

phosphanilic acid to laboratory animals after administration of its solution in the minimum quantity of sodium bicarbonate.

Absorption in Blood.—Phosphanilic acid (300 mgms.) was given orally to a guinea-pig (wt. 600 gms.). There were no signs of irritation of the stomach. Phosphanilic acid was estimated after six hours in the blood from the heart, by Bratton and Marshall's³ method of estimation of sulphanilamide. The drug, however, was not present in the blood.

Similar experiments were carried out with mice (weight 20 gms.) (dose 20 mgms.). But the drug was found to be absent in the blood. In the urine and faeces, however, it was present in considerable amount.

4 gms. of the drug were orally administered to a dog, on empty stomach, through a stomach tube. There were no signs of irritation of the stomach or vomiting. Blood removed from the vein of the leg after one hour, two and five hours was found to contain 1.12, 0.56 and 0.42 mgms. per cent. of the drug respectively. After 24 hours there was a negligible quantity of the drug in the blood.

Toxicity to laboratory animals.—Ten mice were fed with the drug (15 mgms. at a time, three times a day) for ten days. All the animals survived with slight loss in weight and a little disturbance of fur and loss of appetite. When the drug was discontinued they recovered their normal condition very soon. The blood from the heart was examined, but phosphanilic acid could be found only in traces. Histological examination of the solid organs of the animals such as liver, spleen, kidneys, etc., showed no damage excepting some changes similar to autolytic changes in the liver cells. Phosphanilic acid was not found in the liver at all but only in urine and faeces.

The drug, therefore, deserves further trials in intestinal infections as it possesses good antibacterial activity and is poorly absorbed even if given in large doses.

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1. Kanitkar and Bhide, *Curr. Sci.*, 1947, 16, 223.
2. Unpublished observation. 3. Bratton and Marshall, *J. Biol. Chem.*, 1939, 128, 537.

STUDIES IN ANTI-MALARIALS: BIGUANIDO-ARYL-ARSENICALS

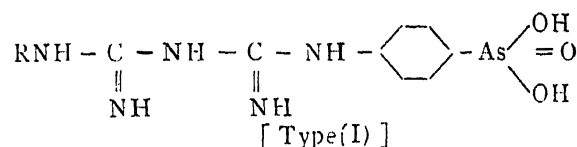
In spite of the various antimalarial drugs available for therapy, treatment of relapsing cases of malaria is considered a very difficult problem. It is known that the benign tertian and the quartan forms of the malarial parasites defy radical treatment and lead to persistent relapses. To free the system from these resistant forms, synergistic treatment with organo-arsenicals^{1,2,3} has been advocated.

With a view to studying the pharmacological properties of organoarsenicals having certain essential structural features of the reputed anti-malarial drug, paludrine,^{4,5} several biguanido aryl-arsenicals of type (I) have been synthe-

sised by reacting cyanoguanidine (for compound No. 1) and aryl cyano-guanidines (for compounds 2-6) with excess of para-arsanilic acid hydrochloride in dilute alcoholic medium. The arsenic acids separated out from the reaction products on neutralisation with dilute alkali and were then purified. The sodium salt of the acids were prepared and characterised. All the acids excepting No. 1 (Table I) and their sodium salts contain water of crystallisation and do not melt even at 300° C. Compounds Nos. 1 and 5 were crystallised from hot water; the others being insoluble in hot water and common organic solvents, were purified by precipitating with acids from alkaline solutions. They are soluble both in acid and alkali and are colourless.

TABLE I

*N*²-R-(*N*¹) p-biguanido phenyl arsonic acids

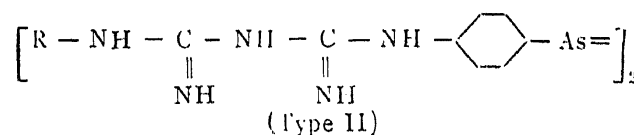


No.	R	Water of crystallisation in mols.	
		Arsonic acid	Sodium salt
1	H-	Nil	6
2	C ₆ H ₅ -	1	4
3	<i>p</i> -CH ₃ C ₆ H ₄ -	1	4
4	<i>p</i> -OCH ₃ ·C ₆ H ₄ -	1	5
5	<i>p</i> -Cl·C ₆ H ₄ -	2	5
6	<i>p</i> -NH·Ac·C ₆ H ₄ -	..	5

It is now widely accepted⁶ that pentavalent arsonic acids become therapeutically active only on reduction, in the body, to the trivalent state. In view of these observations, some compounds of the type (I) have been reduced with hypophosphorous acid and potassium iodide to the corresponding arseno-derivatives (type II),

TABLE II

p-*p*'-Di (*N*²-R-biguanido) arseno benzenes



No.	R	Water of crystallisation in mols.		M.P. with decomp.
		Arseno-compound	Dihydrochloride	
1	<i>p</i> -CH ₃ C ₆ H ₄ -	4	2	228° C.
2	<i>p</i> -OCH ₃ ·C ₆ H ₄ -	2	2	225° C.
3	<i>p</i> -Cl·C ₆ H ₄ -	2.5	2	230° C.
4	C ₆ H ₅ -	Unstable
5	H-	Not determined

which are fairly stable and practically insoluble in water. The yellow arseno-compounds possess no definite melting points, but their hydrochlorides melt with decomposition.

Full details will be published elsewhere.

