Introduction

The symposium was introduced by Boshamer (Wuppertal) by pointing to the necessity of the cooperation of all the disciplines, represented at the meeting, in the solution of the problem of urinary calculosis: clinical medicine, chemistry, colloidal chemistry, pathology and mineralogy. He then gave a historical review of the various theories, still current, as well as the problems they raise.

As a mineralogist, von Philipsborn (Bonn) held that calculosis is purely a problem in crystallization, and rejected the view that the presence of organic material in calculi indicated that the latter was essential in stone formation. On the contrary, he saw a syngensis in which there was simultaneous excretion of crystalline and non-crystalline organic substances. Only in albumin calculi is there primary organic formation. Not the “protective colloids” but magnesium ions guarantee the solubility of calcium oxalate in urine. He discussed the theoretical composition of so-called carbonate apatite, and pointed out that in the structure of apatite, weddellite and whewellite other elements can substitute for calcium. He also described various mineralogical methods for the identification of the constituents of urinary calculi.

Gasser (Vienna) gave a brief review of his work which has already appeared in the Ztschr. f. Urol. (49: 148, 1956; 50:445, 1957). The papers are devoted to the methods of differentiating calculous components, and to studies of the matrix and the urinary colloids. Diurnal and nocturnal variations of urinary pH may account for variations in inorganic and organic layers. In the organic framework of calculi he found an almost constant content of definite proteids. Hermann (Homburg/Saar) reviewed the older studies on urinary proteids and then reported on his own research of urinary surface tension in the healthy and in the calculous patient. He questioned the action of the protective colloids in stabilizing the urine.

Dulce (Berlin) also discussed this problem and his studies of the chemical composition of urinary colloids which led to results similar to those reported by Boyce and Mita, and Gasser and Mita. Unlike Gasser, he found that the matrix included the amino-acids, alanine and tryptophane. He emphasized that the carbo-

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hydrate portion of the organic matrix of the urate stone differs distinctly from that of the calcium stone. Both the matrix of calcium calculi and the albumin stones of the renal pelvis have the same qualitative composition of amino-acids and carbohydrate. Especially long chromatography paper was used.

As a colloidal chemist, Thiele (Kiel) discussed Boyce’s studies. He reported on colloidal synthesis of micellar structures and inter-micellar crystallization. Mucopolysaccharides and proteins with reactive groups belong to the polyelectrolytes which, as anisometric colloids in the form of threads and platelets, carry ionic and reactive groups. Colloidal threads or platelets form gels and “galerts”: the condition of biologic, organic substances. Ionotropic gels with arranged thread-molecules are synthetic micellar structures. It is possible to imitate bone, for example, in
the model. One may also build a structure of two colloidal partners of varied synthetic or native polyelectrolytes (polyurinic acid, mucopolysaccharides, proteins). Such “two-substance systems” have organic matrices in which regularly arranged crystals are deposited. This compares to the collagen/apatite of the bone. Orderly crystallization must not be confused with Liesegang rings, because the latter consist of unarranged crystals. If these researches are to be applied to urinary calculosis, one must assume damage of the renal membrane, thus allowing the passage of proteins, mucopolysaccharides and salt. In this way, even in low concentration as by change of the pH, insoluble salt-like complexes may be formed. In this organic matrix poorly soluble substances may crystallize because of ionic alteration. Nevertheless, it remains unknown how the structures are formed which lead to calculosis.

F. E. Koch (Cologne) briefly discussed his theory of calculous crisis and colloidal corpuscular excretion as the primary factor.

Haase (Cologne) reported on the morphology of these primary formed elements and their relationship to calculosis. The developmental triad (colloidal corpuscles, spheroliths, microliths) is typical of experimentally produced calculi. In the human the investigation of these elements is insufficient to draw any conclusions concerning the presence of calculi and their chemical composition.

Uebel (Cologne) discussed the histologic findings in the human calculous kidneys and those experimentally produced (“crises”) in animals. As seen with the MPS stain, a single dose of sulfathiazole is followed by widening of the basement membrane, red-VIII/1958

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staining of protein granules in the capsular space, and demonstration of partly confluent granules in the distal tubules; whether the latter are comparable to the ultrafine colloidal particles of Shimatsu is questionable. Histologic studies in human calculosis are subject to varied interpretation.

The changes in crisis of concrement formation are close to the nephroblaptoses (Staemmler) which are considered as acute toxic or ischemic, chiefly transient disturbances of the tubular epithelial cells; often smallest vacuoles in human renal tubular cells seem to contain a sort of calculus-forming gel.

The PAS reaction in 4 protein stones has demonstrated that mucopolysaccharides are incorporated into the organic portions of the smallest formed elements.

Staemmler cautions against over-evaluation of histologic and histo-chemical researches and morphologic quantitative results. Microscopy is handicapped by inflammatory changes in the calculous kidney. Certain granuloids are probably given off in the innermost tubular lumen, but their significance in urinary and renal function is still unknown.

To conclude the symposium, Dulce (Berlin) reviewed Thiele’s exposition and his own studies. Mineral substances in calculi do not differ from those in the urine, yet mucoproteids in the calculous matrix of calcium stones differs from colloids in the urine; the former has higher values of nitrogen, hexosamine and hexose, while sulfur remains the same. It is likely that the normal mucoproteids of urine are incorporated into the matrix; yet, there must be aberrant mucoproteids.

Calculi form under one of the following conditions: a) calculus-forming mineral substances are excreted in increased amount and are ready for crystallization (super-saturation), or b) there is
The elective concentration of an organic mineral ground-substance in the sense of an exchange-substance or complex-constructor.

The first condition is probably true of uric acid and cystine stones, the second for concrements built up of inorganic minerals. According to Boyce there is a complex linkage of the pathologic urinary mucoproteids with calcium; crystallization then follows penetration by phosphates. Still open is how oxalate is caused to crystallize and how calcium phosphate precipitates. There is another, closer interpretation corresponding to Thiele’s, based on the capacity for exchange of protein-polysaccharidic sediments (so-called mucin clots or symplexes). Into the clots penetrate calcium or magnesium cations. Anionic diffusion prompts crystallization. In any event it may be assumed that in the case of calcium calculi first the organic matrix appears; this represents an insoluble mucoprotein composed of carbohydrate and protein elements. The different chemical composition of the matrix of uric acid and cystine stones excludes such a process of formation by an exchange-mechanism. In such stones the matrix is probably secondarily incorporated by the appearance of crystallization of the calculous-forming substances now excreted in increased amounts. Addendum: Tsutomu Inada et al.: Statistical Investigation of Urolithiasis in Japan. A questionnaire was sent to 130 hospitals. Urinary lithiasis is now more common than heretofore in northern Japan; ureteral stones are most common followed by vesical renal urethral and prostatic. In some districts upper urinary tract calculi are more common while the reverse is true in other districts. Renal and urethral calculus increased up to 1939 fell off in 1945 and rose again after 1947 (stone waves); the rise still continues. – Lower urinary tract stones do not show this wave-like increase. The condition is most often encountered in the 3rd decade of life and is 5–6 times as frequent in men than in women.