ful fodder value. The proper indus- ploitation of our oil-seed shells and yet to be the .nt out. To indicate lilities in this direction one may refer that have yielded useful industrial as a result of systematic scientific re- It is well known that cocoanut shells sources of phenol and acetic acid on ng subjected to destructive distilla- milarly cashew shell oil which is a uct in the cashew industry on the st of South India is a rich source of henolic compounds capable of yield- ble plastic material on suitable treat- he case of cotton seed hulls is another of hidden wealth brought out to light matic investigation. The hulls have wn by the writer to be a very rich f the valuable chemical substance, uraldehyde which is readily optained by a simple hydrolytic treatment. The furfuraldehyde in the synthetic plas- ry as well as in the synthetic dyestuff is well known. Further the ashes of ed hulls are almost entirely composed es, which are so useful in the fertil- stry. The hulls also yield a dyestuff n colour silk or cotton yellow. The roundnut shells is very similar to that seed hulls, and can yield the same besides pure alpha cellulose. Another in which the shells can be utilised preparation of active carbon. It may n general, therefore, that a systematic ion into the scientific and industrial the immense quantities of the oil-seed l husks is almost an unexplored field ndustrial potentialities and will repay d any amount of investment in the their scientific investigation.

ove are only a few illustrations of industrial possibilities arising from atic scientific research into the indus- sation of our oil seeds and oil-seed It is not an exaggeration to say roperly utilised the raw oil seeds of y form a starting material capable of a variety of useful finished products y way inferior in importance or util- alth to the products of the well-estab- l-tar industry in India or elsewhere. ying out the above schemes of re- is necessary to emphasise that a num- co-ordinated Provincial institutions, exclusively to locally available oil l be more useful than a centralised n any one part of the country. Equal- ant with these is the provision that to be made for the training of skill- s and scientific workers for a periodi- nstration and dissemination of the research among the interested pub- gh the medium of local vernaculars. by such increase of Indian scientific r among the middle class intelligent- s country through vernacular educa- we can gather the moral and social n necessary to raise our country to uard of the progressive nations of l.

eatest hopes, therefore, lie in the new Vegetable Oil Committee which the Government of India have wisely helped to constitute at a most opportune moment in the history of our country.

P. RAMASWAMI AYYAR.

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INFLUENCE OF MERCURY ON INSECT EGGS—PART I

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THE use of mercury for the protection of stored pulses from insects is an age-old practice in Mysore. Kunhi Kannan (1920) first brought this to the notice of Entomologists in India and elsewhere. He also found that the eggs of the pulse beetle, *Bruchus chinensis*, failed to develop and hatch in the presence of mercury. Larson (1922) made similar tests and confirmed this finding. Dutt and Puri (1929) later found that mercury was equally effective in arresting the multiplication of the grain weevil, *Calandra oryzæ*. Gough (1938) working on the flour beetle, *Tribolium confusum*, showed that mercury had a deleterious effect on the eggs while the grubs remained unaffected. Recently, Wright (1944) carried out observations about the effect of mercury on the eggs of other stored grain insects.

This note embodies in brief the results of a series of experiments conducted here to elucidate certain important details of the influence of mercury on the eggs of stored-grain insects. The aim of these experiments has been to fix the exact quantities of mercury and the methods of using it finally in the case of large-scale storage of grain.

TECHNIQUE

In all the experiments, tall and empty cylindrical jars of known volumes were used. Known quantity, by weight, of mercury was exposed in open paraffin crucibles of uniform dimension and thickness. These were kept at a height of 2·5 cms. above the level of the eggs arranged in a single layer, on filter paper in a petri dish. One hundred fresh eggs were taken for each experiment. The jars were kept covered with air-tight lids. Proper controls under identical conditions were maintained (Fig. C).

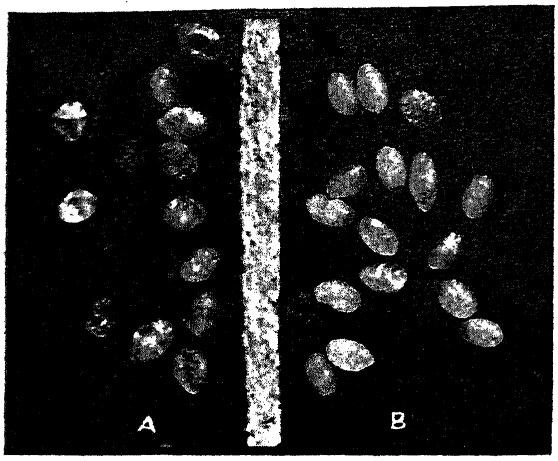
The time allowed to determine the effect of mercury was in each case twice the period taken for the larvæ to hatch out normally from the eggs in the control series. This period was considered necessary in order to allow time for any delayed hatching, in the experimental series.