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1. Goldman, *Amer. J. Med. Sci.*, 1938, 196, 502. 2. Murphy, *South Med. J.*, 1929, 22, 363. 3. Bose, *Indian J. Pharmacy*, 1947, 2, 14. 4. Cuid and Rose, *J.C.S.*, 1946, 720. 5. Bami, Iyer and Guha, *J. Indian Inst. Sci.*, 1946, 29A, 1.

LIFE-HISTORY, BIONOMICS AND CONTROL OF JOWAR STEM-BORER (*CHILO ZONELLUS* SWINHOE)

Jowar (*Andropogon sorghum*) crop is usually attacked by stem-borers, such as *Chilo zonellus*, *Sesamia inferens* and *Anthomyia* flies, of which the first one is of considerable significance in the Bombay Province. The percentage of infestation at Poona varied from 57.7 to 79.4 in different varieties of *jowar* during 1945-46. Previous reports, however, indicate the maximum infestation going up to 86 per cent. in Surat during 1925-26.

The literature on this pest being very meagre, investigations were taken up with a view to studying the systematics of this species as well as its bionomics and other details.

An inquiry among entomologists showed that Rahman (Punjab) and Lal (U.P.) are of the opinion that *C. zonellus* is a synonym of *C. simplex*, whereas Hinton (London) and Cherian (Madras) differ from them in this respect.

Since considerable controversy existed about the presence of two species, namely, *C. zonellus* and *C. simplex*, detailed study was made in this respect, and all the characters were compared with the descriptions and diagrams collected from various countries like Japan, China and the British Museum, London. In India, species were collected from Poona, Padegaon and Delhi on different food plants, namely, *jowar*, maize, sugarcane, rice, grasses, etc., and their characters noted.

Our investigations have shown that *C. simplex* and *C. zonellus* are two distinct species, and the species on *jowar* in India is exclusively *C. zonellus*. Its detailed life-history, seasonal history and the effect of different environmental factors on different stages, have been thoroughly worked out. The nature and extent of damage has been studied and some control measures tried. Parasitization in nature was studied and the different species of parasites recorded.

There are 4 to 5 generations a year, and each life-history may occupy 29 to 210 days, depending upon temperature, overlapping of generations being not uncommon. The egg stage lasts for 4 to 9 days, caterpillar 18 to 193 days and the pupal 6 to 12 days. Hibernation during winter is in the caterpillar stage. Alternative host plants include many of the millets and other wild grasses. It is parasitized by *Dipterous* and *hymenopterous parasites*, the most important being a *tachnid fly*. Preventive methods of control, namely, destruction of "dead-hearts" at the time of thinning, are of practical importance. Exposing the *jowar* stalks or stubbles to direct Sun's heat for 2 to 3 months, or burying the stubbles 5" below the earth for more than a month, kills all the hibernating caterpillars.

The detailed accounts of our findings are being published separately.

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TRIALS WITH 666 AGAINST INSECTS AFFECTING GRAINS IN STORES

THE toxicity of Gammexane to the rice weevil, *Calandra oryzae* L., the red flour beetle, *Tribolium castaneum*, and the saw-toothed beetle, *Silvanus surinamensis*, was determined by (1) mixing the insecticide with the grains, (2) dusting the inside of bags, (3) dusting the godowns and outside of the bags.

One lb. of wheat grain mixed with Gammexane, D 230, and 100 specimens of each of the three species of insects were introduced separately into 2 lb. jars. The insecticide at five different levels of concentration was tried as shown in Table I. The experiment together with control was replicated three times. Temperature and humidity were recorded daily.

TABLE I
Effect of Mixing D. 230 with Wheat

No.	% D 230 mixed with talc	Percentage mortality of insect at 2-day intervals. (Average of three replications)												% 666 on grain				
		2				4				6					8			
		Percentage Mortality																
		C	T	S	C	T	S	C	T	S	C	T	S					
1	0.1	70	20	64	83	28	74	90	38	74	100	52	86	0.0002				
2	0.3	76	40	67	92	52	75	9	64	77	100	84	87	0.0006				
3	0.4	82	60	68	96	64	74	96	70	80	100	84	90	0.0008				
4	0.45	86	64	72	96	65	75	97	73	82	100	93	94	0.0009				
5	0.5	86	68	74	98	70	78	100	76	86	100	95	97	0.001				
6	0.5% Talc.	36	12	4	46	32	21	52	40	27	60	48	34	Nil				
7	Control	18	0	8	27	16	17	36	25	25	48	34	33	Nil				

C = *Calandra oryzae*. T = *Tribolium castaneum*
S = *Silvanus surinamensis*

The above table shows that 0.5 per cent. D 230 gave a 100 per cent. kill of *Calandra oryzae* in 6 days. Other strengths also gave a 100 per cent. kill of the same insect, but in 8 days. *Tribolium castaneum* and *Silvanus surinamensis* were less affected by the insecticide, and cent. per cent. mortality of these insects was not obtained in the same period required to kill *Calandra oryzae*.

Gunny bags of five lb. capacity were dusted on the inside with D 230, two lbs. of infested wheat was then introduced into each bag. The percentage mortality of *Calandra oryzae* is shown in Table II.

Dusting of bags at 1 per cent. D 230 kills all the insects after about 7 weeks, and the effect of the treatment lasts even after 11 weeks.

Three godowns, each of 1,200 cft. capacity, containing 108, 105 and 210 bags of both rice and wheat were dusted with the insecticide at the different levels as shown in Table III. A fourth godown containing 100 bags was left untreated as control. The percentage mortality of *Calandra oryzae* is given below.