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A Chemical Factor in the Causation of Tingling Sensations During and after Release of Stasis.

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At the XIIIth International Physiological Congress¹ a report was made of experiments on the effect of temperature on sensations caused by stasis and its release. Attention was directed entirely to sensations of temperature, but observations had also been made on tingling sensations, and the effects observed have been discussed with many workers. Since the detailed report of these experiments has been delayed in publication, it is desirable that a brief summary of the observations be communicated at this time.

Stasis was produced by a Riva Rocci armlet above the elbow, or by a similar compressing band at the base of one finger. The tissues submitted to stasis were cooled and warmed before, during, and after compression by immersion in rapidly stirred water at a constant temperature to allow thermal equilibrium to be attained. Immersion was continued for at least 20 minutes prior to induction of stasis.

The temperature of the peripheral part of the arm was found to modify profoundly the development of tingling sensations. Stasis to the arm for 5 minutes immersed in water at 24° gave practically no tingling sensation, but, if the forearm was immersed in water at 39°, tingling sensations were intense with the same duration of stasis. At still higher temperatures the tingling developed more rapidly, and very early became altered into a more intense, more continuous, less bearable sensation of somewhat different type. The subject interpreted the sensation as having an element of internal tension. Such sensations have been previously explained as due to pressure on the nerve trunks, but in our experiments no considerable alterations in the condition of these nerves above the water level can be assumed. The causation of the sensations must be peripheral.

During stasis tingling, once developed, remained in evidence but might fluctuate in intensity. On release of stasis it immediately disappeared but returned $\frac{1}{2}$ to 1 minute later in a much more intense form. After prolonged stasis the tingling might last many minutes. The tingling both during stasis and on release was much

¹ *Am. J. Physiol.*, 1929, **90**, 278.

more in evidence the longer the period of stasis, and the higher the temperature of the peripheral surface. Short periods of stasis ($2\frac{1}{2}$ to 5 minutes) gave no tingling at the lower, but intense sensations at the higher temperatures.

Stasis of the finger alone even at the higher temperatures (*e. g.*, 39° for 5 minutes) gave only very slight tingling during stasis and on release, while if the compression was applied to the arm, the fingers appeared to share in the tingling sensations. In the fingers the nerve trunks must be peculiarly exposed to mechanical effects of pressure, and in this locality the changes in temperature also involved these nerve trunks.

It may, therefore, be concluded that the sensations of tingling are induced, directly or indirectly, by some chemical factor, the rate of formation of which varies with the temperature of the tissues. This factor presumably is formed more rapidly in the muscles, since stasis involving muscular regions is much more effective than stasis of the finger, which contains only smooth muscle.

A chemical factor seems the most legitimate hypothesis, but it might act indirectly through inducing osmotic changes.

It should be noted that the tingling was not investigated in detail, since the primary object of the experiments was to study temperature sensations and to arrange the experiments in such a way that tingling did not offer too great a complication.

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Carotid Sinus Reflexes to the Respiratory Center.

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According to Heymans¹ and Koch,^{2, 3} changes in pressure within the carotid sinuses set up reflexes which have a powerful influence upon the respiratory center. Their observations are fully confirmed by the results of perfusion of the carotid sinuses of 15 dogs, 5 rabbits, and 4 cats, with Locke's solution or with blood from a donor animal, by means of a pump. Heymans'¹ conclusion, that

¹ Heymans, C., and Bouckaert, J. J., *J. Physiol.*, 1930, **69**, 254.

² Koch, E., *Die reflektorische Selbststeuerung des Kreislaufes*. Dresden, 1931, 168.

³ Koch, E., and Mark, R. E., *Z. f. Kreislaufforsch.*, 1931, **23**, 319.