✓ A Course of Lectures ON URINE, URINARY DEPOSITS, AND CALCULI.

DELIVERED AT THE PATHOLOGICAL LABORATORY,
DURING THE SESSION 1857-58.

BY

LIONEL BEALE, M.B., F.R.C.P., F.R.S.,

PHYSICIAN TO KING'S COLLEGE HOSPITAL; PROFESSOR OF PHYSIOLOGY
AND OF GENERAL AND MORBID ANATOMY IN KING'S
COLLEGE, LONDON; ETC.

LECTURE X.

URINE IN DISEASE. III. OF DENSE AND OPAQUE DEPOSITS.

Pus. Urates. Phosphates, general characters. Urates. Urinary Deposits associated with Urates. Urates in Urine, without forming a Deposit: Albumen present. Analyses of Deposits of Urates. Pus. Characters of the Urine. Tests for Pus. Of the Presence of Pus in Urine, in a Clinical Point of View. Earthy Phosphates. Triple or Ammoniac-Magnesian Phosphate. Tests. Phosphate of Lime. Phosphate of Lime, in the form of Spherules and Small Dumb-Bells. Peculiar Form of Phosphate, usually regarded as consisting of Triple Phosphate. On the Crystalline Form of Phosphate of Lime.

III.—SECOND CLASS OF URINARY DEPOSITS.

GENTLEMEN,—We now come to the consideration of the second class of deposits, which form a bulky, dense, opaque, and often abundant precipitate, which sinks to the bottom of the vessel, leaving a perfectly clear, or more or less turbid, supernatant fluid.

Pus, Urates, Phosphates. The most important deposits of this class are those consisting of *urate of soda, pus*, and *earthy phosphate*. To the practitioner these three deposits are especially interesting; and, as their presence in the urine is characteristic of important morbid conditions differing widely in their results from each other, while the appearance of the deposits to the naked eye is very similar, it is a matter of great importance that the practitioner should be able to distinguish them from each other with certainty, and at the same time with facility. Before entering, therefore, upon a detailed description of these bodies, let me draw your attention to an exceedingly simple method of distinguishing them. Let the clear supernatant fluid be poured off, and a little of the deposit be transferred to a test-tube. Upon the addition of about half the bulk of solution of potash, one of the three following points will be noted:—*No change* will be produced, in which case the deposit consists entirely of *phosphate*. Secondly, the mixture will become *clear*, and very *stringy* or *viscid*, so that it cannot be poured from the test-tube in drops. In this case, we may be certain that the deposit consists of *pus*. Thirdly, the solution of potash may cause the mixture to become clear, but not viscid, in which case *urate of soda and ammonia* enter very largely into the composition of the deposit. Often liquor potassæ gelatinises the mixture, but does not render it clear, in which case it is probable that both *pus* and *phosphates* are present. In any of the above instances, our conclusion as to the nature of the substance should be confirmed by some of the tests presently to be mentioned, and by microscopical examination.

Urates. From the researches of Heintz (*Lehrbuch der Zoochemie*), it appears that this deposit, usually termed *urate of ammonia*, really consists principally of *urate of soda and urate of ammonia*, with small quantities of *urates of lime and magnesia*. It forms the most common urinary deposit. A

small quantity of urate is held in solution in healthy urine; and, in slight derangement of certain chemical changes going on in the body, it is often secreted in such quantity as to be deposited soon after the urine is passed. Urate of ammonia, when artificially prepared, crystallises in delicate needles; but in this form it is never found in the urine; for, as Dr. Bence Jones has shown, the slightest trace of chloride of sodium

Fig. 30.—Urate of soda crystallised in spherules, from healthy urine concentrated by evaporation.

causes the salt to assume an amorphous character, and increases the solubility of the urate by one-half. Urate of soda is sometimes found in the urine, forming globular masses, from different parts of which sharp spikes of uric acid project. In the urine of children, it is very frequently met with in the form of small spherical globules very like the crystals of carbonate of lime from horses' urine; and these sometimes occur in the adult. Some of the largest spherules I ever saw are figured in the *Archives of Medicine*, vol. i, p. 249. See also *Illustrations*, Plate VIII, Figs. 2, 5, and 6. In Fig. 30, some spherules of urate of soda, obtained by concentrating healthy urine, are represented.

