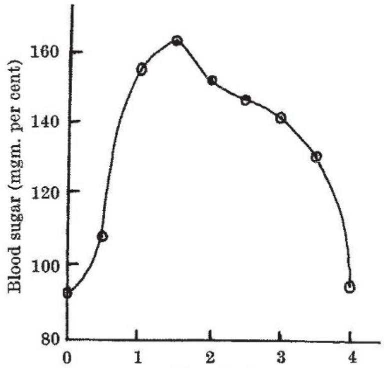

Fig. 1. Changes in blood-sugar level caused by injection of sub-lethal dose of bee venom

The fall in liver glycogen produced by 5 mgm. bee venom is illustrated for two groups of experiments. For each group five rabbits were used, one as a control, and the other four were killed 1, 2, 3 and 4 hr. after the injection and the liver removed.

Table 1. EFFECT OF SUBLETHAL DOSE

Time after injection (hr.)	Control	Liver glycogen (mgm./100 gm.) (mean value)	
		Experiment 1	Experiment 2
0	164·66	166·33	159·66
1	164	153·66	143·33
2	162	131	121·33
3	164	129·66	119
4	159	119·66	118

Since the maximal fall in liver glycogen occurred during the second hour, mobilization of liver glycogen may fully account for the hyperglycæmia, which was maximal 1½ hr. after the injection. The effect may be a direct action of bee venom on the liver, or brought about indirectly by the release of adrenaline from the suprarenals, since Feldberg[4] has shown that bee venom as well as cobra venom injected into the cœliac artery of the cat produced a sustained release of adrenaline from the suprarenals.

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Action of the Hypothalamus

EXPERIMENTS with an analogue model of the heart, demonstrated by me[1], show that a pulse may arise, in a fluid-filled elastic system, in either of two ways: in the first, energy is cycled into the system from a mechanical source, corresponding to the physico-chemical contraction of the ventricles ; in the second, pulsation can be derived from the static head of pressure with the aid of a length of elastic tubing arranged as a wave guide. The latter device, termed an 'oscillator', may be employed to time delivery of energy from the external source, in such a manner that the system is self-oscillating and that the two pulses, of differing origin, are synchronous.

In lesions of the conducting system of the heart, the coronary arterial system behaves, apparently, as an oscillator that utilizes the static head of pressure of the blood to develop a pulse. The same phenomenon is likely to occur at the circulus arteriosus, under normal conditions, however, due to the negative pressure in the internal jugular vein.

Examination of this possibility has led to the following explanation of the action of the hypothalamus :

Independently of the pulse from the heart, a vascular pulse originates in the perforating branches of the circulus arteriosus and is conveyed to the nerve cells in the nuclei of the hypothalamus. Provided the leading edge of the wave is sufficiently steep, the cells are excited to generate electrical impulses, which are utilized by the brain as timing signals.

There are at least two types of excitation. One, in the anterior hypothalamus, is associated with a positive temperature coefficient of frequency: a second, in the posterior hypothalamus, with a negative temperature coefficient of frequency. A third type of excitation probably occurs in the intermediate group of nuclei, with frequency unrelated to temperature. Similar physical relationships are found in connexion with the vibration of piezo-electric crystals, where the direction of the slice, with relation to the axes of the crystal, determines the sign of the temperature coefficient of frequency.

The importance of the structures around the circulus arteriosus suggests that the latter is the most important site in the body at which self-oscillation occurs. The major function of the sinus caroticus is, presumably, that of monitoring the diastolic blood pressure, to ensure stable operating conditions for the circulus arteriosus. Slight variations of frequency will result from changes of venous pressure in the thorax, due to respiration. This effect can be displayed on the model.

To prevent interference between the waves produced by the heart and those generated at the circulus arteriosus, it is essential that there be a co-ordinating mechanism. On one hand it is well known that signals—or nerve impulses—travel from the hypothalamus to the heart by way of the autonomic nervous system. On the other, it would appear that the signals from the heart to the hypothalamus are actually the heart sounds, conducted by the bones of the thorax and vertebral column to the region of the hypophyseal fossa, where they exert a 'pulsactor effect', of which the significance is explained elsewhere[2], on the surrounding vascular structures.

Examples of systems in which two synchronizing signals require co-ordination are to be found in radar. In one example, the transmitter takes signals from the master timing signal generator and, in addition, synchronizing signals from the indicator of the receiver : the more stable system determines the frequency. Applying the analogy to the human body, the hypothalamus is identified as the master timing signal generator.

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