

causes pain always, especially at the end of micturition, and gives rise to significant appearances in the urine. It can also be looked for with the cystoscope, or touched with a sound. A biliary calculus gives no clue in the bile, because we cannot inspect the bile, nor can we see into the gall-bladder or feel around in its cavity.

It is, however, when we come to the origin of the calculi in either case, and their composition, that the greatest contrasts are met with. As regards the etiology of cholelithiasis, much progress has been made of late years, and we especially owe to Professor Naunyn, of Strassburg, the demonstration of some of the most important facts connected with this subject. The first of these is that, in contrast with urinary calculi, general constitutional conditions have little to do with the tendency to their formation. Nothing like a uric-acid diathesis or derangements such as those which cause oxaluria or phosphatic deposits precede the formation of gall-stones. Instead, they arise wholly from local causes and changes in the biliary passages themselves affecting the bile after it is secreted, as the following considerations show.

The bile itself is a secretion about equal in daily amount to the urine, that is, from two to three pints, but of such low specific gravity that it contains only from 1 to 2 per cent. of solids. It is secreted by the liver cells, under such low pressure that it almost resembles a simple leakage, so that the slight obstruction caused by a catarrhal swelling of the mucous membrane of the biliary passages may suffice to cause jaundice. During active digestion it flows uninterruptedly along the hepatic bile-ducts directly into the intestine and not into the gall-bladder, this flow being much aided by the contraction of the diaphragm in active respiration. In the intervals of digestion, and particularly during the repose of sleep, the biliary outlet is closed by the sphincter-like contraction of the muscular wall of the duodenum, and the bile then flows into the gall-bladder instead. In proportion, therefore, to the slow digestion, and to the sedentary habits of many persons, the bile accumulates in the gall-bladder and becomes there more concentrated. But, however concentrated it may be, there is no danger of the formation of a gall-stone so long as the normal constituents of bile are held in solution. These constituents are certain salts, of which the most important are calcium salts, then the bile pigment, then cholesterin, and, lastly, a mucoid secretion which, however, is not mucin, but a complex nucleoproteid. Now, the first step in the formation of a calculus is the precipitation of the calcium by a combination of the calcium with the bile pigment. This forms, as a rule, a small, hard,