of the mosquito have shown that there is nothing antagonistic about what appear to be two very different methods of control, 'shade' and clean weeding. In fact, we may regard 'shade' as a more permanent form of clean weeding, and both measures could be considered as forms of flushing, since the increase in flow or movement of water at the edges is the main factor which renders the breeding place unsuitable in all these cases.

* This is only a partial explanation of control by the shade plant, tarapat.

REFERENCES

Ramsay, G. C. (1930) .. *J. Trop. Med. and Hyg.*, **33**, 352.
Ramsay, G. C., and Macdonald, G. (1936). *Indian Med. Gaz.*, **71**, 699.
Thomson, R. C. M. (1940). *J. Malaria Inst. India*, **3**, 265.
Idem (1941) .. *Ibid.*, **4**, 63, 217.

A Mirror of Hospital Practice

A FEW UNUSUAL CASES OF POISONING

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Case 1.—A Hindu female from district Warangal, Hyderabad (July 1940), killed her husband by giving him a drink containing ground *Bhilawan* (marking nut) and snake poison. No snake poison was detected but *Bhilawan* was detected on a stone on which it was ground and in the remnant of the prepared poison which she said she gave to her husband. It could not be detected in earth soiled with vomited matter nor on a *dhoti* soiled with stools.

The man presented symptoms of severe gastro-intestinal irritation. He died within twelve hours. Quantity administered was not known.

Case 2.—A Hindu female from district Raichur (February 1942) administered with her finger 'something' to a child seven months old. The child started vomiting and diarrhœa soon after. There were blisters on his tongue. A blister also appeared on the part of the chest that was touched by the soiled finger. The child died within twenty-four hours. On the piece of stomach sent to me, there were several blisters on the mucous membrane and small black particles were sticking to the mucous membrane all over. The particles proved to be *Bhilawan*. Later, the woman confessed to have given *Bhilawan* to the child and a box (tin) containing ground *Bhilawan* was found on her. Some unknown alkaloid was also detected in the *post-mortem* organs which failed to kill a frog even in large doses. No alkaloid was present in the acid extract.

Case 3.—A Hindu male, aged 22 years, from district Nalgonda (June 1940) committed suicide by taking a whitish salt at 12 noon. One hour later he was trembling all over, with fists clenched and shouting incoherently, partly unconscious. Vomited once and passed two liquid stools. Died at 6 p.m. Sodium nitrite (not nitrate) was found in the *post-mortem* organ and on a soiled *dhoti*, etc. A tin containing a salt was also recovered by the police. This salt was also sodium nitrite.

Case 4.—A woman from Nalgonda (September 1940), it was alleged, was bitten by a snake in the morning and died after two hours, but no sign of snake bite was found on the body. *Post mortem* the organs contained sodium nitrite. Later it was discovered that a man had two wives, the senior wife (deceased) complained of backache, so the junior wife said that she would give her some decoction of anisi seeds. With the decoction she mixed a 'salt' and gave it to the deceased. Soon after the victim began to feel