cap cells. If the inclusions are tyloses they should be surrounded by cell walls of their own. The presence of a cell wall is still under investigation; but as soon as this has been decided, further data, including other abnormal features in these roots, will be published.

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Liberation of *nor*Adrenaline from Adrenal Medulla by Splanchnic Stimulation

THE active principle of the suprarenal medulla is commonly believed to be adrenaline. Holton[1] has recently shown, in this laboratory, that tumours of the medulla contain the non-methylated primary amine *nor*adrenaline in greater amount than adrenaline.

We have examined extracts of the suprarenal glands of dogs by determining the power of the extract to inhibit (*a*) the isolated rabbit intestine, and (*b*) the isolated rat uterus when stimulated by acetylcholine. The former test measures adrenaline plus *nor*adrenaline, the latter measures adrenaline only. We found that of five glands, two contained adrenaline only, while the active material in the other three was a mixture containing 14, 28 and 52 per cent *nor*adrenaline.

To find if *nor*adrenaline is actually liberated when the splanchnic nerve is stimulated, we have examined the effect of stimulating the splanchnic nerve in the cat. The experiments were carried out in spinal cats from which the viscera were removed and the kidneys excluded from the circulation. In these circumstances, splanchnic stimulation sent impulses to the suprarenal medulla only.

To distinguish between adrenaline and *nor*adrenaline, we used, in each experiment, the nictitating membranes of the same cat, one of which had been denervated not less than eight days previously by extirpation of the superior cervical ganglion. When an injection of adrenaline was made, the denervated membrane usually contracted more than the normal membrane, the mean value for the ratio of the size of the contractions being 1·6. When an injection of *nor*adrenaline was made, the ratio was, however, much greater, the mean value being 9·1. The ratios remained very nearly the same in any one experiment. When the splanchnic nerve was stimulated, the nictitating membranes contracted, and the ratio of the contractions indicated that the stimulation liberated a mixture of adrenaline and *nor*adrenaline. We were able to match the effect of splanchnic stimulation by the intravenous infusion of an equipressor mixture of adrenaline and *nor*adrenaline, and found that in different experiments the proportion of *nor*adrenaline varied from 20 (or less) to 80 per cent of the total active material secreted.

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Central and Peripheral Mechanisms in the Increase of Metabolic Rate; Mode of Action of Thyroxine

IT is sometimes difficult to decide whether an increase in metabolism is due to stimulation of the hypothalamic centres or to direct action on tissue respiration. Neither transection of the cervical spinal cord nor administration of barbiturates furnishes convincing evidence[1,2]. The former does not interfere with the nerve supply of the muscles of the head and the neck, nor with the connexions of the abdominal organs with the central nervous system through the vagi. Barbiturates may directly depress tissue respiration.

Morphine-scopolamine narcosis gives a more definite answer. This combination acts preferentially upon the hypothalamic centres without influencing tissue respiration. It does not decrease the basal metabolic rate of rabbits, nor does it affect the increase in the metabolic rate brought about by adrenaline or 2,4-dinitrophenol, the action of which is known to be peripheral[3,4]. On the other hand, it restores to normal values metabolic rates which have been increased by some central mechanism, as in the case of cooling the animal or administration of β-phenyl*iso*propylamine ('Benzedrine', 'Amphetamine').

If thyroxine is used to increase by 50 per cent the metabolic rate of rabbits, morphine-scopolamine has a depressing effect, although the rate cannot be restored to the normal value. Thus we conclude that, in the thyroxine effect on rabbits, a central as well as a peripheral mechanism is involved.

In birds, red blood-cells can be used for distinguishing between central and peripheral action upon metabolism. If the metabolism of ducks is raised by means of some action depending upon a central mechanism, such as cooling or subcutaneous administration of β-phenyl*iso*propylamine, there is no change in the oxygen consumption of these cells, which have no connexion with the nervous system, as measured on a suspension in the Warburg apparatus. On the other hand, adrenaline or dinitrophenol, administered subcutaneously, increases the *in vitro* respiration of the red cells. If we add blood plasma of an animal thus treated to a normal suspension of red cells, an increase in oxygen consumption of these cells ensues.

It has been found that after administration of thyroxine for four days, the respiration of the blood cells has increased to the same extent as the metabolic rate of the whole animal. Both effects fall off together. Blood plasma of a thyroxine-treated animal is unable to raise the oxygen consumption of a normal red blood-cell suspension. This may be explained by assuming that it takes some time for the thyroxine molecule to be built into the enzyme system of the cell. It is concluded that the metabolism-stimulating action of thyroxine in birds is entirely peripheral.

Detailed accounts of these investigations will appear elsewhere.

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