Control of Bilharziasis by Rural Management

BY

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Because bilharziasis has always been very well managed by the schistosome, aided and abetted sometimes unduly, by man and the snails, it would seem that any management by man should be governed by certain factors relating to all three; but though basic circumstances remain the same the management policy adopted is largely dictated by local ecological conditions.

In South Africa, man and in all probability the schistosome are experiencing a population explosion. The snail is being provided with very many more habitats, which are not over populated except possibly following some outside interference after which things return to normal. The population explosion of man would probably be unimportant by itself were it not that he has been unwilling or unable to cope adequately or at all with certain aspects of his changing environment thus greatly assisting the schistosome which has "never had it so good."

Due to the complicated life cycle of the schistosome the numerous relationships existing between man, snail and worm vary in importance depending on local circumstances. The well established observation that the maximum number of *Schistosoma haematobium* eggs are excreted round midday, by itself may not be of much significance, but is very important when it is remembered that most children go swimming round midday when temperatures are optimum for the miracidial penetration of the snail, (De Witt 1955) and that the increasing number of children swim in the same place day after day, seldom alone, and are being given either an over abundance or too few snail habitats in which to swim. I know of no similar evidence with regard to the timing of *S. mansoni* egg excretion and it is difficult to imagine what this might mean unless man defaecated directly into field waters which is unusual. However a human community usually selects one particular area near the village for this purpose.

Penetration of the snail seems to occur more readily with young snails and there are some broad relationships between the number of young snails available and the numbers of miracidia entering the water at certain times of the year. Following penetration, the incubation period lasts for varying lengths of time, being shortest during the summer and longest when miracidia start incubating at the end of summer or in autumn. These sporocysts together with all those which started to incubate later during the winter and those which temporarily ceased shedding during winter start to shed in spring. In spring therefore there is a sudden large increase in the numbers of shedding snails in all waters which had been frequented by man the previous summer and which would be likely to be frequented again in spring.

The emergence of cercariae is not a haphazard affair taking place at any time of the day or night, but seems to be bound to the habits of the definitive host and controlled to a certain extent by temperature. For instance *S. rodhaini*, whose normal definitive host is probably a nocturnal rodent starts shedding at about 7 p.m. and stops a couple of hours later; *S. mattheei*, is probably a detribalised parasite of game which has adopted stock as a more convenient host, discharges soon after sunrise from about 5.30 a.m. until 9 a.m. during summer and later during winter. It also discharges during the night in summer which Iranian *S. bovis* does not appear to do. But this schistosome is hardly a parasite of game. *S. mansoni* and *S. haematobium* both discharge during the morning starting at 7 a.m. and 9 a.m. respectively and stop at about 2 p.m. From a practical point of view the observations are of some importance because the definitive hosts regularly return to the same field waters to perform the same function at the same time as the field waters contains the maximum number of fresh cercariae.

However it is unlikely that any of these aspects of the life cycle of the parasite would, by themselves, be sufficient to cause a sudden population explosion amongst any schistosome species. But the story is very different when certain factors relating to the human and snail hosts are considered.

The increase in the definitive host population and in intermediate host habitats on irrigation schemes, would also I think not be sufficient to cause much increase in schistosome population if it were not that there has been an enormous increase in local human population density and a relative decrease in the number and size of snail habitats that are regularly used by man.

The increase in Bantu population density has been brought about agricultural and other development such as mines, European townships, forestry, etc., which attracted Bantu labour and their families. These soon increased until numerous settlements or villages sprang up on ground round the only water available, or on ground

which could not be cultivated because it was above the canals or was too close to water. In addition the South African Government policy of housing Bantu in the reserves into loose villages has resulted for all practical purposes in the scattered Bantu populations of 10-15 years ago disappearing.

From these and other observations mainly resulting from rodent immersion, it has become apparant that by far the greatest amount of transmission from snails occurrs in waters which are in the immediate vicinity of human habitation, or in waters which are used regularly by man.

Earlier on I said that the schistosome has never had it so good because man has not coped adequately with certain aspects of his changing environment. He has not coped at all with his water supply. There has been no change, no work, nor research done on the development of Bantu domestic water suplies, nor, in ascertaining the water requirements of congregated Bantu communities, with the result that all these communities are settled round or one might almost say on top of, small collections of water such as streams, rivers, canals, storage dams, etc. The size of the snail population in these waters seems immaterial and somewhat irrelevant to the basic fault, which is a highly polluted, much used, bad and often inadequate water supply. Today any human community should be entitled at least to piped water. More so if the community is part of some development scheme or some organisation employing labour. The water should be sufficient for all domestic requirements and, if provided on a communal basis there should be sufficient stand pipes, laundry slabs, and showers to satisfy the whole community and not just those who happen to be lucky enough to have a stand pipe or shower near their future home.