Urate of soda is not very soluble in cold, but is readily dissolved by a small quantity of warm water; from which, however, it is deposited as the solution cools. It is readily dissolved by alkalis, and also by solutions of alkaline carbonates and phosphates. Pure urate of soda crystallises in small acicular crystals, which are more or less aggregated together. In this form, it is found in the pasty deposits forming chalk-stones in cases of gout. This thick deposit contains much water. In one specimen I examined, the solid matter only amounted to 29.9 per cent., and consisted chiefly of urate of soda.

Deposits of urate of soda vary very much in colour, sometimes occurring as the white or pale "lateritious deposit" or "nut-brown sediment"; while in other cases the deposit has a pink, brown, or even dark reddish colour. The amorphous urate is represented in the *Illustrations*, Plate VIII, Fig. 1. Upon the addition of moderately strong acids, the deposit of urate is slowly dissolved; but in a short time a slight granular precipitate may be observed, which, upon microscopical examination, is found to consist of rhomboidal crystals of uric acid. It is not uncommon to meet with specimens of urate deposit which become decomposed after the urine has left the bladder, when numerous crystals of uric acid are deposited. If urate of ammonia be treated with nitric acid, and, after evaporation to dryness, ammonia be added, the beautiful purple colour, owing to the formation of murexide, is produced. This reaction will come under our notice when we discuss the characters of uric acid. Rubbed with caustic lime, a perceptible odour of ammonia is evolved.

Urinary Deposits associated with Urates. This deposit of urates is more frequently accompanied with oxalate of lime than with any other salt. It has been shown that urates may be readily decomposed into oxalates after the urine has been passed. The crystals of oxalate are often so minute as readily to escape detection in the abundant deposit of urate, unless the latter be dissolved by the addition of a few drops of solution of potash. *Triple phosphate* is not unfrequently met with

amongst the urate, and occasionally a deposit of phosphate of lime has been observed, in which case the reaction of the urine will be neutral or even alkaline. Urate of soda is occasionally the cause of the dark granular appearance exhibited by certain casts, as may be proved by slightly warming the deposit, and then examining it with the microscope, when the casts will be found to have become clear.

Urates present without forming a Deposit: Albumen present. Often the urate remains suspended in the urine without forming a visible deposit, and produces a curious opalescence. Sometimes the urine resembles in appearance the so-called chylous urine; but its true nature is readily made out by the application of some of the tests above referred to. (See also *Chylous Urine*.) If albumen be present in urine containing urate of ammonia, it will not become clear by heat, or rather, it will at first clear, but soon become turbid again, in consequence of the precipitation of the albumen. With a little care, however, in applying the heat, the upper stratum of urine in the test-tube may be made hot enough to coagulate the albumen, the middle stratum being cleared by the solution of the urate without the albumen being thrown down, while in the bottom of the tube the deposit remains unchanged. In performing this experiment, you must hold the test-tube at its lower part.

Analyses of Deposits of Urates. The urine of a child suffering from scarlatina, with delirium and unconsciousness, contained an abundant deposit of urates. It was acid; specific gravity, 1025.

Analysis 60.

Water	932.2	
Solid matter	67.8	100
Organic matter	59.03	87.07
Fixed salts	8.77	12.93
Uric acid	1.19	1.75

In a deposit which was composed of rounded globules, with small sharp spicules projecting from them (uric acid), I found the following constituents: phosphate of lime, urate of soda, and other urates. I found a considerable quantity of these spherules in the urine of a man suffering from pneumonia, and they had the following chemical characters. They exhibited distinct evidence of the presence of uric acid by the murexide test. They were soluble in boiling potash; and when, to the alkaline solution, excess of hydrochloric acid was added, well defined crystals of uric acid were formed. Upon exposure to a red heat, an odour like that of burnt horn was exhaled; and, after decarbonisation, a moderate quantity of a white ash remained, which dissolved in acids with effervescence; and from the acetic acid solution a precipitate was thrown down, upon the addition of oxalate of ammonia. I conclude, therefore, that urate of lime entered into the formation of these crystals. The quantity of crystals at my disposal was far too small to make a quantitative analysis.

