have been rendered relatively impermeable to urea, and the kidneys have acquired the capacity to conserve this substance so that it accumulates in the blood (to the extent of 2 to 2.5 per cent) until the osmotic pressure of the latter is significantly greater than the *milieu extérieur;* in consequence of this osmotic relationship water is absorbed directly, probably by the gills, and made available for the excretion of salts and metabolic waste products in the urine. This active renal conservation of urea is apparently effected by the reabsorption of urea by the renal tubules from the glomerular filtrate.

The observations of Marshall and Grafflin, that glucose can not be excreted by the aglomerular fish kidney, suggested that non-metabolized sugars might be used to evaluate the quantity of glomerular filtrate in fishes and higher animals. For this purpose, we have chosen the pentose, xylose, the excretion of which has been extensively examined in the dog by Jolliffe, Shannon and Smith. Measurements made upon dog-fish, *Squalus acanthias,* show that from 90 to 98 per cent of the urea which must be passed into the glomerular filtrate is normally reabsorbed by the renal tubules; this fraction is greatly reduced by diuresis and by phlorizin. Thiourea, a substance closely resembling urea in physical properties, but differing from it in chemical properties and especially by the fact that it is not decomposed by urease, is almost completely rejected by the dog-fish kidney. Thus the reabsorption of urea is a highly specific process.

By comparisons with xylose it is found that PO_4, Mg and administered creatinine are copiously secreted by the dog-fish kidney in addition to the moiety of these substances which is excreted by simple filtration. The secretion of creatinine and to a lesser extent the secretion of PO_4 and possibly SO_4 are apparently depressed by phlorizin —a result to be anticipated in view of the remarkable action which this drug exerts in depressing the reabsorption of glucose in the renal tubules. In view of this depressing action it is believed that the kidney of a phlorizinized animal is unsuitable for physiological investigations.

The observation of Buijtendijk that medullary *piqure* induces diuresis and the copious excretion of urea in elasmobranchs was not confirmed.

Observations on the Mg and SO_4 content of the urine of the sculpin indicate that the diuresis induced by trauma, etc., (as reported by Grafflin) is in part attributable to an increased tubular excretion of Mg and SO_4. Further studies on the blood flow and glomerular filtrate during this condition are contemplated.

REFLEX CARDIAC INHIBITION OF BRANCHIO-VASCULAR ORIGIN IN THE ELASMOBRANCH, SQUALUS ACANTHIAS

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Receptors which are especially important in regulating the circulation appear to be located in the vascular organs of elasmobranchs

(Lutz, 1930) and mammals (Eyster and Hooker, 1908; Anrep and Segall, 1926). Recently the carotid sinus of mammals has been shown to be an important region, reflexly controlling the heart rate and vasomotor tonus (Heymans, 1929). The physiological stimulus is apparently an alteration of pressure within this vessel. The present work is concerned with an attempt to ascertain whether similar alterations of pressure within the gill vessels of elasmobranchs are effective cardio-inhibitory stimuli.

The dofish, *Squalus acanthias,* was used. The ventral aorta was exposed and ligated between its first and second branches. Changes of pressure in the first branches and their derivatives were effected through a cannula inserted in the ventral aorta anterior to the ligature, and connected with a burette filled with a physiological (urea-saline) solution. The heart beat was recorded on a smoked drum by means of a lever, or a mercury manometer recording ventral aortic blood pressure.

Cardiac inhibition was obtained when the first ventral aortic branches, and thus the gill vessels arising from them, were suddenly subjected to increases of internal pressure applied by opening the connection between the cannula and the burette. A sudden increase of pressure averaging 10.7 mm. Hg above the average systolic pressure existing in the dorsal aorta was found to constitute an adequate stimulus for cardiac inhibition, and in one instance a difference as low as 3 mm. Hg produced the response. When fresh dogfish blood was used in the burette in place of the urea-saline solution a similar inhibitory response to increased pressure in the gill vessels was obtained. The effective stimulus is the initial increase of pressure *per se* and not flow of fluid through the gill vessels, because the inhibition was obtained when the burette was opened and immediately closed, allowing only 0.2 cc. of fluid to enter. Furthermore, holding the burette open until 5 cc. of fluid had entered did not increase or continue the initial inhibition. Moreover, when the gill capillaries were blocked by starch so that a vascular pocket was made on the afferent side against which pressure could be applied without passage of fluid the cardio-inhibitory response was also obtained.

The cardiac inhibition following increase of pressure within the gill vessels is a reflex response inasmuch as it disappeared when the brain was pithed. The efferent pathways for this reflex are in the vagus supply to the heart since cutting these on both sides abolished the response. The pathways for this reflex are crossed as well as unilateral since pressure stimulation of the gill vessels on the same side on which the vagus supply to the heart had been cut produced the response when the vagus on the opposite side was intact. The afferent pathways are in the branchial nerves inasmuch as cutting these nerves on one side prevented the elicitation of the reflex from the gill vessels on the same side.

The average ventral aortic systolic blood pressure in *Squalus acanthias* was found to be 28.2 mm. Hg, the average dorsal aortic systolic pressure 15.4 mm. Hg, and the average ventral aortic pulse pressure 13.3 mm. Hg. The ventricular beat as a factor in maintaining blood pressure is obviously important. The cardio-inhibitory reflex can be elicited by an increase in gill blood pressure well within physiological limits, and may temporarily decrease the diastolic blood pressure to a significant degree. Such a mechanism might come into play during an ejection reflex when the accompanying rise in ventral aortic blood pressure might cause injury to the thin walled afferent system. Changes in blood pressure which gave evidence of the operation of this reflex were seen during spontaneous ejection reflexes. This mechanism, therefore, being of physiological significance, may be compared with the carotid sinus mechanism in mammals. It is conceivable that in the course of evolution the widespread sensitive areas of the ancestral form, possibly typified by the elasmobranch, were concentrated or delimited until the condition seen in the mammal was reached. The carotid arteries of the mammal are derivatives of the primitive branchial system. The cardio-inhibitory reflex following increase of pressure within the gill vessels in elasmobranchs may exemplify, therefore, the evolutionary forerunner of the carotid sinus mechanism of mammals as it existed in whatever may have been the ancestral form. This is one of the many instances in which it is apparent that physiological as well as morphological factors should be considered in phylogenetic speculation.

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THE EFFECT OF ADRENALIN ON THE BLOOD PRESSURE OF SQUALUS ACANTHIAS

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The distribution and relative preponderance of the components of the autonomic nervous system and the effects of adrenalin on the heart and digestive tract in elasmobranch fishes differs considerably from the same factors in mammals, as pointed out by Lutz (1930, 1931). The well-developed chromaphil system seen in elasmobranchs (Lutz and Wyman, 1927) leads one to believe that it must be of functional significance. The well known effect of adrenalin on the blood pressure of mammals, an effect which is relatively brief and readily duplicated by successive doses, appears to differ from its effect on the blood pressure of cold blooded animals (Bieter and Scott, 1929). Following are the results of a preliminary investigation of the effects of adrenalin on the vascular system of the elasmobranch.