In bilharziasis endemic areas certain additional measures are necessary specifically for the control of this disease. On irrigation schemes communities are best sited not too far from but below canals or storage dams. This decreases faecal pollution and at the same time water can be piped by gravity. Sometimes it may be necessary to store the water, and circular cement reservoirs one brick thick and reinforced with wire, have been found satisfactory. From these the water is distributed but it must be available at all times. Ideally water could be filtered and chlorinated but I don't think this is absolutely essential if the village is small, below the canal and the pollution is minimal. The reservoir inlet can be protected by coarse iron gauze screens sufficient to prevent any but the smallest snails passing them. These screens seem to keep out all snails for years and if snails do happen to get in it is an easy matter to get rid of them.

In hot climates swimming is an essential part of the lives of village children. Therefore it is nonsense even to suggest that they stop. This makes the provision of swimming facilities in endemic areas obligatory and they are often more important because they are used more than, e.g., playing fields. They can be built cheaply on the same lines as the reservoirs mentioned above or something more elaborate can be provided if the population numbers of the village warrant it. Filtration and chlorination may be necessary depending on the size of the population to be served. It is not always a good idea to build the swimming pool at the school. Often the schools run on a two session basis, one session in the morning and one in the afternoon and either way the swimming suffers in deference to potential scholastic genius. It is a good idea to fence the swimming pools with a low fence of pig netting on the assumption that any child able to climb or jump over the fence will be large enough not to drown if it strays from home and falls in.

Small cement paddling pools, about 9 inches deep or less for the toddlers are useful and serve the same purpose as the stream or canal in the field in keeping children amused while the mothers do the washing. They should of course be built near the laundry slabs which minimally are nothing more than a cement slab on the ground in the shade with an adjacent stand pipe for water.

The small swimming pools can be filled directly from the main reservoir or from the canal or storage dam with raw water at night. The water is changed once a week or more often if necessary and they are then scrubbed out either by the attendant whose job it is to keep the whole village clean or by the children.

Once all the above facilities have been provided it is then often necessary to prevent access to potentially dangerous waters near the villages by fencing or other means. In practice we have fenced only those waters within a quarter of a mile of the village. In some areas fencing has the effect of encouraging a dense growth of vegetation inside the fence which reduces the amount of faecal pollution, makes access more difficult and snails do not seem to appreciate dense shade. Where it can be expected that vegetation growth will become sufficiently dense within the fence to preclude human access, only that side of the stream nearest the village need be fenced. Where necessary protected pathways must be built across fenced waterways and we have found that

narrow cement bridges serve very well with a fence on both sides. In some places we have erected man proof fences, for example round a storage dam in the middle of village, taking care to allow ducks in and out, but generally speaking man proof fencing has not been used. Canals running through villages have been covered or the water piped and any waterway between the village and say the local school in the next village must be protected from access by the children who cross it twice a day.

Latrines although recommended are to my mind not an anti-bilharzial measure. Any number of them will not prevent human beings urinating when they get into water nor will they stop indiscriminate defaecation, when under normal circumstances the Bantu empty their bowels about three times a day.

These methods alone were started in 1959 and were completed in 1963 or 64 on an irrigation farm some 12-15 square miles in extent. The infection rates of 277 school children between 5 and 9 years old were 75 per cent. *S. haematobium* and 68 per cent. *S. mansoni* in 1959. In 1968 they were 41 per cent. and 49 per cent. respectively of 216 children in the same age group. The results are based on one examination of urine and stool. This decrease may be slow — this was expected, but there has been no recurrent expenditure and the inhabitants are left with a good permanent water supply sufficient for all purposes.

Once the environmental side has been established and is a permanent fixture other measures can then be used immediately; an obvious example is the use of drugs. Accordingly after the 1968 survey all positive school children were treated with an attempted six-day course of Ambilhar. Unfortunately the *S. mansoni* rate was only reduced by about 15 per cent. in the treated children but the *S. haematobium* rate was reduced by 98 per cent. The rate in the 5-9 year olds now stands at 22 per cent., 70 per cent. of which was in new school children who entered school at the beginning of 1969. Unfortunately, and this applies mainly to *S. mansoni* we have not found that courses of drugs of more than 4-5 days' duration practicable on a mass treatment basis especially when the schools operate on a five day week, or where, as occurs on many farms, there are no schools and where the mothers are out working. Present day anti-bilharzial drugs to my mind still have to be administered under medical supervision but the time is possibly rapidly approaching when this will fall away with obvious advantages.

The big limiting factor to this and possibly other types of control in South Africa is the size of the controlled area. If it is not large enough much of the work done is negated by migration to and from the controlled area. For instance in 1969 out of 201 new school children of all ages living on the controlled area 140 (70 per cent.) came from outside areas, and between the time of completion of the Ambilhar therapy and follow up 6 months later, 20 per cent. of the treated children had gone elsewhere.

One additional measure which I feel could be used with advantage in the future is the use of mechanical water filters and other gadgets. Some of these that are being produced today are simple and large enough to supply large communities but at present the costs are rather high for general installation and many of them are still in the experimental stages.

Discussion

Dr. Clarke: Could you give us some information on the filter? The only one which will deal with a reasonable amount of water at reasonable cost is the Thomas Tube.

Dr. Pitchford: So far, the only satisfactory filters are Berkefeld filters. Thomas tube lets through plenty of water, but also lets through 100 per cent. of cercariae until it has been operating for some hours. More recently a combination sand and flock filter has been introduced. It is very expensive.