

by phosphorus compounds in nerve, muscle, and bone physiology. Several investigators did not note these great quantities of urinary organic phosphorus. However, their studies did not include many pathological conditions. A more extended search was, therefore, made to find instances of such an abnormal state.

The organic phosphorus was separated from the inorganic by treating the urine with Mathison's¹ magnesium citrate mixture. The filtrate was tested for complete precipitation by Scott's² reagent and an aliquot digested with sulphuric and nitric acids. The digest was neutralized and prepared for colorimetric readings according to Benedict and Theis. It was unnecessary for the subjects of study to be placed on a specific dietary regimen since it has been found that ingestion of various kinds of organic phosphorus compounds does not increase the organic phosphorus excretion.

The following diseases were included in this study: hyperparathyroidism, hypoparathyroidism, hyperthyroidism, diabetes insipidus, diabetes mellitus, chronic arthritis, Paget's disease, amyotrophic lateral sclerosis, syphilis of central nervous system, tuberculous meningitis, epidemic encephalitis, cardiac decompensation, lobar pneumonia, pulmonary emphysema, psoriasis, dermatitis herpetiformis, obstructive jaundice, carcinomatosis, and Hodgkin's disease. The effects of general anaesthesia and the febrile reactions following intravenous typhoid vaccine were also included. The amount of organic phosphorus excreted in the urine was invariably quite small. The average was 13.4 mg. in 24 hours; the maximum 49 mg.

5679

**Increase in Cholesterol Content of Gallbladder Bile Following
Ligature of Cystic Duct.**

ROBERT ELMAN AND J. B. TAUSSIG. (Introduced by Evarts A. Graham.)

From the Department of Surgery, Washington University Medical School.

The action of the gallbladder wall on the cholesterol content of the bile within its lumen has long been the subject of much dispute. To study this problem experimentally a number of different procedures were carried out. One of these consisted in ligating the cystic duct,

¹ Mathison, G. C., *Biochem. J.*, 1909, **4**, 233.

² Scott, F. H., *J. Physiol.*, 1906-97, **25**, 119.

aspirating a sample of the gallbladder contents and comparing its composition with that obtained several days afterwards. As such a puncture tends to leak it is necessary to tie a ligature around it, which usually causes a more or less severe inflammatory reaction. To obviate the effects of the ligature on the wall of the organ, at the suggestion of Dr. W. H. Cole, gallbladder contents were obtained by puncturing the posterior wall of the viscus, introducing the needle through the liver parenchyma, thus doing away with the necessity of tying a ligature. In some experiments we incised the cystic duct, aspirated through this opening and ligated on either side. In other experiments only a few cc. were removed and the correction due to change in volume by concentration (through absorption of water) or dilution (through the secretion of mucus) taken into account by measuring the bilirubin of the bile each time. In only one case out of seven was there evidence of absorption of cholesterol by the gallbladder. In this experiment there was an increase in the cholesterol concentration of 93% during 2 days but since the bilirubin concentration increased 107% it is obvious that a small amount of cholesterol had disappeared and presumably had been absorbed. This difference is slight and may even be within the range of experimental error. In the other 6 experiments there was a much more marked increase in cholesterol concentration than in the bilirubin. In 3 of them this increase was found in spite of a decrease in the concentration of bilirubin, this decrease being presumably due to dilution from the secretion of mucus. In dog 166 at autopsy nearly all the bile had been absorbed, including the bile pigments, yet there was an abundance of cholesterol crystals found in the shrunken lumen of the gallbladder.

In 3 other dogs the entire content of the gallbladder was removed and a measured amount of bile reintroduced, keeping a sufficient sample for analysis. This obviated the necessity of bilirubin determinations since the cholesterol content and volume of the bile reintroduced was known. In each case a definite increase, *i. e.*, 18, 49, and 300% in the total amount of cholesterol in the bile during its sojourn (2, 3 and 16 days respectively) in the gallbladder. Since the cystic duct was closed we may infer that the increase came from the wall of the gallbladder.

The rôle of infection was noted incidentally in many of these experiments by study of the gallbladder wall at autopsy. Unfortunately these observations were limited. Most of the specimens showed no evidence of inflammatory change. In dog WH in which definite changes were noted, however, the increase in cholesterol was

quite marked. On the other hand, in Dog B45 in which the greatest increase (300%) in the cholesterol content of the gallbladder bile was found, no inflammatory changes were made out. However, this experiment was of 16 days' duration, and an acute inflammation may have occurred and subsided, leaving no histological trace.

The high cholesterol content of the peritoneal fluid in Dog 830, where there was a localized peritonitis, may be explained by the fact that inflammatory exudates in general may contain much cholesterol.¹ The method for quantitating cholesterol was the colorimetric one and will be described in detail elsewhere. That used for bilirubin is described in a paper by Rous and McMaster.²

5680

Addition of Cholesterol to Hepatic Bile Subjected to Gallbladder Influence.

ROBERT ELMAN AND J. B. TAUSSIG. (Introduced by E. A. Graham.)

From the Department of Surgery, Washington University Medical School.

To study the influence, if any, of the gallbladder on the cholesterol content of bile, a series of experiments were performed in which a "partitioning ligature" was so placed¹ that 2 portions of the liver were drained into separate rubber balloons through intubation of the common duct. One part of the bile flowed directly from the liver, whereas the other part was subjected to gallbladder influence, before flowing into the collecting bag. This device was first used by Rous and McMaster¹ in their classic studies on the concentrating activities of the gallbladder.

Dog. I, weight 12 kg., under ether anesthesia a ligature was placed around the common duct just proximal to 2 hepatic ducts which were then made to drain directly into a rubber balloon intubated at the termination of the choledochus. A second balloon was connected with the common duct proximal to the ligature. This drained the rest of the liver, including the gallbladder which, however, was first completely emptied. The abdomen was closed in layers and the bags left therein. Five days later the dog, in excellent condition, was killed with chloroform. The upper bag (in connection with

¹ Wells, H. G., *Chemical Pathology*, 5th Edition, Philadelphia, 1925, 301.

² Rous, P., and McMaster, P. E., *J. Exp. Med.*, 1921, **34**, 47.

¹ Rous, P., and McMaster, P. D., *J. Exp. Med.*, 1921, **34**, 47.