Fifteenth meeting.[1]

[Third annual business meeting.]

Physiological Laboratory of the New York University and Bellevue Hospital Medical College. February 21, 1906. President Wilson in the chair.

21 (113). **"On the intermediary metabolism of lactic acid": A. R. MANDEL and GRAHAM LUSK.**

Administration of phlorhizin to a dog poisoned with phosphorus causes the excretion of dextrose, the mother-substance of lactic acid, and the latter then disappears from the blood and urine. On the other hand *d*-lactic acid (Kahlbaum), when given to a diabetic dog, may be completely converted into dextrose.

22 (114). **"The primary factor in thrombosis after injury to the blood-vessels": LEO LOEB.**

No uniformity of opinion exists in regard to the essential processes leading to thrombosis. According to some authors thrombosis is essentially due to coagulation of plasma or of cells. Others hold that two factors enter: Agglutination and coagulation. Klemensiewicz and Gutschy expressed the opinion that the primary formation of a fibrinous membrane at the place of injury is necessary.

We find the same diversity of views in regard to the so-called first coagulation of arthropod blood, which, as the author has already shown experimentally, is identical with thrombosis in that animal. That no explanation of thrombosis has found general recognition so far is due to the fact that microscopic examinations alone, based on staining reactions, are entirely inadequate for a decision of this question. Almost all previous work rests mainly on morphological investigation.

Sahli's work, however, forms an exception. He found that after injection of leech extract into the circulation of a rabbit, thrombi no longer formed around foreign bodies introduced into the blood-vessels. He concluded quite logically that his results prove the correctness of the view of Hanau and others, namely, that thrombosis is a process of coagulation. The results of his experiments are directly opposed to the fact repeatedly pointed out by the author, viz., that agglutination of blood plates occurs in

[1] *Science*, 1906, xxiii, p. 662; *American Medicine*, 1906, i (N. S.), p. 33.

birds and in mammalian blood outside of the body under conditions that entirely exclude coagulation, as after phosphorus poisoning, also in hirudin blood, and in bird's blood collected according to Delezenne's method.

In order to clear up these discrepancies the author carried out experiments on a relatively large number of animals. In arthropods, and especially in Limulus, he found in various experiments that the collection of blood cells around the foreign body, which leads ultimately to the formation of a hyaline thrombus, was due to a primary process of agglutination and that coagulation processes could be entirely excluded. The same applies to the extravascular coagulation of Limulus blood.

In birds and dogs the blood was made temporarily noncoagulable by injecting hirudin or peptone. In a number of experiments not only was the increase in the coagulation time of the blood in the injected animal observed, but the blood was also tested in regard to its reaction toward the tissue coagulins which accelerate the coagulation of the blood. The blood vessels were injured in different ways and were later examined microscopically. In the large majority of cases serial sections were made of each injured blood-vessel. Seven geese were used for hirudin injections, including the controls; 38 blood-vessels of 19 dogs were examined after hirudin injections (controls included); 25 blood-vessels of 12 dogs were examined after peptone injections (controls included).

The following conclusions may be drawn from the results obtained:

In invertebrates as well as vertebrates an agglutination of blood-cells or of blood-plates may take place around foreign bodies or at the place of injury of the vessel-wall. This agglutination can be present without the occurrence of any simultaneous or previous formation of fibrin. The formation of such agglutination thrombi corresponds to the clumping of the same cellular elements outside of the body, where the agglutination can take place without being accompanied by any coagulative process.

In birds the injection of hirudin does not materially alter the readiness with which a thrombus is formed. In dogs, on the other hand, it is very probable that injections of hirudin delay or may sometimes prevent the formation of agglutination thrombi. The

effect, however, is not directly due to the inhibition of the coagulation of the blood, but probably to changes in the blood which will still have to be determined.

23 (115). **"Granula and ameboid movements in the blood cells of arthropods": LEO LOEB.**

If one observes a drop of blood of Limulus, or of other arthropods, under the microscope immediately after it has left the body, an interesting phenomenon is seen. The large majority of the cell granula become smaller and soon disappear. The cells which were at first oval become round and send out hyalin protoplasm and pseudopodia. Movements of the protoplasm may be observed for a long time, but ultimately they cease, when the cells are spread out entirely and in this condition the cells gradually die.

It has been the author's aim to determine the conditions which inhibit or accelerate this apparently spontaneous dissolution of the cell granula. From the results of these investigations, which cannot be given here in detail, it follows that the fate of the granules of arthropod blood-cells depends upon certain mechanical conditions, and that the apparently spontaneous dissolution of cell granula can to a large degree be inhibited by preventing certain mechanical irritations of the cells. The changes taking place in the granules are very fine indicators of certain mechanical or chemical alterations in the environment of the cells. Such changes are determined by the character of the foreign bodies with which the cells come in contact, lipoid substances being especially favorable for the preservation of the granules. Temperature, osmotic conditions and the reaction of the medium in which the cells are suspended, influence the granules in a definite way. Furthermore, the presence of certain electrolytes is necessary for the preservation of the granules in isotonic, hypotonic, and, with the exception of sugar solutions, also in hypertonic solutions. The cell granules are dissolved in isotonic solutions of non-electrolytes. Different electrolytes exert different, specific influences.

We see, moreover, that certain substances may dissolve cell granules without enabling the protoplasm to carry out ameboid movements, but in the large majority of cases a certain parallelism is observed between the fat contents of the granules and the ameboid