Pus. The next deposit to be considered is pus. Pus is not found in healthy urine, although it is very frequently met with in the urine of persons passed the middle period of life whose general health is good. The changes by which a healthy mucous membrane becomes converted into a pus-forming surface are not yet well understood; but certain it is that such a change may take place without the essential purposes of the mucous membrane being interfered with. The portion of the genito-urinary mucous membrane most frequently affected in this way is undoubtedly the urethra, and I believe, next to this, that of the ureters and pelvis of the kidney; while the functions of the bladder, as a general rule, become seriously deranged before its mucous membrane forms much pus. To this last statement there are, however, exceptions. That an enormous quantity of pus may be formed in the pelvis of the kidney and in the infundibula, without seriously interfering with the general health of the patient, is a fact which has been confirmed by many cases. One I particularly recollect—a woman in the hospital, about five or six years ago, under Dr. Todd, who for upwards of a twelvemonth had been passing urine a fourth part of the bulk of which consisted of pus. This patient had not suffered in nutrition or in general health, and she had gone through her occupation as servant as usual.

Much pus is often formed upon the mucous membrane of the vagina, which will, of course, be found in the urine, accompanied with some of the large cells of vaginal epithelium. The urine of men after the age of forty often contains a greater or less number of pus-corpuscles—a fact of which I was not aware until I had subjected the urine of a great number of

hospital patients indiscriminately to examination. In private practice, the same point is noticed very frequently. It is, indeed, more common to find a few pus-corpuscles in the urine after this period of life, than to find it free from them. This fact is important, and shows that the existence of pus in the urine must not, *per se*, be regarded as evidence of serious disease.

Characters of the Urine. Pus generally forms an opaque cream-coloured deposit, which sinks to the bottom of the vessel, the supernatant fluid being generally slightly turbid, from the presence of a few pus-globules. The deposit, however, readily diffuses itself again by agitation. The urine will always be found to contain a little albumen derived from the liquor puris. If, however, the albumen exist in large quantity, it is probably derived from some other source. If the urine be alkaline, the pus is no longer present as a cream-coloured deposit, but exists as a gelatinous or stringy mass, which adheres firmly to the sides of the vessel containing it. It is to this glairy mass that the term mucus has been, and even still is, carelessly applied. The viscid, glairy, mucus-like deposit arises from the carbonate of ammonia, set free by the decomposition of urea, reacting on the pus-globules in a manner similar to that in which potash behaves. The microscopical characters of the pus-corpuscle are clear and well defined.

Tests for Pus. The tests, then, which may be relied upon for detecting the presence of pus in urine, are, the addition of solution of potash to the deposit; and of nitric acid, and the application of heat to a portion of the supernatant fluid, in order to detect the

Fig. 31.—Pus corpuscles from urine.

Fig. 32.—Pus corpuscles acted upon by acetic acid.

presence of albumen. Cases from time to time come under notice in which the amount of albumen is very small; but still the quantity may appear to us to be in too large a proportion to the pus-cells present, to belong solely to the liquor puris. In such a case, we should be led to suspect kidney-disease, and should therefore very carefully search the deposit for casts of the tubes.

Microscopical Characters of Pus. In those cases in which the pus is in too small quantity to be detected by chemical tests, we must rely upon the microscopical examination of the deposit, and the development of two or three small round bodies in the centre of each pus-globule upon the addition of a drop of acetic acid. Pus globules always have a granulated appearance in the microscope, and, when fresh, exhibit, under ordinary magnifying powers, no well defined nucleus; the outline is usually distinct and circular, but it is finely crenated. Upon the addition of acetic acid, the globule increases somewhat in size, becomes spherical, owing to endosmosis, with a smooth faint outline; and from one to four nearly circular bodies are developed in the centre of each. (Fig. 32.)

Of the Presence of Pus in Urine in a clinical point of view. You will have gathered from what I have already said, that the presence of a few pus-corpuscles in urine is a fact which need

not excite our alarm; that the mucous membrane of the urethra in many cases becomes affected in a slight degree in the same manner as some other mucous membranes; and that pus-corpuscles are formed in small number upon its surface, without causing any material impairment of structure or derangement of function. In the urine of the female, it is very common to find small quantities of pus which are derived from the mucous membrane of the vagina. When, however, pus is found in the urine in sufficient quantity to form a deposit visible to the naked eye, it should excite our attention. The fact will probably bear in a very important manner upon the diagnosis of the case. Pus may be derived from any part of the genito-urinary mucous membrane; from the surface of the urethra; from the prostate; from the bladder, or from the follicles of the mucous membrane in these parts; from the ureters; from the pelvis of the kidney, or from the secreting structure of the organ. The pus may also come from an abscess opening upon any part of the surface of this mucous membrane.

