THE SITES OF SEQUESTRATION OF THE UGANDA–PALO ALTO STRAIN OF *PLASMODIUM FALCIPARUM*-INFECTED RED BLOOD CELLS IN THE SQUIRREL MONKEY, *SAIMIRI SCIUREUS*

Henry N. Fremount and Richard N. Rossan

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The Sites of Sequestration of the Uganda–Palo Alto Strain of *Plasmodium falciparum*-infected Red Blood Cells in the Squirrel Monkey, *Saimiri sciureus*

The distribution of schizont-infected erythrocytes of various species of plasmodia within the vasculature of the internal organs of the host has been studied (Desowitz et al., 1969, Tr. Roy. Soc. Trop. Med. Hyg. **63:** 198–202; Miller, 1969, Am. J. Trop. Med. Hyg. **18:** 860–865; Miller and Fremount, 1970, J. Parasit. **56:** 1028–1029; Wellde et al., 1972, Am. J. Trop. Med. Hyg. **21:** 260–271). All distribution studies with *Plasmodium falciparum* have been conducted in the douracoulis monkey, *Aotus trivirgatus*, and with the Malayan Camp strain. The present study was undertaken to determine if vascular sequestration of parasitized red cells occurs in a different host, the squirrel monkey, *Saimiri sciureus*. In addition, an ultrastructural study was conducted to determine if an African strain of *P. falciparum*, the Uganda–Palo Alto, produced membrane abnormalities in host erythrocytes as were observed in the douracoulis monkey infected with Asian Camp falciparum.

Four *Saimiri* monkeys were inoculated intravenously or intraperitoneally with 1.6×10^6 parasites of the Uganda–Palo Alto strain of *P. falciparum* from *Saimiri* donors. When peripheral parasitemias reached approximately 1% the animals were killed and organ crushes prepared as previously described (Miller et al., 1971, Am. J. Trop. Med. Hyg. **20:** 816–824). The number of parasitized red cells per 5,000 red cells was counted in each organ and statistical analysis performed with a test of equality using the analysis of means applied to per cent defective. Tissue from each organ, as well as intestine and adipose tissue, was fixed in Zenker's fluid and processed for light microscopy. The distribution and histopathology of parasitized red cells within the vascular bed was studied. Tissue taken for electron microscopy was fixed for 1 hr at 23 C in 1% osmium tetroxide buffered at pH 7.4 with Dalton's dichromate. After complete dehydration, tissues were embedded in Epon and polymerized at 60 C for 3 days. Thin sections were cut, stained with lead citrate, and viewed in a Hitachi HU-11A electron microscope operating at 75 kv.

The distribution data of the four *Saimiri* are indicated in Figure 1. The concentration of schizonts in the spleen, bone marrow, and heart was significantly higher than in other organs ($P < 0.01$). Data obtained from the examination of stained tissue sections corroborate this finding. The anatomical distribution of the African Uganda–Palo Alto strain differed considerably from that of the Malayan Camp strain. Miller (loc. cit.) found that parasitized red cells of the Malayan Camp strain of *P. falciparum* in *A. trivirgatus* were concentrated in veins and capillaries of the heart as well as vessels of the adipose tissue. However, the distribution of red cells para-

