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A Study of Muscle Temperature During Bacterial Chill.

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It still remains the general opinion that heat production in the body depends mainly on the muscles, although it is admitted that a certain amount of heat is liberated by the chemical processes occurring in viscera, especially the liver. In comparison to the amount of heat produced by the muscles it is considered insignificant. Moreover there are different chemical processes that occur in the liver, which actually absorb heat, instead of producing it. In other words, any noticeable increase in the body temperature is attributed to the muscular activity.

Since the production of heat is constantly associated with the activity of the muscles and especially when the muscles are in action, it is also generally accepted that any tremor of muscles is accompanied with heat production. The bacterial chill, in which we have a contraction of muscular fibers and rigor, is accompanied with an elevation of body temperature. This increased heat production is usually attributed to apparent muscular activity. Briefly, to the muscular tremor, whenever it occurs, we ascribe heat production and associate the rise in temperature of the patient with bacterial chill to this cause.

In disagreement with this general opinion Petersen and Müller¹ presented experimental evidence indicating that the chill in the dog produced by continuous injection of colon bacilli is always associated with an increase in the splanchnic activity on the one hand and muscular tremor and leukopenia on the other. But this muscular activity is not accompanied by increased temperature in the muscles themselves.

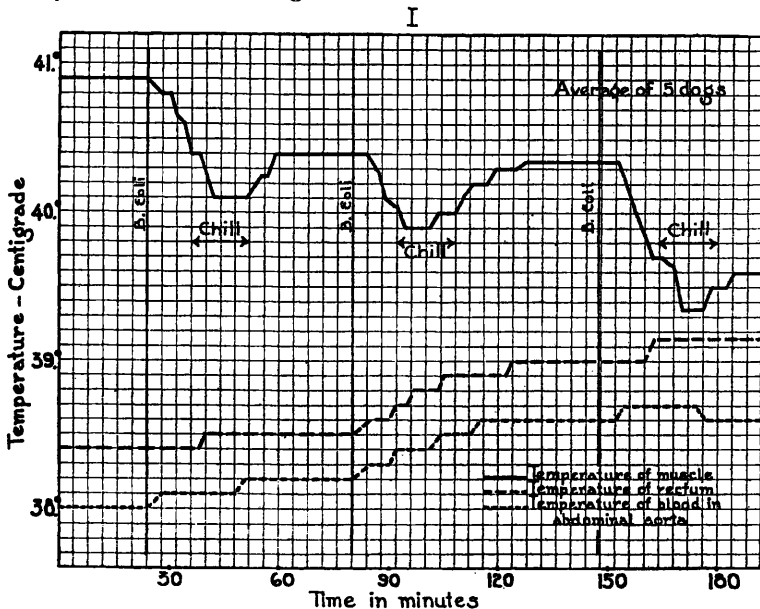
The temperature determinations were made with clinical thermometers inserted into the body cavities and into the skeletal muscles and inasmuch as the temperature changes are presumably of small degree, these determinations might be subject to criticism. They particularly stressed the importance of the splanchno peripheral balance and emphasized the general vasoconstriction of the peripheral tissues as well as the fact that the "muscle tremor" of bacterial chill is to be regarded as an expression of a wholly differ-

¹ Petersen, W. F., and Müller, E. F., *Arch. Int. Med.*, 1927, 40, 575.

ent mechanism than that of normal muscle contraction which is of course associated with prompt vasodilatation.

In our studies of temperature changes on the surfaces of the body, and in the liver and kidney in their relation to heat and cold on the skin we introduced the simultaneous measuring of the temperature in the abdominal aorta which is more or less stable in comparison with the temperature of the body surfaces and viscera and these studies have been extended to a re-investigation of the muscle temperature in bacterial chill using a very sensitive thermocouple for the determination of the muscle temperature.

Our experiments were conducted as follows: Under nembutal anesthesia we gained access to one muscle of the dog's thigh and bloodlessly separated the fibers of it so that 3 thermocouples (devised by Dr. Bachem) could be easily introduced into the muscular tissue. Then the skin was brought together and the thermocouples were fastened with adhesive to the skin in such a manner that they were held firmly in place in the muscle tissue. Heparin was injected intravenously (0.01 per kilo), the femoral artery opened and a long thin glass thermometer introduced through it into the abdominal aorta. An ordinary glass thermometer was introduced into the rectum for about 2 or 3 inches and fastened. A suspension of half an agar slant of *B. coli* in 20 cc. of NaCl solution was injected intravenously at the time through the femoral vein.



The results are shown on the accompanying graph. The abscissa represents the time from the beginning of the experiment, the ordinates, temperature in centigrade. The straight lines represent the temperature of the muscle, the dotted line temperature of the blood in the abdominal aorta and the broken line temperature in the rectum. The perpendicular lines show the time of injection of the bacterial suspensions.

Graph represents an average of the results of experiments on 5 dogs. The temperature in the abdominal aorta and in the rectum gradually rises, while the muscle temperature falls after each injection of *B. coli* suspension.

The results, as observed in our experiments, substantiate the findings of Petersen and Müller.¹ During the visible bacterial chill there is a rise in the body temperature, as shown by temperature recordings in the abdominal aorta and rectum, but this temperature is not generated in the muscles. On the contrary, the muscular temperature falls. Of course, with time the muscle temperature rises after the readjustment of the splanchno peripheral balance, but at least not in the beginning of a visible chill.

The muscular tremor which was observed during the bacterial chill is not accompanied with an increase of the temperature in the skeletal muscles, so this muscular activity is of a different type than the one we have in ordinary muscular work, which is accompanied by production of heat.

7646 P

Temperature Changes in Gastrointestinal Tract in Relation to Heat and Cold on Skin.

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For our temperature readings of a mucous membrane of gastrointestinal tract we used a Queen's potentiometer.

Ten dogs were used. Under nembutal anesthesia, the abdomen was opened and an opening in the stomach or intestine was made. For measurements of temperature of mucous membrane of the stomach the ends of 3 thermocouples (devised by Bachem), covered