It is often difficult to form an opinion as to the exact seat of formation of the pus; and it must be obvious that we ought never to come to a decision on such a point until we have accurately weighed all the evidence that a careful investigation of the case will afford. Microscopical examination will give us important help; but we must not rely upon this, or indeed upon any single mode of investigation. The question is an extensive one, and I shall only refer to one or two points connected with the evidence deduced from microscopical examination, as you are quite familiar with the nature of the other evidence to be obtained in such cases. You may often form some idea of the locality from which the pus has been derived by examining attentively the characters of any epithelial cells which may be mixed with it. (Lecture ix.) When pus is derived from the bladder, it generally contains crystals of triple phosphate, and granules or small spherules of earthy phosphate mixed with it; and the symptoms of the case will generally enable you to decide if the pus is formed in this viscus. Large quantities of pus may escape from the bladder for a number of years. I know of one gentleman who has passed pus in considerable quantity from the bladder during a period of twenty-five years. The suppuration of the bladder may be due to gonorrhoea, to gout, and to a state of mucous membrane which is termed catarrh of the bladder. When the pelvis of the kidney is dilated and sacculated (a form of pyelitis), the quantity of pus passed in the urine is often enormous; and this may last for years, until the kidney becomes a mere pus-forming cyst, which, in favourable cases, gradually contracts; the formation of pus ceases; the cyst slowly wastes; and the patient perfectly recovers; the work of the two kidneys being performed by the remaining one, which has gradually undergone an increase in size corresponding to the increased work it is called upon to perform. When pus is derived from the pelvis of the kidney, the earthy phosphates are very frequently completely absent. There is a chronic state of ulceration of the ureters and pelvis of the kidney and bladder, in which pus is formed in considerable quantity, leading to the most distressing symptoms. Pus may depend upon the existence of old stricture.

Abscesses form in the kidney as in other organs; and, after the abscess has burst, pus makes its way into the urine. The inflammation of the mucous membrane of the kidney often extends upwards from the bladder. The presence of a calculus in the kidney, in the ureter, or in the bladder, may set up inflammation which may go on to the formation of pus. A very small calculus will sometimes excite great irritation in the kidney, so that both pus and blood are voided in the urine.

Pus may be derived from a sloughing process going on in the kidney. Sometimes a portion of the organ sloughs off entire in these cases. My friend Mr. Newham, of Bury St. Edmunds, sent me, a short time since, a piece of kidney which had sloughed off, and was passed with much pus in the urine. Pus may also depend upon the presence of cancer in the kidney, or upon tubercle developed in the same situation.

Pus may come from an acute affection of the uriniferous tubes, and the corpuscles will be found free in the urine, and entangled in considerable number in casts. These cases are often very rapidly fatal. (See *Illustrations*, Plate xvi.)

Earthy Phosphates. The earthy phosphates soluble in acids, but insoluble in water and alkaline solutions, which are most commonly met with as deposits in urine, are, the ordinary triple or ammoniaco-magnesian phosphate, or the phosphate of ammonia and magnesia; and the phosphate of lime.

Triple or Ammoniaco-Magnesian Phosphate. The triple phos-

phate crystallises in two or three different forms. The most common form is that of the triangular prism with obliquely truncated ends; but these are sometimes complicated by the bevelling of the terminal edges. Not unfrequently the crystal is found much reduced in length, and the truncated extremities become so approximated as to give the appearance of a square the opposite angles of which are connected by straight lines; and thus an appearance very closely resembling that of an octohedral crystal of oxalate of lime is produced. Crystals

Fig. 33.—Crystals of triple phosphate and small globules of phosphate of lime, from urine.

of this salt are very frequently deposited from acid urine; and, when clear and unmixed with other deposits, they form a most beautiful microscopic object.

Tests. If ammonia be added to fresh urine, or to a solution of phosphate of soda and sulphate of magnesia, ammoniaco-magnesian phosphate is precipitated in the form of beautiful stellate crystals, as I mentioned when speaking of healthy urine. Besides these forms, Dr. Golding Bird describes two others in the form of simple stellæ, often so crowded as to appear like rosettes and penniform crystals, which latter are very rare.

Ammoniaco-magnesian phosphate is slightly soluble in pure water, particularly if it contain carbonic acid. It is insoluble in solutions of ammoniacal salts. Heated in the blowpipe flame, ammoniaco-magnesian phosphate evolves a disagreeable odour of ammonia, and afterwards fuses, producing a whitish enamel. If the phosphate of magnesia thus formed be dissolved in a little dilute acid, the triple salt may be again formed upon the addition of ammonia. The presence of phosphoric acid can readily be proved by the appropriate tests.