(1) *Observed results of exposure of the eggs to mercury.*—Eggs (not older than 16 hours) of the following insects were tested: ***Corcyra cephalonica***, ***Bruchus chinensis***, ***Calandra***

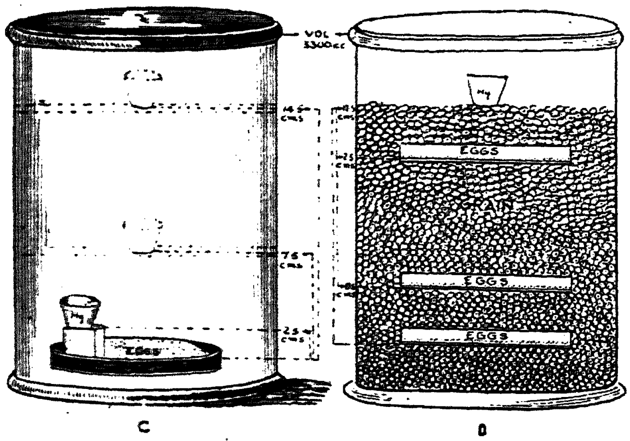
oryzæ, *Tribolium confusum*, *Rhizopertha dominica* and *Sitotroga cerealella*.

In all the experimental series the larvæ failed to hatch from the eggs even after double the period of time normally taken by the eggs to hatch in the controls.

For detailed observations the eggs of *Corcyra cephalonica* and *Bruchus chinensis* alone were chosen.



1. Eggs of *Corcyra cephalonica* exposed to mercury (A) and unexposed (B).



2. Diagram showing the location of mercury and eggs in empty (C) and grainfilled (D) jars.

The eggs of *Corcyra cephalonica*, when exposed to mercury, underwent visible changes externally. Usually 48 hours after exposure, the eggs commenced to shrink; the internal contents also appeared shrunk and pushed to a side. The shining creamy-white colour of the eggs gradually faded. On account of the shrinkage a sort of depression on the exposed surface of the eggs was noticed four days after the first exposure; the colour of the eggs also turned brownish (Fig. A). About 3 per cent. to 6 per cent. of the exposed eggs of *Corcyra cephalonica*, however, did not undergo any perceptible change. The internal contents were found shrunk, but no depression of the surface chorion was visible. Such eggs were kept under observation for a longer period, but in no instance did any larvæ hatch out.

The eggs of *Bruchus chinensis* on exposure to mercury reacted similarly to those of *Corcyra cephalonica*. The eggs, which are usually glued to the grain by the female beetle, became shrunk and flat and gradually turned brown in colour.

Observations on the exact nature of the internal changes in the eggs are still in progress and not quite completed.

(2) *Effective (lethal) dose of mercury for particular volume of empty space.*—A series of trials was set up using different weights of mercury to find out the effective lethal dose for a particular volume of space. Fresh eggs of *Corcyra cephalonica* and *Bruchus chinensis* were used in these series. The technique adopted was the same as before; but the quantity of mercury used was diminished gradually from series to series. Two definite volumes, *viz.*, 3,300 c.c. and 4,000 c.c., were selected for this work. The following table gives the effect of different quantities of mercury on the eggs in particular volumes of empty space.

Quantity of Hg	Effect on eggs	
	3,300 c.c.	4 000 c.c.
1 gm.	Effective	Effective
·5 ,,	,,	,,
·1 ,,	,,	,,
·05 ,,	,,	,,
·03 ,,	,,	Not effective
·02 ,,	Not effective	,,
·01 ,,	,,	,,

The lethal dose was assessed to be that minimum weight of mercury which would be effective on the enclosed eggs in a particular volume of space. From the above table it could be seen that ·03 gm. of mercury is the minimum weight effective upto 3,300 c.c. and ·05 gm. upto 4,000 c.c. of empty space.

(3) *The relation between the age and stage of development of eggs and influence of mercury.*—A series of tests with the several post-embryonic stages of the eggs were made but none was found in the least affected. They developed normally into adults in the presence of mercury. The adults also behaved normally and lived their usual lengths of life. Copulation and egg-laying occurred without any visible hindrance.

To determine the exact age at which eggs were affected by mercury, the eggs laid by *Corcyra cephalonica* in wire-gauze oviposition cages were taken and at the time of their exposure to the mercury, they were not older than 16 hours. Different stages of eggs, between 16-48 hours were separately tested. Likewise, the eggs of *Bruchus chinensis*, laid on pulse grains 16 to 72 hours old, were tested.

