Physiology. — *"Veratrine contraction of the frog's heart."* By ARIE QUERIDO. (Communicated by Prof. G. VAN RIJNBERK.)

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The function of the heart of a cold- or warm-blooded animal will be changed profoundly when the animal has been poisoned by veratrine.

Those changes have a twofold character: the rhythm of the pulsations is affected — it becomes irregular, more frequent at first, to slow down afterwards, and the coordination between the subdivisions of the heart is impaired — as the poisoning progresses, a partial heartblock becomes more and more apparent.

The activity of the heart muscle as indicated by the shape of each contraction is influenced only quantitatively, in accordance to the changes of the rhythm in wich the pulsations follow each other; the character of each contraction however is similar to that of the non-poisoned organ, contrary to the conduct of the skeletal muscle after poisoning. When we bear in mind that a poisoned skeletal muscle which is stimulated at a sufficient rapid rate will yield contractions that are identical to normal twitches, and that the heart muscle is under analogous conditions as a frequently stimulated skeletal muscle, it is clear that we cannot expect a functioning heart to yield veratrine contractions.

In order to obtain this result it will be necessary to suspend for a period the normal activity of the heart.

The faradisation of the Nervus Vagus seems to be the simplest way to reach this. BUSQUET and PACHON [1]) have demonstrated that veratrine poisoning of an animal results in loss of influence of the Vagus on the activity of the heart.

This is true only, if veratrine be applied on the heart in a concentration higher than 1 : 100.000. If more diluted solutions are used the heart will still stop on vagal stimulation, at least in the first minutes following the application of the drug. I have studied the nature of the reaction on an extra stimulus, when the heart has been poisoned previously by a slight dose of veratrine and has been stopped by faradisation of the N. Vagus.

Method. The brain of a large-sized frog is destroyed by a needle introduced in the median line behind the acustic membranes. The animal is pinned on the back, and the heart is exposed by removing a part of the sternum and opening the pericard. I connect the apex of the ventricle with

[1]) Comptes-rendus Soc, Biol. 1906, LXI, 89.
Ibid. 1907, LXII, 943.

a light writing lever, and at one side (which is irrelevant) I expose the N. Vagus by means of a partial resection of the lower jaw; the nerve is cut, and its peripheral end is placed on a pair of stimulating electrodes, connected with the secundary of an induction coil. After ascertaining that faradisation of the Vagus causes the heart to stop, I inject into the peritoneal cavity 1 cc. of a veratrine solution 1 : 10.000. While the movements of the heart are being registrated on the smoked drum, faradic stimuli are applied on the N. Vagus; the heart stops; after a few seconds, I touch the ventricle lightly with a glass rod which is drawn out into a fine point. Faradisation of the Vagus is continued until the contraction set up by the contact has come to end.

Fig. 1 shows the result of such an experiment; the last contraction of

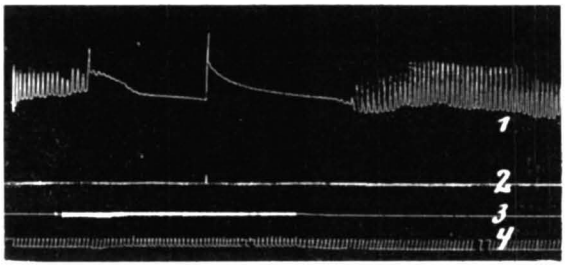

Fig. 1.
1. Suspension curve from ventricle. 2. Signal for mechanic stimulation.
3. Signal for vagal stimulation. 4. Time, 1 sec.

the heart before it responds to vagal stimulation and stops, shows already a peculiar lengthening; on mechanical stimulation a contraction is elicited that is undoubtedly of the veratrine type, viz. reaches a greater height than the other contractions, that is considerably prolonged, and that shows two consecutive shortenings of the muscle, the second one being the slower. When faradisation of the Vagus ceases, the heart resumes its former activity.

In those experiments we meet the difficulty that the heart sometimes „escapes" the influence of the Vagus, and contracts once or twice during the vagal stimulation; this is seen repeatedly in non-poisoned preparations, but after veratrine poisoning this tendency to escape becomes much stronger. Sometimes it appears to be impossible to force the heart to rest long enough to obtain a veratrine contraction on mechanic stimulation. The contractions may have a somewhat longer duration and may be slightly larger than their predecessors, but the differences are not clear enough. Therefore I used also another method to obtain veratrine contractions from the heart after a period of artificial rest.

A frog's heart is removed from the body and is pinned on a cork by the vessels that arise from it.

The apex of the ventricle is connected with a lever. Now I perform

the so-called first ligature of STANNIUS, viz. with a silk thread the Sinus venosus is separated from the rest of the heart. This causes the heart to stop. After waiting a couple of minutes — not too long, since the heart will resume its activity after a certain interval, and the duration of this interval varies widely in the experiments — a few drops of a veratrine solution 1 : 10.000 are trickled on the heart; 2—3 minutes afterwards the heart is touched by the glass rod.

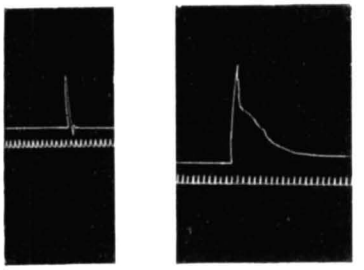

Fig. 2.

Fig. 2 shows the outcome of such an experiment; two contractions are represented, yielded by the heart after the STANNIUS ligature on mechanic stimulation, the first before, the second after veratrine poisoning. It is clear that the second curve is identical with the shortening curve of a skeletal muscle after veratrine poisoning.

The first series of experiments was repeated 18 times, the second series 26 times; the results were similar in all single cases.

When a contraction was elicited after stopping the heart and applying veratrine, this contraction always showed the shape that is characteristic for the shortening curve of veratrine-poisonend skeletal muscle.

In the cases in which stoppage of the heart was obtained by stimulating the Vagus, I have not investigated the shape of a contraction on mechanic stimulation before veratrine was applied; but in the second series of experiments this control was taken regularly, and the difference in shape of contraction curve before and after poisoning could be demonstrated in each experiment.

Conclusion. When the rhythmic activity of the frog's heart is suppressed, either by stimulating the N. Vagus or by the first ligature of STANNIUS, and the heart is poisoned by veratrine, the ventricle will give a contraction on mechanic stimulation that is identical to the contraction of a skeletal muscle after veratrine poisoning.