Deposits associated with Triple Phosphate. Ammoniaco-magnesian phosphate seldom occurs alone as a urinary deposit. Its presence is often associated with urate of ammonia, and sometimes with uric acid. I have also observed crystals of oxalate of lime mixed with those of triple phosphate. In highly alkaline urine, it is usually accompanied with phosphate of lime.

Phosphate of Lime occurs as minute granules, as small spherical masses, and it may also be noticed in the form of minute dumb-bells—an appearance probably due to the adhesion of two little spherules, which afterwards become coated with a fresh deposit of the phosphate. Phosphate of lime is usually associated with the triple salt, and is deposited from alkaline urine. In cases of disease of the bladder in which the urea becomes very rapidly decomposed into carbonate of ammonia, much amorphous phosphate of lime and triple phosphate are precipitated. It must not, however, be supposed that highly alkaline urine necessarily contains a very large excess of earthy phosphate; for often an excessive quantity of the salts have been found dissolved in acid urine. When the secretion is alkaline, the phosphates are precipitated, and become visible to the naked eye as a deposit. Phosphate of lime dissolves in strong acids without effervescence; and from this solution is precipitated in an amorphous form, upon the addition of ammonia. The salt is infusible before the blowpipe, unless mixed with triple phosphate; and its fusibility increases according to the quantity of the latter salt present. The lime may be recognised in the usual way by the addition of a solution of oxalate of ammonia to a solution of the salt in acetic acid.

Phosphate of lime is soluble in albumen; indeed, it is by reason of its solubility in this substance that the phosphate of lime formed by the action of phosphoric acid on the egg-shell becomes applied to the formation of the osseous system of the embryo chick. Mucus also is a solvent of this salt, and from the mucus of the gall-bladder a considerable quantity is deposited as decomposition proceeds. (Fig. 34.)

Phosphate of Lime in the Form of Spherules and small Dumb-Bells. Deposits of phosphate of lime are generally granular; but after a deposit has been allowed to stand for some days, little spherules are very frequently found, and it is also not uncommon to meet with small dumb-bell crystals. Crystals of the latter character are very often deposited in decomposing mucus, derived from several mucous surfaces, as well as in that of the urinary mucous membrane. Some of the

largest of these dumb-bell crystals of phosphate of lime are represented in Fig. 35. They were found in the urine of a patient suffering from continued fever, under the care of Mr. Carver of Cambridge, who sent me the specimen.

Fig. 34.—Dumb-bell crystals of phosphate of lime from the gall-bladder.
Fig. 35.—Dumb-bell crystals of phosphate of lime from urine.

A peculiar form of deposit of earthy phosphate is represented in Fig. 30. It consisted partly of phosphate of lime,

Fig. 36.—Unusual form of triple phosphate, and phosphate of lime. From the urine of a gentleman suffering from dyspepsia. X 215.

and partly of triple phosphate. There were no true crystals, neither was the deposit in a pulverulent form. The little angular masses represented were the only bodies found in this peculiar deposit.

Peculiar Form of Phosphate, usually regarded as consisting of Triple Phosphate. A phosphate of the form represented in Fig. 37 is not uncommonly found in urine. I have not been

Fig. 37.—More uncommon form of phosphate, usually regarded as triple phosphate, crystallised differently from Fig. 33, which represents its usual form. These are probably the "simple stellæ" of Dr. Golding Bird's "neutral salt."

able to connect its presence with any special state of the system, nor to ascertain the conditions upon which its deposition depends. It is very frequently associated with oxalate of lime, and occurs in acid urine. A considerable quantity of these crystals were deposited from the urine of a man who had a rough oval calculus, composed of oxalate of lime, impacted in the ureter. The case is given in Dr. Todd's *Clinical Lectures*, 2nd ed., p. 562. They were examined as follows:—

(March 1851). "The deposit from about a pint and a half of urine was well washed with water and alcohol, and filtered; it was then dried, incinerated, and decarbonised. The form of the crystals had not been materially altered by the ignition; for, when examined by the microscope, scarcely any change could be observed.

"A portion of the decarbonised crystals were dissolved in dilute hydrochloric acid (they were only very slowly soluble in acetic acid).

"1. Ammonia and potash produced gelatinous precipitates.