It was observed from these series of tests that the eggs of *Corcyra cephalonica* less than about 24 hours old, only, were affected by mercury. Eggs older in age were not affected and larvæ later hatched out as in the control series. The eggs of *Bruchus chinensis* less than about 48 hours old were affected and those older than 48 hours were not affected but hatched into larvæ. It was also observed that there was scarcely any reduction in the percentage of affected eggs as the age of the same advanced; in other words, the percentage of kill, due to exposure to mercury, of the eggs of *Corcyra cephalonica* and *Bruchus chinensis* less than 24 hours and 48 hours old respectively, was uniformly 100, whereas in the case of the eggs older than 24 and 48 hours respectively, it was also uniformly nil to two.

(4) *Mode of penetration of mercury vapour.*—The main object was to find out whether mercury vapour penetrated the egg through the micropyle or through the general surface of the chorion or through both. Eggs of *Corcyra cephalonica* and *Bruchus chinensis* (12 to 16 hours old) were selected and were painted with Euparol of a particular viscosity. In one series of tests only the micropylar end of the eggs was painted with Euparol. In another the entire general surface of the eggs excluding the micropyle was coated with Euparol. Proper controls with eggs painted with Euparol as in the corresponding experimental series, but without mercury, were maintained. In the control series larvæ hatched out in the same manner as in the case of normal and untreated eggs. (This incidentally also proved that Euparol had no ill-effects on the developing eggs.)

In the experimental series it was found that larvæ hatched out from eggs whose micropylar ends only were painted with Euparol whereas the eggs got shrivelled and shrunk in the case of those whose general chorion, excluding micropylar end was coated with Euparol. It appeared clear from this that mercury vapour penetrated the egg through the micropyle and not through the general surface of the chorion.

(5) *Time required for the action of mercury.*—As already stated above, double the period taken by the larvæ to hatch out normally was allowed to test the efficacy of mercury, on the several eggs exposed. Experiments were set up to study the minimum period required by mercury to kill the eggs. Fresh eggs of *Corcyra cephalonica* and *Bruchus chinensis* (12 to 16 hours old) were used in all these experiments. As before, the experiments were conducted in tall, air-tight and empty cylindrical jars (3,300 c.c. and 4,000 c.c.). It was seen that the eggs thus exposed to mercury for 24 hours and later continued in the same jar, but, with the mercury removed, were not at all affected. Eggs exposed to mercury for 48 hours and later removed from out of the jar into the open, became affected.

These experiments were repeated with the mercury placed at different elevations from the eggs spread out on the filter-paper in the petri dish; mercury was placed at 2·5 cms., 7·5 cms. and 14·5 cms. heights from the eggs (Fig. C) in the same jars and the same volumes of space; in each case after about 48 hours the eggs were found affected. It was thus seen that, for the same volume of empty space, the lethal dose of mercury affected the eggs at the bottom, equally effectively whatever the heights at which the mercury was placed.

The minimum period found required for the volatilisation of mercury—the lethal dose—(or for the required vapour pressure in a particular volume of space) and penetration of the vapour into the eggs to kill them in a particular volume of space, was thus about 48 hours.

In all the series of experiments mentioned here, the eggs and mercury were enclosed in the jars simultaneously. This procedure is slightly different from that adopted by other workers, who enclosed, not eggs but adult insects along with mercury. In the latter method there was sufficient interval between the time the adults were put in and the time the eggs were laid by them. During this interval a certain amount of mercury vapour already pervaded the interior of the receptacle. In the present series mercury commenced to volatilise only after the eggs were enclosed.

(6) *Effect of mercury in grain-filled space.*—The lethal dose of mercury found to be effective on the eggs in a particular volume of empty space was enclosed in the same volume of space (3,300 c.c.) filled with grains. Mercury was placed in the paraffin crucibles at the top of the grain. Fresh eggs of *Corcyra cephalonica* were kept at heights of 2·5 cms., 9·5 cms. and 12·5 cms. below the level of mercury (Fig. D). It was found that eggs kept at a height of 2·5 cms. below the level of mercury were affected while those kept lower down hatched out into larvæ. [As already noted in section (5)—in a series of tests with mercury placed at different heights in the same volume of empty space (3,300 c.c.)—it was found that mercury kept at the maximum height of 14·5 cms. above the level of the eggs was found to affect the eggs.]

(7) *Conclusion.*—From these observations it can be concluded—

(*i*) that mercury acts adversely on eggs of stored grains' insects; larvæ and adults, however, develop normally in its presence;

(*ii*) that eggs of *Corcyra cephalonica* and *Bruchus chinensis*, only about 24 hours and 48 hours old respectively are affected;

(*iii*) that ·03 gm. and ·05 gm. of mercury are the minimum lethal doses for 3,300 c.c. and 4,000 c.c. of empty space respectively;

(*iv*) that mercury vapour penetrates the eggs through the micropyle;

(*v*) that, in a known empty and enclosed volume of space in which eggs and mercury are kept simultaneously, mercury kills the eggs of *Corcyra cephalonica* and *Bruchus chinensis* 48 hours after exposure;

(*vi*) that the minimum lethal dose of mercury effective in a particular volume of empty space is not necessarily wholly effective on all the eggs in the same volume of grain-filled space.

