and three of these were subsequently proved to be such at operation. Twenty-three cases were definitely reported negative to liver abscess. Of the remaining fourteen cases eight were suspected clinically of having gall-stones; these eight were negative radiographically to liver abscess or gall-stones and they got well subsequently without operation. Out of the remaining six cases examined the *x*-ray signs were indefinite in five, and one case was diagnosed hydatid of the liver, and the cyst was demonstrated on the *x*-ray film.

Radiological findings in the Routine Examination of cases suspected of Amœbic Abscess of the Liver.

Normal.	Hepatitis.	Liver abscess.
(1) Lung fields clear.	Lung fields may or may not be clear.	Lung fields usually obscured at the right base.
(2) Diaphragm silhouette clear.	Diaphragm silhouette may or may not be clear.	Diaphragm silhouette (right) usually obscured.
(3) Diaphragm movement range may reach 2 inches.	Diaphragm movement range rarely more than 1 inch.	Diaphragm movement range (right) practically always under 1 inch and commonly practically immobile.
(4) Diaphragm, no local bulge.	Diaphragm, no local bulge.	Diaphragm often local bulge on right dome.
(5) Palpation, no subcostal pain.	Palpation, subcostal pain usual.	Palpation, subcostal pain may be considerable.
(6) Diaphragm silhouette always seen.	Diaphragm silhouette always seen.	Diaphragm silhouette may be completely obscured.
(7) Heart and lungs no displacement.	Heart and lungs no displacement.	Heart and lungs may be displaced.
(8) See-saw movement never present.	See-saw movement not usual.	See-saw movement (right dome up and left dome down) may be present.
(9) No lung complications present.	Lung complications rare.	Lung complications (pleurisy, etc.) are not uncommon.
(10) Diaphragm position normal.	Diaphragm position normal usually.	Diaphragm often abnormally high.

REMARKS.

1. The diaphragm range is measured on the screen with a compass.
2. The trunk-vertical position is the best.
3. The fluoroscopic part of the examination need not take more than a few minutes.
4. An opinion cannot be given on fluoroscopy alone. Skiagrams are essential.
5. In fluoroscopy use an electric current of 3 m.a. I found that larger currents are unnecessary; besides they may give rise to screen-lag.

CONCLUSIONS.

In cases suspected of liver abscess the *x*-ray method of examination affords valuable information in the following manner:—

(*a*) A doubtful diagnosis of amœbic abscess made on the clinical signs may be cleared up.

(*b*) The presence or absence of lung complications may be indicated.

(*c*) Cases negative to amœbic abscess, radiographically usually yield to non-operative measures, i.e., emetine, etc.

(*d*) The *x*-ray examination aids prognosis, e.g., lung complications add to the gravity of the disease and clear lung fields are indicative of more favourable prognosis.

(*e*) Within my experience no case where the *x*-ray evidence was wholly negative has subsequently been proved to have been a case of amœbic abscess.

PARIS GREEN AS AN ANOPHELINE LARVICIDE.

By S. N. SUR, M.B., D.P.H. (Lond.), D.T.M. (Liverpool),
Assistant Director of Public Health, Malaria Research, Bengal,

and

HARIPADA SARKAR, L.M.S., D.P.H. (Cal.),
Assistant to the Assistant Director of Public Health, Malaria Research, Bengal.

THIS paper has been written mainly for the information of practical malariologists and in it the observations on Paris green of Drs. Gosio, Missiroli, Chalam, Hacket, Dalal and others as well as of our own have been put together. The merits and demerits of this remedy and its probable cost of operation in Bengal have been discussed, which may be of interest to the field workers.

Paris green or Schweinfurt's green is a chemical compound of arsenic, copper and acetic acid. Its chemical name is copper aceto-arsenite, its formula being $3\ Cu\ H\ As\ O_3 + Cu\ (C_2\ H_3\ O_2)_2$. It is therefore a double salt of copper arsenite and acetate. It is a microcrystalline powder of emerald green colour. It is practically insoluble in water. It is perfectly soluble in ammonia and concentrated acids. In the pure state it contains 58.6 per cent. of arsenious anhydride ($As_2\ O_3$). Paris green is often adulterated. The percentage content of arsenious anhydride should therefore be ascertained from the dealer when ordering it for larvicidal purposes. Some manufacturers guarantee it to contain 55 to 58 per cent. of arsenious anhydride.

It has been used with great success as an anopheline larvicide in America and Southern Europe. It has also been used with success by Dr. Chalam, Dr. Dalal and others in India.

