

Plasmodium rodhaini Brumpt, 1939

IN 1920, Reichenow studied the malarial parasites of chimpanzees and gorillas in the Cameroons and found three species which he considered identical to *P. vivax*, *P. falciparum*, and *P. malariae* in man. Blacklock and Adler (1922) in Sierra Leone and Schwetz (1933, 1933a, 1934) in the Belgian Congo saw the same three forms. The first authors did not accept the Reichenow view of their being human malaria counterparts because they proposed a new name *P. reichenowi* for the falciparum-like parasite. Schwetz, on the other hand, considered them identical to those of man. Rodhain and Muylle (1938) did not accept the Schwetz opinion because they were unable to infect human subjects with falciparum- and vivax-type parasites from the chimpanzee. Brumpt (1939), after considering the morphological similarity between the ape and human forms, the failures in cross infection experiments, and the lack of success in infecting known human vectors with the chimpanzee parasites, decided that the forms were different. In that paper, he named the vivax-like parasite *Plasmodium schwetzi* (see chapter 12); to the quartan parasite he gave the name *Plasmodium rodhaini* in honor of the Belgian investigator Dr. Jerome Rodhain. At that point, each of the three human-like malarial parasites of apes had received names.

Rodhain was not satisfied. His interest was more biological than taxonomic and, to that end, he entered upon a susceptibility study which continued intermittently during the rest of his life. In 1940, he succeeded in transferring *P. malariae* from man to the chimpanzee by the inoculation of parasitized blood and *P. rodhaini*

from a chimpanzee to each of two people by the same route (1940, 1940a, 1941). Other human infections resulted under similar circumstances, as detailed in the above papers, with moderate to low parasitemias and fever up to 40° C. The above results convinced him that the *P. rodhaini* parasite of Brumpt was in fact *P. malariae*. In 1943, Rodhain and Dellaert reported the transfer of *P. rodhaini* from a chimpanzee to a patient in the Hospital Stuyvenberg. The patient became infected and from him twenty-three other patients were given the infection in tandem.

It was clear that *P. rodhaini* of the chimpanzee when blood passed to man would grow and produce disease. However, there was no evidence that the reciprocal would be equally true. This was answered by Rodhain in 1948 when he reported the successful transfer of *P. malariae* to each of three young chimpanzees. Following this experiment, he again declared that the quartan parasite in man and the chimpanzee was *P. malariae*.

In 1956, Garnham *et al* transferred *P. malariae* to an intact chimpanzee which exhibited a light infection. When the spleen was removed, the parasitemia increased to a peak of 160,000 per mm³. They were not able to infect mosquitoes. Bray (1960) was able to infect *Anopheles gambiae* mosquitoes when fed on man with *P. malariae*, and on chimpanzees carrying *P. rodhaini*. *Plasmodium malariae* infections were obtained in the chimpanzees by mosquito bites, but he was not able to carry out the reverse procedure. Nevertheless, he was willing to accept the name *P. malariae* for the quartan parasite of man and the higher apes. Garnham (1966) concurred in that opinion,

which is accepted generally, when, in speaking of Rodhain's work of 1940 (loc. cit.) he wrote "This was the first step in the sinking of *P. rodhaini* into synonymy with *P. malariae*." At present, we cannot take issue with the view that the quartan parasite of man and the chimpanzee are the same parasite.

Granted that *P. rodhaini* is synonymous with *P. malariae*, then, one must conclude that the human parasite became adapted to the chimpanzee, or that it was a simian parasite originally which became adapted to early man. It seems likely, in the light of recent work involving other simian malarial parasites (Coatney, 1968), that in relatively recent times it went from man to the apes, and, therefore, qualifies as an anthroponosis. If that is not the case, then it is a zoonosis of long standing.

For reasons stated above, plus the fact that

we were unable to obtain an infected animal from which we might obtain material, we elected not to include a plate depicting the blood forms of the parasite; reference should be made to our plate of *P. malariae*.