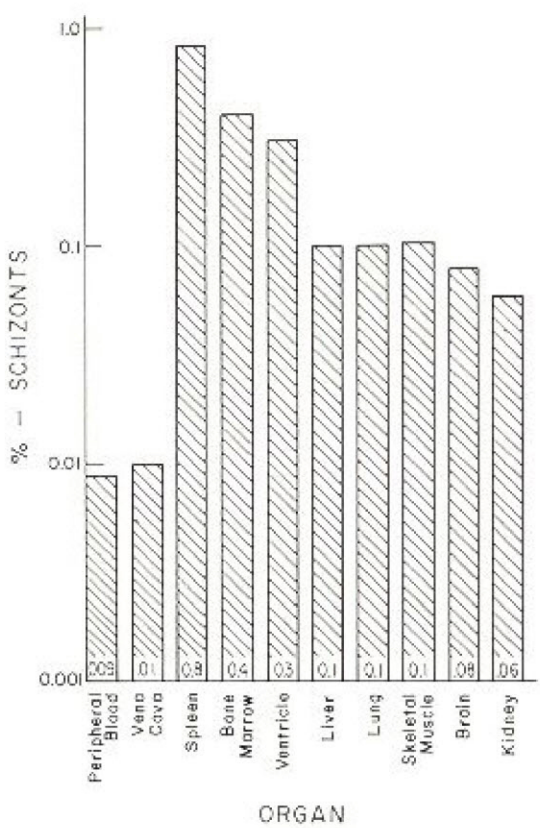
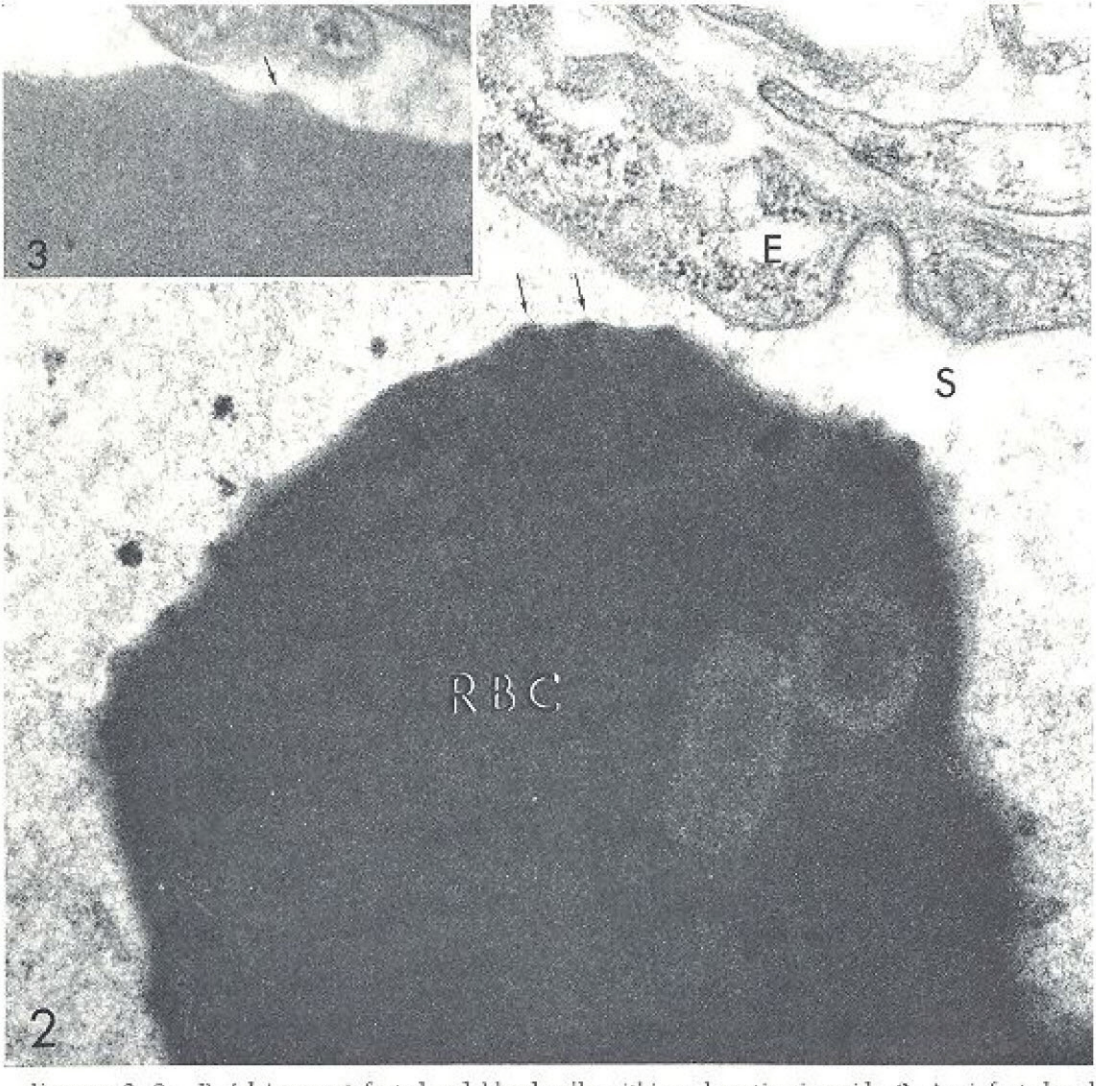


FIGURE 1. Graph showing the concentration of schizonts of *Plasmodium falciparum* (Uganda–Palo Alto strain) in *Saimiri sciureus*.



FIGURES 2, 3. *P. falciparum*-infected red blood cells within a hepatic sinusoid. **2.** An infected red blood cell (RBC) within a hepatic sinusoid (S) and in close proximity to the endothelium (E). Arrows point to electron-dense excrescences within the plasma membrane of the infected red cell. Magnification 56,000 ×. **3.** An enlargement of two lesions (arrow). Note that the lesion is submembranous. Magnification 114,750 ×.

sitized by the African Uganda–Palo Alto strain is characterized by concentration within the splenic vasculature, the bone marrow and vessels of the cardiac ventricle being involved to a somewhat lesser degree (Fig. 1). The difference in distribution between this study and the previous ones (Miller, loc. cit. and Wellde et al., loc. cit.) may be due to strain and/or host differences as well as the immunological status of the host. In both studies parasite concentration in the kidney and the brain was low while that in the spleen was comparatively high. It is possible that this combination of events may reflect the immune status of the host.

Ultrastructural studies of parasitized red cells have shown a host cell membrane lesion (Figs. 2, 3) identical to that described by Trager et al. (1966, Bull. WHO **35:** 883–885) and Luse and Miller (1971, Am. J. Trop. Med. Hyg. **20:** 655–660) for the Malayan Camp strain. The significance of this finding in the present study is that although anatomical distributions differ between hosts studied

the parasite regardless of strain and host produces identical membrane lesions. This membrane abnormality may influence vascular sequestration observed in *P. falciparum*.

Henry N. Fremount* and Richard N. Rossan, Gorgas Memorial Laboratory, Balboa Heights, Canal Zone.

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