For use Paris green is diluted with some inert dust in the proportion of 1 part of Paris green to 99 parts of road dust by weight. In the

absence of road dust, clay dust, sawdust, powdered French chalk, or soap stone powder may be substituted. Soap stone or steatite can be had locally in India and is known as *ramkhalli*. The mixture must be perfectly dry before use, otherwise the presence of the least moisture will cause the mixed dust to sink soon. It will also not spread over the surface of the water to form a film of the powder. As the season for anti-malarial operations in Bengal is just the one when one gets frequent showers of rain, it is very important that the road dust should be collected in the dry season and stored for use in the wet season. It is better sieved before putting into bags. If this precaution is not taken there will be great difficulty in securing dry dust at the time when it is greatly needed. In such cases French chalk powders may be used as diluent but will greatly enhance the cost of operation, although the price of Paris green itself may be insignificant.

Experiments with Paris green were carried out in a tank near the Central Jail at Krishnagar in the months of November and December, 1928. The diluent used was dry road dust and the mixture was applied by means of a hand blower devised by Dr. Hacket. The tank was full of such aquatic vegetation as *Vallisneria, Utricularia* and *Hydrilla*. In our experiments, Paris green was mixed with dry road dust in the proportion of 1 in 100 by weight. It was found very effective in killing anopheline larvæ as will be evident from the experiments detailed below. In our experiments the same pan of 10 in. diameter was used for collection of larvæ. In each case 15 dips were made to compare the number of living larvæ and the same place was tested.

EXPERIMENTS.

	I		II		III				
	Before spraying.	24 hours after spraying.	Before spraying.	24 hours after spraying.	Before spraying.	½ an hour after spraying.	1 hour after spraying.	2 hours after spraying.	24 hours after spraying.
Number of larvæ	94	nil	82	8*	43	42	23	18	nil
Average per dip	6·3	nil	5·5	nil	2·9	2·8	1·5	1·2	nil
A. rossi ..	22%	nil	27%	nil	11%	12%	17%	39%	nil
A. barbirostris	6%	nil	2%	nil	nil	nil	nil	nil	nil
A. fuliginosus	72%	nil	71%	nil	89%	88%	83%	61%	nil

*They could not be identified as the larvæ seemed to have just emerged from the egg-shells during the course of the day. They were very tiny.

It is therefore seen that total eradication of larvæ cannot be expected within 2 hours of the application of the powder. A total eradication may be expected within 24 hours. It also becomes apparent from the experiment II that it has no action on the eggs which hatched out during the course of the day into small tiny larvæ. From experiment III it seems that *A. fuliginosus* larvæ are more vulnerable than *A. rossi* larvæ. Experiments were also carried out in dishes on the life of Culicine larvæ and Anopheline pupæ. It was found that the mixture had no effect on them.

The alimentary tracts of dead larvæ were dissected out and the contents were examined under the microscope. These showed the presence of typical granules of Paris green in the different regions of the œsophagus and the gut. It therefore acted as a stomach poison. Under ordinary conditions the dust forms a film on the surface of the water and floats for some time. The anopheline larvæ being surface feeders the minute granules of Paris green are taken automatically by them with the inward current produced by their feeding brushes. Arsenic and copper being powerful stomach poisons they die even when a very minute quantity of Paris green is ingested by them.

The quantity of the mixture required to kill all anopheline larvæ in a water area of 20 square yards was about 3 ounces, containing only 14 grains of Paris green. The cost is therefore insignificant. It may be had at Rs. 88 per 1 cwt., which works out the cost of Paris green as a larvicide to be about one anna per 1,000 square feet of water surface. If the diluent is road dust collected and stored beforehand the expense is inconsiderable. But if the diluent used is French chalk powder or steatite powder, the cost would come to about 6 annas every 1,000 square feet, the price of French chalk powder being about Rs. 4-8 per cwt.

The powder may be used by means of hand bellows as devised by Dr. Hacket or by means of any powder blowers such as found in the market like "Misto" powder blowers. When a breeding-place overgrown with tall grass or water hyacinth is to be treated, it is better to have a special long nozzle attached to the blower to be introduced into the growth before blowing the powder. Otherwise powder blown over the growths will settle on the leaves and the larvæ would not be affected. In big swamps which are full of weeds not only in the edges but also in the mid portion, it is better to apply it over the whole surface. This may be done by the operator sitting on a *bhela*—an improvised float made of *sola* or Indian pith such as fishermen use or made of blocks of plantain trees. The only precaution required is that the operator should always keep himself on the windward side of the dust cloud.

Paris green should be applied at least once every six days. As it has no action on the egg stage and the pupal stage of anophelines, the interval between the two applications must therefore

be shorter than the period which takes just hatched out larvæ to develop into pupæ. As the length of this period varies in different seasons, in summer the time taken being very much shorter than the average, the interval must not therefore be prolonged more than six days.