Plasmodium rodhaini is a quartan malaria of the chimpanzee (*Pan satyrus verus*). The infection extends along the coast of West Africa from Sierra Leone to Angola and thence east to some point deep in the Congolese Republic. The infection rate appears to be low. Reichenow (1920) found it in only two of eight chimpanzees, Rodhain and Dellaert (loc. cit.) reported finding it in some of the young chimpanzees available to them, and Bray, according to Garnham (1966) examined seventy-eight chimpanzees in Liberia and found it in only eight percent of them.

REFERENCES

- BLACKLOCK, B., and ADLER, S., 1922. A parasite resembling *Plasmodium falciparum* in a chimpanzee. *Ann. Trop. Med. & Parasit.* 16 : 99-106.
- BRAY, R. S., 1960. Studies on malaria in chimpanzees. VIII. The experimental transmission and pre-erythrocytic phase of *Plasmodium malariae*, with a note on the host-range of the parasite. *Am. J. Trop. Med. & Hyg.* 9 : 455-465.
- BRUMPT, E., 1939. Les parasites du paludisme des chimpanzés. *C. R. Soc. Biol.* 130 : 837-840.
- COATNEY, G. R., 1968. Simian malarial parasites in man: facts, implications, and predictions. *Am. J. Trop. Med. & Hyg.* 17 : 147-155.
- GARNHAM, P. C. C., LAINSON, R., and GUNDERS, A. E., 1956. Some observations on malaria parasites in a chimpanzee, with particular reference to the persistence of *Plasmodium reichenowi* and *Plasmodium vivax*. *Ann. Soc. Beige Med. Trop.* 36 : 811-821.
- GARNHAM, P. C. C., 1966. *Malaria parasites and other haemosporidia*. Blackwell Scientific Publications, Oxford.
- REICHENOW, E., 1920. Ueber das vorkommen der malarieparasiten des menschen bei den afrikanischen menschenaffen. *Centralbl. f. Bakt. I. Abt. Orig.* 85 : 207-216.
- RODHAIN, J., 1940. Les plasmodiums des anthropoides de l'Afrique centrale et leurs relations avec les plasmodiums humains. *Ann. Soc. Beige Med. Trop.* 20 : 489-505.
- RODHAIN, J., 1940a. Les Plasmodiums des anthropoides de l'Afrique centrale et leurs relations avec les plasmodiums humains. Receptivité de l'homme au *Plasmodium malariae*. (*Plasmodium rodhaini* Brumpt) du chimpanze. *C. R. Soc. Biol.* 133 : 276-277.
- RODHAIN, J., 1941. Les plasmodiums des anthropoides de l'Afrique centrale et leurs relations avec les plasmodiums humains. *Bull. Acad. Roy. Med. Belgique* 6 : 21-60.
- RODHAIN, J., 1948. Susceptibility of the chimpanzee to *P. malariae* of human origin. *Am. J. Trop. Med. & Hyg.* 28 : 629-631.
- RODHAIN, J., and DELLAERT, R., 1943. L'infection à *Plasmodium malariae* du chimpanze chez l'homme. Etude d'une première souche isolée de l'anthropoïde *Pan satyrus verus*. *Ann. Soc. Beige Med. Trop.* 23 : 19-46.
- RODHAIN, J., and MUYLLE, G., 1938. Sur la spécificité des plasmodium des anthropoides de l'Afrique centrale. *C. R. Soc. Biol.* 127 : 1467-1468.
- SCHWETZ, J., 1933. Sur les parasites malarieux (*Plasmodium*) des singes supérieurs (Anthropoides) africains. *C. R. Soc. Biol.* 112 : 710-711.
- SCHWETZ, J., 1933a. Sur une infection malarienne triple d'un chimpanze. *Zentralbl. f. Bakt. Parasit. Infektionskrankheiten I. Abt. Orig.* 130 : 10s-110.
- SCHWETZ, J., 1934. Sur le paludisme des pygmées. *C. R. Soc. Biol.* 115 : 1228-1229.