us are prismatic and changeable, flashing forth one color and sometimes another, perhaps in the course of a lifetime displaying them all, but never all at once and equally in all directions.

The true object of education is the cultivation of the faculty of prevision. If you young people have been properly educated, you have had your heads turned. . . . Providence means seeing ahead. . . . You should be able to distinguish between a rising statesman and a false alarm.

Nations are always conquered from the inside. So long as we are normally strong, we shall be strong in every other way. . . . Those who perpetrate injustice, those who appeal to violence, those who stir up class hatred are the men whom we as a nation have to dread and against whom we have to protect ourselves. Liberty and independence, law and order, are not preserved by written constitutions and statutes, not by police and armies, not by wealth and success, but by the morality of the people. . . . Americanism is one of the fine arts, the finest of all the fine arts, the art of getting along peaceably with all kinds and conditions of men. We Americans have had more experience with the practice of this art than other nations, and it is not undue boasting to say that we have acquired a certain proficiency in it.

If all sermons were so graciously composed and so full of meat as those of Dr. Slosson, the churches would not worry over empty pews.

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SPECIAL ARTICLES

ASEXUAL REPRODUCTION WITHOUT LOSS OF VITALITY IN MALARIAL ORGANISMS

THE life-cycle of *Plasmodium praecox*, the protozoan parasite of bird malaria, is similar to that of the plasmodia of the human malarias. Asexual reproduction (schizogony) occurs in the vertebrate host, a bird, and sexual reproduction (sporogony) in the invertebrate host, a mosquito. The infective stages of the parasite, known as sporozoites, when inoculated by the mosquito into the blood of the bird, attack red blood corpuscles into which they penetrate. They grow within the corpuscles at the expense of the surrounding protoplasm until they almost completely fill them. Then the nucleus divides into from ten to twenty daughter nuclei, each of which, with a small amount of cytoplasm, is cut off as a minute merozoite. The average number of merozoites formed by each parasite is about fifteen (L. G. Taliaferro, 1925).[1] These merozoites escape into the blood stream when the corpuscle breaks down and some of them succeed in parasitizing new cells, thus starting another asexual cycle. Not all the merozoites undergo asexual reproduction; a few of them grow into sexual cells known as gametocytes. The gametocytes, however, do not pass through the stages of maturation, fertilization, etc., as long as they remain in the body of the bird; but if they are sucked into the stomach of the proper species of mosquito, they continue their development, and, after fertilization has taken place, produce by sporogony large numbers of sporozoites. Sexual reproduction thus takes place only in the mosquito and asexual reproduction only in the bird.

Bird malaria has been encountered in the common English sparrow on several occasions in this country; Whitmore in the month of August, 1913, secured parasites from a sparrow in New York which he inoculated successfully into canary birds. In 1918 I obtained infected birds from him and the strain has been maintained in canaries in my laboratory ever since. In 1924 Hartman obtained another strain from a sparrow in Baltimore; this strain has also been maintained since then in canaries.

The transfer of the infection from one bird to another is very simple. A small amount of blood from a vein in the wing or leg is sucked up into a syringe containing normal saline or sodium citrate solution and is then injected into the breast muscle or peritoneal cavity of a fresh bird; a few days later parasites can be found in the blood of the newly inoculated bird.

L. G. Taliaferro (1925)[1] has proved by plotting the mean size of parasites at frequent intervals that the asexual cycle of the strain of *Plasmodium praecox* from New York is thirty hours in length and of that from Baltimore twenty-four hours long. This periodicity occurs not only during the acute attack but also during the latent and relapse periods that usually follow. The normal course of an infection with bird malaria includes (1) a prepatent period between the time of inoculation and that of the appearance of parasites in the blood; (2) an acute period during which the parasite number increases very rapidly, finally reaching a peak, and then decreases until no parasites can be found in the blood by ordinary technical methods; (3) a latent period during which parasites are present in the blood but can be demonstrated only by prolonged and patient search; and (4) a period of relapse, either spontaneous or induced, when the parasites increase until they are again abundant in the blood. The period of relapse is followed by another latent period; and there may be several periods of latency and relapse.

[1] Taliaferro, L. G., 1925, "Infection and Resistance in Bird Malaria, with Special Reference to Periodicity and Rate of Reproduction of the Parasite," *Amer. Journ. Hyg.*, 5: 742–789.