"2. Chloride of barium caused a slight precipitate in the acid solution; but, upon the addition of excess of ammonia, a bulky white precipitate occurred.

"3. After the addition of ammonia and resolution of the precipitate by acetic acid, oxalate of ammonia was added, and a white granular precipitate was produced.

"4. After the addition of nitrate of cobalt and ignition in the blowpipe flame, a beautiful blue was given to the mass." This reaction usually occurs with phosphate of lime, as well as with alumina. Those crystals then consisted principally of phosphate of lime.

In another case which I examined, the crystals appeared to consist principally of phosphate of lime. They were dissolved in nitric acid, and ammonia added. An amorphous precipitate

occurred; but no crystals were formed after the lapse of some hours. After separation of the lime by oxalate of ammonia, and filtration, ammonia and phosphate of soda were added. A very few crystals of triple phosphate formed after the lapse of some time. There was an abundant precipitate of oxalate of lime.

In other cases, a phosphate of magnesia seemed to predominate. From not being able to make satisfactory quantitative analyses, owing to the small quantity of the salt obtained for examination, I was unable to determine the exact nature of these crystals. They are, as I before said, found in acid urine; and phosphoric acid, lime, and magnesia, are present. These are probably the crystals which were regarded by the late Dr. Golding Bird as "small calculeous concretions and simple stellæ of the neutral salt".

On the Crystalline Form of Phosphate of Lime. Dr. Hassall, in an interesting paper published in the *Proceedings of the Royal Society*, vol. x, p. 281, Jan. 1860, has stated that phosphate of lime is very commonly found in deposits from human urine in a crystalline form. He gives quantitative analyses of four specimens of deposit which contained the phosphates in the following proportions:—

Bibasic phosphate of magnesia	. 0.15	0.47	4.30	
Bibasic phosphate of lime	. 1.85	6.18	5.41	1.96
	2.00	6.65	9.71	

Dr. Hassall states that Dr. Golding Bird's "penniform" crystals of ammoniaco-magnesian phosphate are really a modification of those of phosphate of lime. The crystals represented by Dr. Hassall in Figure 1 appear to be similar crystals to those I have delineated in Fig. 35, the chemical composition of which I have alluded to. See also *Illustrations*, Plate xxxi, Figs. 1, 2, 3, 4, 5, 6. I have never obtained these crystals in sufficient quantity for a quantitative examination, but have examined several specimens qualitatively, and usually found that they contained ammoniaco-magnesian phosphate, as well as phosphate of lime. The latter was regarded as the less important constituent of the salt; and, in the absence of more exact examination, I thought it better to retain Dr. Golding Bird's nomenclature. If the crystalline form of the pure salt in Dr. Hassall's fourth analysis is represented in his Fig. 1, the composition of these crystals is determined, and the phosphate of magnesia obtained in some of my examinations must be regarded as an impurity, and not as a necessary constituent.

Dr. Hassall, however, in the paper referred to, goes so far as to say "that phosphate of lime, in the form of crystals, is of much more frequent occurrence in human urine than the triple phosphate;" and that "granular calcareous deposits are much more rare than the crystalline." Now, in these statements, I think he will find that few observers will agree; for that the ordinary crystals so commonly present in the urine, and usually termed triple phosphate, are actually composed of that salt, there cannot be the smallest question. Crystals of exactly similar form may be readily obtained artificially. The salt is easily obtained from any urine by precipitation by ammonia, and is often found very nearly pure, in large quantity, in urinary calculi. That these crystals, so familiar to every one, are more frequently met with than any other form of earthy phosphate, crystalline or non-crystalline, I conclude no one will deny. That phosphate of lime often occurs in urine in an amorphous form, and not unfrequently in little spherules and small dumb-bells, as have been figured; and that, when thrown down from its solutions, the deposit is amorphous; and that in calculi it is amorphous,—are facts generally assented to, and they have been repeatedly confirmed. It seems to me that these observations militate against the conclusion arrived at by Dr. Hassall as to the relative frequency of the crystalline forms of phosphate of lime and triple phosphate.

It is important to bear in mind that in many cases, when large quantities of phosphate of lime are excreted in the urine, the salt is dissolved, and does not form a deposit. You must not, therefore, from the absence of a deposit, conclude that these salts are not excreted in abnormal quantity. The various forms of phosphate which have been described often occur in very small proportion, so that the observer would probably expect to find them in the third class of urinary deposits; but I have thought it better to describe them here, with the other salts of this kind, than to postpone their consideration.