Insoluble or Slightly Soluble Chemicals as Molluscicides *

by F. S. Barbosa, *Instituto Nacional de Endemias Rurais, Centro de Pesquisas Aggeu Magalhães, Recife, Brazil*

Individuals engaged in bilharziasis work have been using soluble substances as a routine practice for killing the aquatic snail vectors of schistosomes. At present, copper sulfate ($CuSo_4$) and sodium pentachlorophenate (NaPCP) are the most commonly used molluscicides.

The advantages and disadvantages of the two chemicals are well known and depend on several circumstances, some of them of a local nature. The existing molluscicides, when properly applied, even in rather low concentrations, may be highly effective in controlling snails.

In spite of good results obtained in the field, the shortcomings of $CuSO_4$ and NaPCP have been pointed out by several investigators. Problems of application, lack of uniform dispersion, cost, toxicity to animals and man, and inactivation by contact with natural waters are the main factors limiting the widespread routine use of these molluscicides for controlling bilharziasis in countries with extensive endemic areas.

To all the factors mentioned above, one should add the lack of slight residual effect of these compounds. To ensure persistent action in flowing waters, maintenance of lethal concentrations of these molluscicides for an adequate period of time is required, and this involves complex technical and economic problems on which little progress has been made.

Reasons for failure in the use of these molluscicides are not completely understood. Differences, from complete success to utter failure, have sometimes been reported by one and the same author. The effectiveness of NaPCP reported by Dobrovolny & Barbosa,[a] for example, varied a great deal.

Taking it for granted that the molluscicides have been correctly applied, failures reported may be due to local situations such as the ecological characteristics of the habitat or the biology of the snail itself. This is particularly true of north-eastern Brazil, where molluscicides have not shown very promising results.

It is well known that in north-eastern Brazil the snail vectors of *Schistosoma mansoni*—*Australorbis glabratus* and *Tropicorbis centimetralis*—are able to resist desiccation for several months.[b,c] During the dry season these snails are commonly found on the banks of the streams above the water-level. Following treatment of the stream the snails can be easily carried down into the water by occasional summer rains and thus repopulate the habitats.[a]

All the foregoing provides strong support in favour of continuing research on the development of new molluscicides with residual action. This has been stressed by several investigators and recommended by such WHO groups as the Expert Committee on Bilharziasis[d] and the Study Group on the Ecology of Intermediate Snail Hosts of Bilharziasis.[e]

Copper carbonate as a molluscicide

Insoluble or slightly soluble substances may come to be used most effectively as molluscicides. This has lately been realized by those who have observed that low solubility in water may be desirable to prolong the effect of the chemical. As noted above, the molluscicides now in general use have little or no residual activity, a limitation which makes it very desirable to develop other substances which can remain active in the water for a long time.

The most important disadvantage of an insoluble molluscicide, such as copper carbonate, has been said to be its unsatisfactory results in flowing waters.

Experiments conducted by Barosa and co-workers[f] in Pernambuco, Brazil, have shown that

* Note submitted to the WHO Expert Committee on Bilharziasis, September 1960.

[a] Dobrovolny, C. G. & Barbosa, F. S. (1953) *Publ. avuls. Inst. Aggeu Magalhães*, **2**, 121.

[b] Barbosa, F. S. & Dobbin, J. E., jr (1952) *Publ. avuls. Inst. Aggeu Magalhães*, **1**, 145.

[c] Olivier, L. & Barbosa, F. S. (1955) *Publ. avuls. Inst. Aggeu Magalhães*, **4**, 79, 105.

[d] *Wld Hlth Org. techn. Rep. Ser.*, 1953, **65**.

[e] *Wld Hlth Org. techn. Rep. Ser.*, 1957, **120**.

[f] Barbosa, F. S., Carneiro, J. C., Morães, J. G. & Carneiro, E. (1956) *Publ. avuls. Inst. Aggeu Magalhães*, **5**, 7.

copper carbonate was effective in most places when applied in 13 slow-current streams at rates of at least 30 g/m². In 11 of the treated streams, 100% of the snails (*Tropicorbis centimetralis*) were killed 48 hours after the application of the molluscicide. Five of the 13 streams were free from snails after 12 months, while the others were reinfected within two to six months. In the remaining two streams mortality of over 90% of snails occurred for the first month, but the streams were reinfected by snails from a pond situated above the treated area.

The results presented by Barbosa and co-workers [f] were very consistent for each treated area. In Matagipe four streams were free from snails for the first 12 months. In Pirapama the period of freedom from snails varied from six to 12 months. In two other areas there was a similar uniformity of results. In Nazaré only one stream was treated. There was no correlation between the amount of copper carbonate used and the results obtained.

Most remarkable was the presence of copper in Matagipe and Pirapama streams 12 months after the treatment notwithstanding heavy rains which had fallen during the wet season. Mud from three Matagipe streams brought to the laboratory at the end of the twelfth month after the application of molluscicide was still effective in killing snails.

Comments and suggestions

Evidence adduced by Barbosa and co-workers [f] demonstrates that an insoluble or slightly soluble molluscicide (copper carbonate) may, in certain conditions remain in treated streams for one year. It should be pointed out that such a long residual effect has never been observed before with any other molluscicide.

Results also indicate that unknown local conditions may play an important role in fixing the copper carbonate on the bed of the stream.

On the basis of these experiments it is suggested that research might usefully be conducted to find out what happens to copper carbonate or other substances, which, instead of being inactivated by mud or changed by sunlight, retain a prolonged lethal action in snail habitats.

The mode of action of copper carbonate is not clear. It may act through its soluble fraction or, after being ingested by the snail, it may act as a stomach poison. Brackett [g] observed *Lymnaea stagnicola* feeding on lettuce powdered with copper carbonate and saw them die three days later.

The possibility that insoluble substances can be used as stomach poisons is open to discussion. Although very little is known about the feeding habits of the planorbids, more remarkable is the little amount of information available concerning the physiology of the digestion in these freshwater snails. Research on the possibility of using stomach poisons as molluscicides requires additional investigation on this subject.

Under laboratory conditions snails eating copper carbonate found mixed with mud on the bottom of the aquaria die within a few days. The same happens when snails feed on Standen's alginate to which small amounts of the copper salt have been added. However, copper carbonate has some repellent effect on snails when present in large amounts.

The effects of low concentrations of NaPCP on the fecundity of *A. glabratus* recently reported by Olivier & Haskins [h] open new possibilities for experiments with molluscicides. Other molluscicides may show the same effect. In that case impregnation of the mud on the bed of a stream with a slightly soluble substance such as copper carbonate might ensure the maintenance of such a concentration of the chemical in the water as to act negatively on the egg productivity of snails.

[g] Brackett, M. A. S. (1939) *J. Amer. med. Ass.*, **113**, 117.

[h] Olivier, L. & Haskins, W. T. (1960) *Amer. J. trop. Med. Hyg.*, **9**, 199.