material from the second parrot, again filtered, caused the disease and death in a third parrot.

These observations indicate that from the original parrot and also from the human contact we obtained a filtrable virus and that this virus is the primary etiological agent of the disease.

This virus will kill mice whether the material be filtered or not. The virulence for mice does not seem very great, as a few mice survive.

There is an inherent source of error in observations of this character, *viz.*, the danger of "picking up" a virus in the experimental animals used. This possibility has been excluded as far as possible by using parrots from sources free of disease and parrots which had been imported sometime before the appearance of the disease.

As this preliminary note was being prepared a short report in the *Lancet*, February 1, 1930, of the work of Bedson, Western and Simpson came to our attention. They, likewise, believe that they have demonstrated a filtrable virus in parrots. They do not report a similar demonstration in the case of human materials.

We also have caused the death of a parrot with emulsions of the organs of a fatal human case, but filtration experiments on this presumed virus are not completed.

Our observations and those of the English investigators seem for the first time to offer definite indications as to the etiology of the disease psittacosis.

CHARLES KRUMWIEDE
MARY MCGRATH
CAROLYN OLDENBUSCH

BUREAU OF LABORATORIES,
DEPARTMENT OF HEALTH,
NEW YORK CITY

BACTERIUM GRANULOSIS AND TRACHOMA OF AN URBAN WHITE POPULATION

IN a recent issue of SCIENCE[1] a brief note has been published extending the original publication of Noguchi on *Bacterium granulosis* (*nov. spec.*) in relation to the trachoma occurring among the Indians in New Mexico and Arizona. The present report has for its purpose to record the isolation of *Bacterium granulosis* from cases of trachoma occurring in New York City and further experiments on contact infection.

Through the kindness and cooperation of Dr. Martin Cohen, we obtained specimens removed for curative purposes from two patients who had suffered from trachoma two and ten years, respectively. In both patients the pannus and scar-formation, characteristic sequels of the trachomatous disease, were present.

The specimens were employed in the preparation of cultures according to the original Noguchi methods, and from both bacteria were isolated which conformed in all biological properties with *Bacterium granulosis* as obtained from cases of Indian trachoma. Moreover, when the cultures obtained from the New York cases of trachoma were inoculated into monkeys by the Noguchi method, they gave rise in from seven to thirty-three days to the granular conjunctival condition characteristic of experimental trachoma and resembling closely trachoma in man.

Tyler[2] had found that when monkeys in which the the experimental granular, trachomatous lesions are present and normal monkeys with smooth conjunctivae are caged together, the previously healthy animals acquire the experimental disease. Noguchi had previously observed the extension of the lesions from the inoculated to the uninoculated eyes of *Macacus rhesus* and chimpanzees. This presumable contact infection was shown by Tyler's experiments to be possible between inoculated and uninoculated animals.

We have since found that when the secretions from monkeys with the granular lesions are taken on cotton swabs and transferred directly, by rubbing, to the eyes of normal *Macacus rhesus*, the experimental trachomatous disease is promptly produced. In addition, it has been found that when cultures of *Bacterium granulosis* are instilled into the conjunctival sac of normal monkeys and the eyelids gently massaged, infection also occurs and the granular lesions appear quite as early (thirteen days) as after subconjunctical injection.

PETER K. OLITSKY,
JOSEPH R. TYLER

THE LABORATORIES OF THE
ROCKEFELLER INSTITUTE FOR
MEDICAL RESEARCH,
NEW YORK, N. Y.

ACCUMULATION OF GAS IN CLOSED COLLODION SACS IMMERSED IN FLOWING TAP WATER

IN SCIENCE for September 20, 1929, there appeared an article by Stacy R. Guild with the title given above. The essential experimental fact reported is that when a closed collodion sac containing water or an aqueous solution is immersed in running water under some circumstances a bubble of air will be slowly formed within the sac, and grow at a rate proportional to its own surface, while at other times a bubble already present will dwindle away. The experiments suggest

[1] E. B. Tilden and J. R. Tyler, SCIENCE, 71: 186, 1930.

[2] J. R. Tyler, SCIENCE, 70: 612, 1929.

strongly that the controlling factor is the amount of air dissolved in the water; when this amount is known to be large, the bubble grows, and when the water has been degassed before use, the bubble shrinks. Guild appeals to physical chemists to "determine the laws governing this phenomenon and to work out the true explanation of it."

