3 (49). **"The transformation of negatively heliotropic animals (Gammarus pulex) into positively heliotropic animals by chemical means": JACQUES LOEB.** (Presented by **SIMON FLEXNER.**)

After it had been proved that the heliotropism of animals and plants is identical, it seemed desirable to find means by which positively heliotropic animals could be transformed into negatively heliotropic ones, and vice versa. Groom and Loeb found that such a transformation was possible in the nauplii of *Balanus perforatus* at Naples by the influence of light, inasmuch as these animals were positively heliotropic in very weak light and negatively heliotropic in strong light.[1] Later Loeb found that the marine *Copepods* and young larvas of *Polygordius* became positively heliotropic on lowering the temperature as well as on increasing the concentration of the seawater, while they became negatively heliotropic under the opposite influences.[2] Moreover Loeb observed that negatively heliotropic *Copepods* can be made positively heliotropic by mechanical agitation,[2] and Miss Towle showed that the sign of heliotropism in *Cypridopsis* can be reversed by contact with solid bodies.[3] Holmes made the discovery that the positively heliotropic terrestrial *Amphipods*, e. g., *Orchestia agilis*, become negatively heliotropic when thrown into water.[4]

The author had tried in vain to change the sense of heliotropism in animals by chemical means, and this gap was felt the more keenly, inasmuch as he was led to believe that chemical changes might ultimately determine changes in the sense of heliotropism. Recently, however, the author succeeded in finding instances in which specific chemical substances were capable of transforming the sense of heliotropism in animals.

The experiments were made with a fresh water shrimp (*Gammarus pulex*), which can be obtained at any time in large quantities at Berkeley. If one puts a large number of these animals suddenly into distilled water or into common tap water, they all become at first very negatively heliotropic. It is possible that this is caused by the mechanical agitation, connected with the trans-

[1] Groom and Loeb: *Biologisches Centralblatt*, 1890, p. 160.
[2] Loeb: *Pflüger's Archiv.*, 1893, liv, p. 81.
[3] Towle: *American Journal of Physiology*, 1900, iii, p. 345.
[4] Holmes: *Ibid.*, 1901, v, p. 211.

ferral of the animals from one vessel to another, but this has not yet been ascertained with certainty. Half an hour or an hour later, the negative gathering of the animals becomes less dense, and the animals are scattered in the vessel.

These negatively heliotropic animals can be transformed instantly into positively heliotropic animals by the following substances: (1) many of the anesthetics of the fatty series; (2) many acids, except very weak ones like boric acid; (3) certain salts, like ammonium salts. Alkalis, like NaOH or Ba $(OH)_2$, and neutral salts, like NaCl or $CaCl_2$, bring about a scattering of the negatively heliotropic animals, but do not make these animals instantly and without exception positively heliotropic, as do the anesthetics or the acids.

A few quantitative data may be mentioned here by way of illustration. Ethyl acetate and similar esters instantly make all the shrimps positively heliotropic in a concentration of about $\frac{m}{50}$. Ether is effective at a higher concentration, namely, $\frac{m}{6}$. Ethyl alcohol brings about an equally rapid transformation of the negatively heliotropic animals into positively heliotropic ones in a much higher concentration, namely, $2\frac{1}{2}$ *m* solution. Paraldehyde is active at a concentration of about $\frac{m}{10}$. So far as the acids are concerned, HCl, oxalic acid and acetic acid make the animals instantly and without exception positively heliotropic in a concentration of about $\frac{m}{500}$. In boric acid, the animals remain negative even at a concentration as high as $\frac{m}{10}$. CO_2 acts in the same way and, inasmuch as this substance is produced in the animal itself, and as the amount produced varies under certain conditions, we may now be able to account for apparently "spontaneous" changes in the heliotropic sensitiveness of these and other animals. NH_4Cl instantly makes the negatively heliotropic *Gammarus* positively heliotropic in a concentration of $\frac{m}{25}$. NH_4OH acts similarly in the same concentration. So far as neutral salts are concerned, they usually do not make the negatively heliotropic *Gammarus* positively heliotropic until the concentration is over $\frac{m}{4}$ or $\frac{m}{2}$, and even then, as a rule, no instantaneous and complete gathering of the animals at the positive side of the vessel can be produced, but only a slow and partial gathering.

Since the concentration at which the transformation of nega-

tively heliotropic *Gammarus* into a positively heliotropic animal is produced differs for different substances and inasmuch as the transformation is brought about most promptly by such substances as diffuse most rapidly into the tissues, *we must conclude that we are not dealing here with an osmotic, but with a chemical effect.*

4 (50). **"Trypanosomes and bird malaria": F. G. NOVY** and **W. J. MACNEAL.** (Presented by **GARY N. CALKINS.**)

The studies made heretofore upon the malarial parasites of birds have shown the existence of four species or types. These are:

Proteosoma.

Halteridium.

Hæmamœba majoris, Lav.

Hæmamœba Ziemanni, Lav.

In the course of an extended study of the parasites of birds, the authors encountered several new species, and, since the number is likely to be still further increased, it seemed desirable to attempt a classification. The authors based their classification largely upon the type of multiplication and the habitat of the parasite. Two genera were given; one, *Plasmodium*, characterized by formation of segmenting forms in the peripheral blood and invasion of fully developed red blood cells. The injection of blood having these parasites results in an infection. For the other genus the authors used the priority name of Kruse's, *Hæmoproteus*. This genus is characterized by an entire absence of segmentation-forms in the peripheral blood, and, with the exception of two species which form a transition as it were between the two genera, invasion of young erythroblasts is the rule. Injection of blood having these parasites does not lead to infection.

With this division, the species are arranged as follows:

A. Plasmodium, including parasites of man, some of birds, and very probably some of cold-blooded animals.

1. — *Plasmodium relictum*, syn. *Hæmamœba relicta*, Proteosoma.

2. — *Plasmodium vaughani*, n. sp.

B. Hæmoproteus, including chiefly parasites of birds, and probably offering transitional forms to the hemogregarines of cold-blooded animals.