29 (1776)

On the relation of blood-volume to the nutrition of the tissues. IV. The effects of hemorrhage and subsequent injection of gum-saline on total oxygen consumption.

By ROBERT GESELL, CHARLES S. CAPP and FREDERICK S. FOOTE.

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The effects of progressive hemorrhage were studied on the dog under morphine-urethane anesthesia. We found that the greater the hemorrhage the greater the reduction in the amount of oxygen consumed and that a hemorrhage amounting to 1/2 per cent. of the body weight may elicit a decided reduction. Subsequent injection of gum-saline, bringing the blood volume back to normal, increased the amount of oxygen consumed. The amount of oxygen consumed immediately after an injection was greater than the consumption a few minutes later. We believe this, along with the decreased amount of oxygen consumed, points to an oxygen hunger during a period of decreased blood-volume. The results here reported are in agreement with those recently published by Doi.[1]

30 (1777)

A comparison of the waves of blood pressure produced by slow and by rapid breathing.

By ROBERT TROTTER, PHILIP EDSON and ROBERT GESELL.

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The effects of rapid breathing were compared with those of more normal breathing upon the systolic blood pressure in man. Supplementary data were also obtained on the dog and cat.

For the well-known changes of blood pressure that occur during a single respiration, and which are more or less synchronous with the changing respiratory phases, we have proposed the name of simple cardio-respiratory waves to distinguish them from those waves produced by rapid breathing.

[1] Doi, Y., *Journal of Physiology*, 1921, lv, 249.

The oscillations of pressure elicited during rapid breathing by the interference method we have designated as cardio-respiratory interference waves.

The most striking difference in the respiratory relations of the simple and interference waves is that in the simple waves the blood pressure changes are complete within the period of a *single* respiration, while in the interference waves the gamut of the blood pressure changes is run through in the interval of *several* respirations.

The production of interference waves of blood pressure is dependent upon the establishment of cardio-respiratory cycles in which the number of respirations is greater by one or lesser by one than the number of heart beats making up the waves and occurring in the same time interval.

When these conditions are fulfilled we may conceive of the heart beats as moving through respiration, the direction of the movement being determined by the relative rates of the heart and respiration, that is, whether the respiratory rate is slower or faster than the heart rate. A cardio-respiratory cycle is complete when two beats (the first and last of the interference wave) fall at approximately the same time in respiration.

Whereas in the simple respiratory waves we found the highest pressure to be associated with approximately the beginning of inspiration, in the cardio-respiratory interference waves we found the highest pressure to obtain at approximately the beginning of expiration.

Without definitely assigning the responsibility for the production of interference waves to any particular respiratory factor, we are inclined to favor the hypothesis that they are primarily due to the changing intra-thoracic pressure accompanying respiration.

It is possible by breathing slightly slower or slightly faster than half the heart rate to produce double interference waves of blood pressure, that is, under these conditions, two waves of blood pressure may be in progress simultaneously. Each of the double waves is formed by alternate heart beats, one being made up of the even numbered and the other of the odd numbered beats. Double cardio-respiratory interference waves are to be explained in the same manner as the single waves.

The results of these experiments on the dog and cat are in agreement with those obtained in man.

Cardio-respiratory interference waves particularly of the double type with alternating beats occur simultaneously in sacrifice experiments in dogs and cats. We therefore point to our work as occasionally explaining pulsus-alternans and blood pressure waves of the third order.

ABSTRACTS OF THE COMMUNICATIONS, MINNESOTA BRANCH.

First meeting.

Minneapolis, Minnesota, October 12, 1921.

31 (1778)

Experimental rickets.

By **J. F. McCLENDON** and **HARRY BAUGUESS** (by invitation).

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In a large number of experiments on feeding albino rats in which white wheat flour was used as the main part of the ration, bone abnormalities were absent or transitory. Since Sherman showed that rickets could be inhibited by simply adding phosphate to the diet we concluded that the normal condition of the bones of our rats was due to the phosphoric acid content of the casein used in the diet. After substituting casein by lactalbumin or edestin, bone abnormalities appeared in one hundred per cent. of our rats. If casein was fed to the extent of 6 per cent. of the ration bone abnormalities were reduced and apparently the disturbance was transitory, since the bones became hard and cast dense shadows with the x-rays without changing the diet, yet some of the deformities were preserved. With a basic ration of white flour containing 6 per cent. sea salt, the addition of edestin or lactalbumin to improve the protein did not in any way decrease the abnormalities. The edestin carries vitamine B and if wheat germ extract is added to the lactalbumin in order to furnish vitamine B, the abnormalities still persist. The addition of spinach up to 5 per cent. of the ration did not decrease the ab-