the cells were alive. The possibility that serum antibodies accumulated on the dead cells and were carried into the final inoculum was ruled out by appropriate tests.

Suspensions of individual, washed cells procured from cultures of Shope tumor tissue, or from rabbit embryo cultures inoculated with vaccinia, were found to carry the virus. When the cells were alive incubation with immune serum had no effect on the associated virus, whereas when they had been killed in one of the ways mentioned the virus was more or less completely neutralized by the serum. In cultures of Shope tumor tissue the virus seems to be strictly localized to the cells.

The experiments would appear to throw light on the process of infection with the viruses studied and they offer an explanation of some of the difficulties of serum treatment. A protection of bacteria by living cells has been demonstrated in a previous paper from this laboratory and its implications have been pointed out.[3] The cells of a chicken sarcoma protect the associated causative agent so well that growths frequently develop when they are transplanted to fowls having immune principles in circulation that are capable of neutralizing the agent as such.[4]

7009 P

Observations on Life History of a Gregarine of the Striped Shore Crab, Pachygrapsus crassipes.*

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The common striped shore crab, *Pachygrapsus crassipes,* of the Pacific Coast is frequently infected by a Cephaline gregarine which inhabits the mid- and hind-gut, the infection rate sometimes running from 70% to 100%. No correlation is apparent between the extent of infection and the locality or ecological habitat of the host, nor does there seem to be seasonal distribution of the infection.

Apparently, the entire life history of this gregarine takes place in

[3] Rous, Peyton, and Jones, F. S., *J. Exp. Med.*, 1916, **23**, 603.

[4] Fischer, A., *Z. Krebsforsch.*, 1927, **14**, 580.

* Aided by a grant from the Board of Research of the University of California.

the lumen of the mid-gut and hind-gut of the host, no intra-cellular stages having been seen. Trophozoites, forms "in copula", encysting stages, and cysts may all be present at the same time in the digestive tract.

The classification of this gregarine depends largely upon the method by which the infection is transmitted from one host to another. In the family Porosporidae, the encysted gregarines are transferred in the form of a multinucleated cyst to a mollusk; this cyst invades the gills and produces infective spores for the crab. On the other hand, there are certain genera, such as *Uradiophora* and *Cephaloidophora* for which no intermediate hosts are necessary.

It is possible to obtain parasite-free crabs in the laboratory by starving and isolating them for 2 weeks. "Clean" crabs so obtained were kept alive in separate aquaria for several months by feeding them on a diet of chopped liver. The intestinal contents of infected animals were then fed to these clean crabs, and the latter were examined at intervals for gregarines. It was possible to transmit the infection from crab to crab; control animals captured at the same time but not fed infected material showed no parasites in their gut. This artificially transmitted infection proved in some cases to be exceptionally heavy. All of the various stages of this parasite could pass through the anterior portion of the digestive tract of the crab unharmed. Infection thus may be transmitted without the intervention of any intermediate host.

Crabs are ordinarily cannibalistic; and infection is probably transmitted from host to host, at least in part, in this way. Crabs kept together in an aquarium and not fed will prey on their weaker fellows. Such crabs retain their infections for considerably longer periods than do similar isolated ones. No infected animals have been found among those forms commonly associated with the crab, such as barnacles or mussels, which might be suspected as serving as possible intermediate hosts. Infection by the discharge of resistant stages into the sea water is uncommon, if it occurs at all normally, since the parasite is rarely found in the posterior part of the hind gut or in the feces of the crab.

The organism resembles most closely forms in the genus *Uradiophora* created by Mercier.[1] However, the incomplete life history and the confused taxonomy of the gregarines parasitizing the Crustacea do not warrant classifying this form at present beyond the Cephalina.

[1] Mercier, L., *Arch. Zool. Exp. et Gen.*, 1912, **10**, 177.

The effect of parasitism on the crab seems to be limited to the destruction of the epithelial and cuticular lining of the gut by the mechanical action of the parasite. The epithelial lining may be thinned out beneath the point of attachment of the parasite, or in other cases may be sloughed off, especially in heavy infections. Since the gregarine does not appear to pierce the cells, it must obtain its food supply from the lumen of the digestive tract. Although an exceedingly heavy infection might destroy sufficient tissue to inconvenience the host, it is doubtful if this would occur normally since, even in severe infections, comparatively few of the host's epithelial cells seem to have been materially injured.

7010 C

Reticulocyte Counts in Bartonella Muris Anemia.

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The striking stimulation of the bone marrow in splenectomized rats suffering with *Bartonella muris* anemia is reflected in the reticulocyte count of the peripheral blood. In the course of extensive studies in this disease[1-7] the appearance of large numbers of reticulocytes during the height of the anemia was noted.* A detailed correlation of the degree of anemia as reflected in the blood count and hemoglobin determination with the reticulocyte count and the appearance of Bartonella bodies has yielded certain interesting observations. For the study and demonstration of reticulocytes in

[1] Marmorston-Gottesman, J., and Perla, D., *J. Exp. Med.*, 1930, **52**, 121.

[2] Perla, D., and Marmorston-Gottesman, J., *J. Exp. Med.*, 1930, **52**, 131.

[3] Perla, D., and Marmorston-Gottesman, J., *J. Exp. Med.*, 1931, **53**, 869.

[4] Marmorston-Gottesman, J., and Perla, D., *J. Exp. Med.*, 1931, **53**, 877.

[5] Perla, D., and Marmorston-Gottesman, J., *J. Exp. Med.*, 1932, **56**, 777.

[6] Perla, D., and Marmorston-Gottesman, J., *J. Exp. Med.*, 1932, **56**, 783.

[7] Sandberg, M., Perla, D., and Marmorston-Gottesman, J., *J. Exp. Med.*, 1933, **57**, 81.

* For a review of *Bartonella muris* anemia see Lauda[8] and the papers of Perla and Marmorston-Gottesman, and the recent review of Kikuth.[9]

[8] Lauda, E., In Kolle, W., and von Wassermann, A., *Handbuch der pathogenen Mikroorganismen*, Jena, Gustav Fischer, 3rd ed. (Kolle, W., Kraus, R., u. Uhlenhuth, P.) 1930, **8**, Liefg, 20, 1073.

[9] Kikuth, W., *Ergebn. d. Hyg. Bakt. Immunitätsforsch. u. exp. Therap.*, 1932, **13**, 559.