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A CHLOROSIS OF PADDY (*ORYZA SATIVA* L.) DUE TO SULPHATE DEFICIENCY

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SINCE 1926 the author has been engaged in studies on the nutritional disorders of the paddy plant and on their correction by manurial treatment. A large volume of work has been carried out but publication was held up in the hope of completing the studies and presenting the work in comprehensive form. Owing to unexpected developments, however, further work on the subject is likely to be indefinitely delayed so that the publication of important facts appears to be desirable. This note deals with the effects of sulphate deficiency.

A chlorosis of paddy, fairly widespread on the Mandalay Agricultural College Farm, was attributed by the author to a possible deficiency of sulphur on the basis of the following observations:—

(1) Experiments on the manuring of paddy on the Farm soil with cyanamide, urea and ammonium bicarbonate during 1926-29 showed that the treated plants were generally chlorotic whereas treatment with ammonium sulphate gave healthy green plants. (2) In the Permanent Manurial Experiment on the Farm, treatment of paddy with sodium nitrate gave chlorotic plants while ammonium sulphate gave normal green plants. (3) There was no trace of chlorosis in the Farm area under the control of the Economic Botanist, Burma, apparently owing to the regular application of Nicifos II on this land, whereas elsewhere on the Farm chlorotic patches were numerous and extensive.

The plants affected by the disorder had the following characteristics:—(1) A general chlorosis with leaves of yellowish green colour, the older leaves being somewhat more greenish than the younger leaves. (2) There was no tendency for the premature death of the older leaves as is usual in cases of nitrogen deficiency. (3) The affected plants were relatively stunted and had fewer tillers and a smaller leaf area than the healthy plants. (4) The chlorotic plants gradually recovered their green colour and remained green and immature at the usual harvest time when the healthy plants had become golden yellow in colour, indicating full maturity. (5) Grain formation was not suppressed but the yield of both straw and grain was greatly reduced. (6) The ratio of straw to grain was much narrower in the chlorotic plants than in the healthy plants.

The first experiment to test the effect of sulphate on the chlorotic plants was carried out by the author[1] during the season 1931-32 with the collaboration of the Professor of Agriculture, who provided the necessary facilities. The treatments included magnesium oxide, magnesium chloride and magnesium sulphate with and without ammonium phosphate (free from sulphate). In all cases where sulphate was present the chlorotic plants recovered their normal green colour, made rapid growth and were ripe and ready for harvest along with the healthy plants. On the other hand the plants remained stunted and characteristically immature in all the other treatments. It was thus evident that the chlorosis was not due to a deficiency of nitrogen, phosphate or magnesium. The author's finding that sulphate is the curative agent for the chlorosis was subsequently confirmed by the Mycologist[2] and the Agricultural Chemist,[3] Burma, but neither of them attributed the trouble to sulphur deficiency. The latter[3] also expressed a warning against expecting a beneficial effect from applications of sulphur under normal conditions of growth.

As sources of sulphate for the plant the author found that gypsum, powdered sulphur, iron pyrites and the usual sulphate-containing fertilisers were equally effective, and that a rate of application of ten pounds of sulphur per acre in any of these forms was sufficient to cure the trouble and produce the maximum yield in this soil. The treatments produced their effect within three days after application. Under Burma conditions, iron pyrites appeared to be the most suitable source of sulphate as the mineral is found extensively in the country.

Since many areas on the College Farm were found to respond to ammonium sulphate and to superphosphate, comparative tests were carried out in areas of sulphate deficiency to discover whether the action of these fertilizers was due to their characteristic constituents or due to their sulphate content. It was found that treatment with nitrogenous and phosphatic fertilizers gave large increases in yield when they contained sulphate but not when they contained only chloride or nitrate in place of the sulphate. For instance, ammonium sulphate was far superior to ammonium chloride, urea mixed with calcium sulphate to urea alone, superphosphate to pure monocalcium phosphate, and Nicifos II superior to pure ammonium sulphate. The significance of sulphate in the manuring of paddy has been pointed out by the author[4,5] elsewhere.

The composition of the crop showed the following characteristics:—(1) In the chlorotic plants the straw as well as the grain contained abnormally high percentages of nitrogen compared to the healthy plants, and the yield of crop was found to vary inversely with the nitrogen content (Sen,[6] however, did not find any difference in nitrogen content between the untreated yellow plants and the plants treated with gypsum). The nitrogen test was found to be so sensitive that it could be used to detect the existence of abnormality in the