We think that the phenomenon is much less obscure than Guild supposes. In fact, his own experiments are extensive enough to show that there are no very obscure factors operating. It is merely necessary to suppose that a collodion membrane is permeable to air. Tap water is commonly saturated with air at a pressure greater than atmospheric; that is, the partial vapor pressure of the dissolved air is greater than one atmosphere. Then if the membrane is permeable to air (that is, nitrogen, oxygen, etc.) air will pass through until the water on both sides contains air at the same partial pressure. But if this partial pressure is greater than the mechanical pressure on the water, which is, of course, one atmosphere, then the system is unstable, air will be evolved more or less rapidly and a bubble will form. Once the bubble is started, the rate of growth will be proportional to the interface, that is, to the surface of the bubble. When we have the bubble in the sac and flow degassed water past it, the same processes occur in the reverse direction. The water inside the sac is saturated with air at a pressure greater than that outside, so that air is lost to the running water and the bubble shrinks.

P. L. K. GROSS

DEPARTMENT OF CHEMISTRY
POMONA COLLEGE

LOUIS S. KASSEL
National Research Fellow in Chemistry
CALIFORNIA UNIVERSITY

HISTORY OF THE DISCOVERY OF PERIODIC REVERSAL OF HEART-BEAT IN INSECTS

SUPPLEMENTARY NOTE

IN a recent paper[1] I have traced the early history of the discovery of periodic reversal of peristalsis of the heart in Lepidoptera, a phenomenon which accompanies metamorphosis and continues to the end of life, resembling in certain respects a similar phenomenon in ascidians. Periodic reversal in Lepidoptera, discovered by Malpighi in 1669, expressly denied in the first half of the nineteenth century by such excellent observers as Herold (1823) and Verloren (1844), confirmed for the chrysalis (silkworm) by Cornalia (1856), was first adequately described by Bataillon (1893, 1894).

In writing this historical review I was unaware of the second paper on the subject by Bataillon,[2] in which he extended his observations to the adult silkmoth and found, as I have done recently, that periodic reversal in the direction of the heart-beat is not a temporary phenomenon connected with metamorphosis but, in confirmation of Malpighi's observations, is characteristic of the adult moth. I will here briefly summarize and translate Bataillon's later conclusions.

He states that, having regarded the phenomenon as connected with disturbances in nutrition during metamorphosis, he had been skeptical of Malpighi's observations on the adult, especially in view of the fact that they were made on the eviscerated insect under obviously abnormal conditions. Continuing he says:

> If the dorsal integument is carefully shaved and the median line smeared with glycerine to make it more transparent, the heart becomes visible, and its movements can be observed until death. Here, again, in spite of the defects of his technique, Malpighi was right. The circulation takes place sometimes in one direction, sometimes in the other.

On the basis of experiments upon full-grown larvae, he concluded that pupation and periodic reversal of circulation in the dorsal vessel depend upon three factors which presumably reduce internal pressure, *viz.*, elimination of the contents of the intestine, transpiration and spinning.

Of the adult insect he says:

> There are, at first, successive periods of direct or of reversed circulation every one or two minutes; then these periods are longer, especially while the individuals are in copulation. Finally, the contractions of the dorsal vessel succeed each other regularly and alternately, from in front backward and from behind forward, becoming less and less marked at the approach of immobility and death.

Thus he calls attention to the comparatively short periods of forward and backward peristalsis in the young moth, to the longer phases sometimes induced by copulation and to the reduction of the successive alternating phases in old age to single beats, observations similar to those which I have made.[3]

Hypodermic injection of saline solution (seawater) into the blood of the adult moth caused an immediate cessation of reversal; forward beating alone occurred for several hours. The employment of suction, on the other hand, was followed by long periods of backward beating. By the injection of air into the hemolymph, the forward flow of the blood

[1] J. H. Gerould, *Biol. Bull.*, 56 (3): 215–225, 1929.

[2] E. Bataillon, "Nouvelles recherches sur les méchanismes de l'évolution chez le Bombyx mori," *Revue bourguignonne de l'enseignement supérieur*, 4: 1–16, 1894.

[3] J. H. Gerould, "Periodic Reversal of Heart Action in the Silkworm Moth and Pupa," *Jour. Morph. and Physiol.*, 48: 385–430, 1929.