and Delahant[6] have observed much less tuberculosis in hamsters than in guinea pigs after the inhalation of suspensions of tubercle bacilli (R_1 strain) in concentrations of 40-50 microörganisms per oil immersion field.

Conclusions. The hamster is highly resistant to doses of a virulent strain of the human type of tubercle bacilli that produces widespread tuberculosis in guinea pigs. Twenty-four days after infection 0.1 cc of 5% and 10% Old Tuberculin elicits no skin response. Therefore, in our opinion, we consider hamsters of little or no value in routine diagnostic procedures for tuberculosis.

6 Gardner, L. U., and Delahant, A., personal communication.

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Relation of Plasma Level of Atabrine to Morphology and Motility of *Plasmodium vivax.**

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(Introduced by Carl Ten Broeck.)

The effects of therapeutic doses of atabrine on the appearance of malaria parasites in stained films were noted soon after this drug had come into use. They have been described in detail for *Plasmodium vivax,*[1] for *P. falciparum,*[2] and for *P. lophuræ,*[3] a parasite of birds. The early changes consist essentially of the appearance of pale-staining wisps of cytoplasm stretching out from the cell, aggregation of the pigment in a well defined clump, and fragmentation of the chromatin. In these studies no attempt was made to correlate the morphological changes with the concentration of atabrine in the blood and plasma. It was, however, found for the monkey parasite *P. knowlesi* that the maximal blood level of atabrine occurred within one-half hour after intramuscular injection of the drug, and that the parasite count began to diminish shortly after the peak atabrine level had been reached.[4]

In the present note it is desired to present observations made with living *P. vivax,* and especially to call attention to the possibly reversible effect of otherwise lethal concentrations of atabrine if they act over only a short period of time. The work constituted a small portion of an extensive study of relapsing *vivax* malaria in the Southwest Pacific theater of the war.

Cases of *vivax* malaria were selected which, on admission to the hospital, showed a parasite count of about 500 or more parasites per 500 white blood cells, with most of the parasites in the late ameboid stage. Before treatment was begun, a sample of blood was taken and used for the preparation of a wet film and for the preparation of plasma for atabrine assay. The patient was then injected intramuscularly with 200 mg of atabrine dihydrochloride in water. Blood samples were taken at intervals after the injection and used for wet films and for atabrine determinations. The wet films were all examined on a warm stage within a few minutes after preparation. Plasma atabrine levels were determined by the double extraction method of Brodie and Udenfriend.[5]

The results for 7 patients are presented in Table I. Before treatment it was easy to find in the wet films large motile parasites with

* This work was done in 1943 in Australia at the 92nd Evacuation Hospital and the 6th Army Training Center. It is a pleasure to acknowledge the whole-hearted cooperation of the staffs of both of these organizations.

1 James, S. P., *Trans. Roy. Soc. Trop. Med. and Hyg.,* 1934, **28**, 3.

2 Hühne, W., *Deut. trop. Z.,* 1942, **46**, 385.

3 Hewitt, R. I., and Richardson, A. P., *J. Infect. Dis.,* 1943, **73**, 1.

4 Chopra, R. N., Ganguly, S. K., and Roy, A. C., *Indian Med. Gaz.,* 1936, **71**, 443.

5 Brodie, B. B., and Udenfriend, S., *J. Biol. Chem.,* 1943, **151**, 299.

TABLE I.
Relation Between Appearance of *P. vivax* Parasites and Plasma Level Following an Intramuscular Injection of Atabrine.

Patient	Time of sample	Motility of ameboid forms	Appearance of pigment	Parasites per 500 w.b.c.	Atabrine μg per l plasma
HK	1 hr before treatment	+ +	Normal. Fine, dispersed	1170	17
	15 min. after "	± —	Aggregated	1180	110
	75 " " "	— —	Dense clumps	1390	87
	195 " " "	± —	Normal in a few	970	27
Hn	15 " before "	+ +	Normal	330	17
	20 " after "	+ +	"	340	48
	80 " " "	— —	Clumped	170	80
	200 " " "	— —	"	200	52
Ml	30 " before "	+ +	Normal	510	15
	20 " after "	+ +	"	530	65
	170 " " "	— —	Clumped	380	43
By	30 " before "	+ +	Normal	660	0
	20 " after "	+ +	"	570	194
	60 " " "	+ —	Some normal, some clumped	840	69
	190 " " "	+ —	" " " "	700	39
Cy	1 hr before "	+ +	Normal	1690	5
	30 min after "	+ ±	Aggregated in a few	1960	187
	90 " " "	— —	Dense clumps	2160	182
	210 " " "	± —	Normal in a few	1690	50
In	15 " " "	+ +	Normal	2570	219
	75 " " "	+ —	Half normal, half clumped	2770	125
	10 hrs " "	+ +	Normal	2010	28
Bz	10 min " "	+ +	"	3530	182
	70 " " "	+ —	Half normal, half clumped	2580	100
	190 " " "	+ +	Mostly normal	2750	33

finely dispersed pigment. Some of the patients at this time showed a low concentration of atabrine in the plasma, since they had been taking the drug, but in doses too small to give effective suppression of the malaria. It will be noted that the plasma atabrine level rose rapidly, following the injection, to a peak, and then fell off rather rapidly. In each case, at the time of the peak atabrine level, or shortly thereafter, the proportion of normal motile parasites with finely dispersed pigment was greatly reduced, and instead there appeared non-motile parasites with a clumped pigment mass. In 4 out of the 7 patients, the samples taken more than 3 hours after the injection, when the atabrine level had fallen considerably, showed a greater proportion of normal appearing, motile parasites than the sample taken near the time of the peak atabrine level. Since no increase in parasite number occurred during the brief period of the observations, the results suggest that some of the parasites are only temporarily injured by a short exposure to an ordinarily more than effective concentration of atabrine, and that they recover when the atabrine concentration has dropped to a relatively low level. This would account for the need for repeated injections when malaria is treated parenterally with atabrine.

No change in the appearance or motility of the parasites was observed within the first 3 hours after the oral administration of quinine, although the concentrations of quinine were 6 to 10 mg per liter of plasma.

Summary. In patients infected with *P. vivax* and given a single intramuscular injection of atabrine, most of the large ameboid parasites were non-motile and showed clumped pigment at the time of the peak plasma level of atabrine, which occurred within an hour after the injection. Several hours later, when the plasma level of atabrine had fallen, there was some recovery of both motility and normal pigment distribution.