At present a mixture of pesterine and kerosene or fuel oil and kerosene is being largely used as a larvicide in areas where anti-malarial operations have been undertaken in Bengal. The cost of this mixture is about 5 to 6 annas per 1,000 square feet.

The advantages of the use of Paris green as a larvicide are:—

(1) It is inexpensive in comparison with pesterine or kerosene, etc., the cost being about an anna per 1,000 square feet. But if French chalk powder is used as a diluent, the cost per 1,000 square feet comes up to the same level as that of pesterine or fuel oil.

(2) It has no smell, whereas the odour of pesterine or liquid fuel is very much objected to by the public.

(3) The solubility of Paris green is so negligible and the quantity used is so small for the area treated that there is no fear of toxic effects. It sinks to the bottom of the tank after a certain period, and being practically insoluble it does not materially affect the composition of the water. According to Drs. Gosio, Missiroli and Hacket, even when Paris green comes in solution in minute quantity, there is no accumulation of arsenic in solution in the water, as it is eliminated within 48 hours by natural biological processes through the agency of aquatic vegetation, viz., *Penicillium brevicaule*, a species of lower fungus which is present in most water collections and absorbs all arsenic in solution. In our experiments we found that the quantity used was not toxic to even small aquatic fauna such as fish, frogs, leeches, water-bugs. Ducks and cattle using the water were not affected.

(4) It is equally effective in weedy water collections as in clean ones; the cost of preliminary expense for the clearance of weeds before spraying with oil is thus saved.

But it has the following disadvantages:—

(1) It cannot kill the eggs and pupæ of anophelines and has no effect on the aquatic stage of culicines. In rural towns where there is some sort of water works without underground drains the mosquito nuisance is so great that the campaign should not only be against anophelines but also against culicines. In such cases Paris green is useless.

(2) A shower of rain or high wind just after the application may vitiate the result. In such cases, it should once again be applied.

(3) It may not be useful in waters with a strong current such as are found in submontane regions.

(4) Although fish and ducks have been found not in the least affected, there is a general apprehension of arsenical poisoning by doctors, as tank water is very much used by the Indians for drinking purposes. Where there is a piped water supply, its use is safe.

REFERENCES.

Gosio and Missiroli (1927). *China Medical Journal*, Vol. 41.
Dalal and Madon (1927). *Indian Medical Gazette*, Vol. 62.
Challam (1927). *Indian Journal of Medical Research*, Vol. 14.
Hacket (1927). *Journal of Tropical Medicine and Hygiene*, Vol. 30.

SIMPLE TESTS FOR STOCK SOLUTIONS OF QUININE AND POTASSIUM IODIDE.

By J. W. D. MEGAW,
COLONEL, I.M.S.,
and
HERBERT HAWLEY, M.SC., F.I.C.,
Public Analyst, Madras Presidency.

IN a note in the *Indian Medical Gazette* of May 1928 the senior writer in collaboration with Professor Sudhamoy Ghosh and Mr. N. R. Chatterjee of the Calcutta School of Tropical Medicine called attention to the great frequency with which stock solutions of quinine in hospitals and dispensaries are seriously under the stated strength. A simple test was given by which inspecting officers could easily check the strength of the solutions.

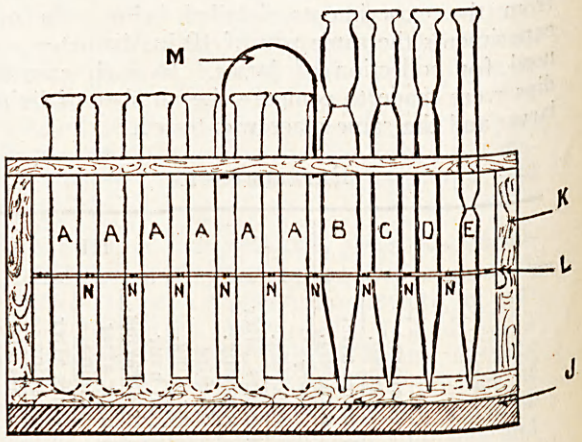

FIG. I.

Teakwood rack (drawn approximately to scale).
A Test tubes of equal calibre.
B Pipette for quinine test reagent. (*Capacity about 2|3 that of test tubes.*)
C Pipette for iodide test reagent. (*Capacity slightly less than ½ that of the test tubes.*)
D Pipette for iodide mixtures. (*Capacity about ½ of C.*)
E Pipette for quinine mixtures. (*Capacity about 1|10 that of B.*)
J Lead plate for stability.
K Teakwood frame.
L Wire supports to keep test tubes in place.
M Wire handle for rack, placed on one side of the cross piece.
N Wires running between the supports to keep the tubes in position.
(A perforated tin plate may be used instead of the wires L and N.)