Periodicity in bird malaria has been confirmed for the Baltimore strain by Drensky and Hegner (1926).[2] Whether or not the period of the asexual cycle of the New York strain has become longer during its extended cultivation in canaries without asexual reproduction is not known. If we accept thirty hours as the length of the asexual cycle of the New York strain we can easily compute the number of asexual generations this strain has passed through since it was obtained in 1913. This period consisted of slightly over twelve and one half years, or about 109,440 hours. Dividing this number by 30 gives 3,648, which is approximately the number of asexual generations this strain passed through during that period without the intervention of sexual reproduction.

If we accept twenty-four hours as the length of the asexual cycle in the Baltimore strain the data are as follows: total period, about one year and one half; number of days, about 550; number of asexual generations, about 550. Whitmore reported, in 1921,[3] that three of his canaries remained infected with the New York strain for twenty-nine months (until their death) after they were inoculated—a period during which about 700 asexual generations must have taken place in a single host. Mazza (1924)[4] records a bird that was still infective four years and two months after the original inoculation, but the number of asexual generations can not be computed in this case because the length of the asexual cycle is unknown for his strain.

The length of the asexual cycle is known for the organisms of human malaria; that of *Plasmodium vivax,* which causes tertian malaria, is forty-eight hours; that of *P. malariæ,* of quartan malaria, is seventy-two hours; and that of *P. falciparum,* of estivoautumnal malaria, is twenty-four to forty-eight hours. It seems certain that asexual reproduction continues at the same rate throughout human infections as it does in those of birds, hence the number of asexual generations may be calculated approximately by dividing the number of days of the infection by the length of the asexual cycle of the species concerned. It is of course necessary to prove that the infection measured is due to one group of parasites and not to sporozoites inoculated by mosquitoes subsequent to the original infection.

The rate of asexual reproduction is usually accepted by protozoologists as a measure of the vitality of a strain. This rate has been shown to be maintained by the Baltimore strain of *Plasmodium praecox* for over a year and there is every reason to believe that the rate will not decrease to any considerable extent in the future. Another criterion of vitality exists among parasitic protozoa and that is virulence. The evidence shows that both the New York and Baltimore strains have maintained their virulence throughout the entire period since they were secured. A factor of interest in regard to the rate of reproduction and virulence observed is the constant environment in which the malarial organisms live.

Does reorganization take place during asexual reproduction in *Plasmodium praecox?* This is a question that can not be answered. No such phenomenon is known, but this does not prove that a reorganization process is absent since we know very few of the cytological details of the malarial parasites during reproduction. We do know that a differentiation takes place in the blood, resulting in the production of sexual cells from the asexual generation, but as stated above these sexual cells do not continue development in the blood. Perhaps other changes corresponding to endomixis occur at some stage during the growth of the schizonts or when the merozoites are formed.

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[2] Drensky, Kosta, and Hegner, R. W., 1926, "Periodicity in Bird Malaria," *Amer. Journ. Hyg.,* 6: 312–314.

[3] Whitmore, E. R., 1921, "Observations on Bird Malaria and the Pathogenesis of Relapse in Human Malaria," Johns Hopkins Hosp. Bull., 29: 62–67.

[4] Mazza, S., 1924, "On the Duration of Relative Immunity in Malaria of Birds," *Journ. Trop. Med. and Hyg.,* 27: 98–99.

CERAMIC PIGMENTS OF THE INDIANS OF THE SOUTHWEST[1]

THE chemical nature of the coloring matter used by the ancients as ceramic pigments has been definitely established in a great many instances, but the small quantities available for analysis have frequently served as a barrier to their identification. As a matter of fact, the literature on this subject is very meager. The Encyclopaedia Britannica[2] states that all the black pigments ordinarily used contain carbon as the principal constituent. They are ivory black, lamp black, charcoal black, india ink and graphite (sometimes called black lead or plumbago). The same publication[3] in an article on Italian ceramics after the year 1200 A. D. states that black was made from a mixture of various colors. These included antimonate of lead for the yellow, ferric oxide for the red, copper oxide for the green, oxide of cobalt for the blue and manganese for the brownish purple.

Robbins, Harrington and Freire-Marreco[4] state that the modern Tewa Indians use a black paint for the decoration of pottery made from the Rocky Moun-

[1] From the Department of Chemistry, University of Colorado, Boulder, Colorado.

[2] Encyclopaedia Britannica, 21, 598 (1911).

[3] Encyclopaedia Britannica, 5, 737 (1911).

[4] "Ethnobotany of the Tewa Indians," Bureau of American Ethnology, Bulletin 55, 58 (1916).