counsel and who did the work, at a time when there was excellent authority for doing it in that way. The family physician, like the other physicians upon whom I depend, would to-day be ashamed to call me to a case of appendicitis in which pus had formed.

This patient has given the usual history of slight exacerbation, of constipation and of little septic impressions since the time of his first acute attack. Three years ago he had a dangerous exacerbation, but was not where he could be operated upon.

The abdominal incision is now made; and I proceed to enucleate the appendix from a conglomerate mass of omentum, mesentery, colon, ileum, and adventitious tissue. The base of the appendix is ligated with fine eye silk, and the stump is buried with four Lembert sutures of catgut. On examination of the specimen, you observe that the muscular structure of the appendix is complete and hypertrophied. On inspection of the interior of the specimen, it is seen that the mucosa has disappeared and various tiny black or gray gangrenous spots are readily distinguished on the surface of the swollen and infiltrated adenoid layer.

We have had to learn three principal things in appendicitis within the past decade: (1) that appendicitis is very common, and that it simulates many kinds of abdominal disease; (2) that we must operate for removal of the appendix before pus has formed, if we would prevent deaths and hernia and uncomfortable complications; (3) that we do not need to make much of an incision, and that the operation is a neat and pretty one, instead of a thing to be dreaded in itself.

Original Articles.

NOTES ON PHOSPHATURIA.¹

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DURING the last three or four years the writer has had the care of a number of cases such as are often described and discussed in medical writings under the name of "phosphaturia." The perplexity which several of them caused him led to the collection of these notes from the meagre and unsatisfactory knowledge of the subject at our command; and it is the object of this paper merely to arrange these notes and present them to the Society in a way which it is hoped may prove of use.

Cases characterized by well-marked symptoms of digestive and nervous disturbance, perhaps also by neuralgic pains in the abdomen, back and loins, and associated with a more or less persistent phosphatic cloud in the urine, are the ones to which the writer refers. They are common enough to be familiar to us all, and are often severe enough to make serious inroads upon the patient's health. The patient comes to you complaining of a series of gastric symptoms: distress immediately after eating, heart-burn, eructations of gas, passage of flatus, constipation, and often of pretty severe colicky pain in the bowels. With these symptoms, more or less marked and pointing directly to fermentative changes going on in the stomach, are often associated extreme nervous irritability and sometimes indefinite but none the less annoying neuralgic pains in the back, loins and thighs. The urine is either

alkaline in reaction and turbid from the cloud of precipitated phosphates, or is neutral or slightly alkaline in reaction, clear in color, and becomes cloudy when even very slightly heated. If the trouble has persisted for any length of time, there is emaciation to a greater or less degree, and due of course to the ingestion of an insufficient quantity of food which is not properly taken care of after it reaches the stomach. Let us consider the urine of such a case for a moment, and the causes which may bring about such a state of affairs.

The phosphoric acid excreted in the urine is derived from the oxidation of the waste albuminoid tissues of the body, and also directly from the food. It is excreted by the kidneys at the rate of about three grammes daily, in combination with various bases, notably potassium, sodium, calcium and magnesium. Of these phosphates, those of potassium and sodium are very soluble and so are never deposited as precipitates in the urine; but the earthy phosphates (of calcium and magnesium) being soluble only in acid solutions, are often deposited from alkaline or neutral urines, and appear as a milky cloud in the urine. So it is at once apparent that this appearance of a phosphatic cloud in the urine has not of necessity anything whatever to do with the amount of phosphoric acid which is being excreted in the urine, and which can be estimated only by carefully quantitative analyses of the urine of a patient whose diet on successive days is carefully regulated; but it is merely an indication of a lack of acidity of the urine.

Now, when urine loses its acidity it does so (a) either from the formation of ammonia due to the decomposition of urea, that is to say, because the urine spoils after its secretion by the kidneys, and either somewhere in the genito-urinary tract (dependent upon some local lesion of the organs through which it passes or upon dirty instruments introduced into those organs) or in the air after it has been voided; (b) or it loses its acidity from the constant presence in it of too great a quantity of alkaline material which is not the result of any process of decomposition, but is a fixed alkali excreted in the urine chiefly in the form of carbonates of sodium and potassium. It is with these latter urines, those which are neutral or alkaline from the more or less constant presence of a fixed alkali, that we are concerned to-night. These persistently alkaline urines seem to be associated with a series of digestive and nervous symptoms which are of frequent occurrence and are of enough clinical importance to demand recognition as a distinct malady. It is as descriptive of this condition that the term phosphaturia is so often used. It would seem then that it is not the amount of phosphoric acid eliminated by the kidneys, but the diminished acidity of the urine and its associated symptoms, which are of interest in this class of cases. Many explanations for this lack of acidity have been offered us.

Bence Jones thought that when the contents of the stomach were most acid, for example, in certain disturbances of digestion, the urine was least so, the one counterbalancing the other. This explanation hardly suffices, as it is surely evident that in such conditions of the stomach, the excess of acid is not withdrawn from the tissues and so kept out of the urine, but is formed by the changes going on in the stomach.

Dr. Roberts thought the alkalinity was the result of the increased addition to the blood of alkaline bases from the food; but as the appetite in the condition is much more apt to be bad than good, and as there is no

¹ Read at the meeting of Boston Society for Medical Improvement, November 27, 1893.

evidence that food containing such alkaline bases is either eaten or absorbed in larger amounts than usual, this supposition does not seem of much value. What is true is that such urines contain a surplus of alkaline carbonates, as shown by analyses, and the alkalinity is most probably due to the constant and excessive elimination of these carbonates of potassium and sodium.

Ralfe says that this excessive elimination of carbonates may well be accounted for by three conditions:

(1) A general debility and its coincident feeble respiratory acts, leading to an accumulation of carbonic acid in the tissues. It is a noteworthy fact that in such conditions, for example, in patients convalescing from acute diseases, such urines are very frequently met with.

(2) A diminished secretion of bile, the frequent result of a duodenal catarrh produced by the irritation of the acid contents of the deranged stomach being poured into the duodenum. The bile being the chief secretion by which alkaline salts are excreted from the body, any diminution of its quantity gives rise to an accumulation of these carbonates in the blood, and therefore to a greater elimination of them by the kidneys.

(3) The acids formed by the fermentative changes which go on in the deranged stomach being of the fatty acid series, on entering the system are oxydized into carbonic acid and unite with the alkaline bases to form carbonates, which increase the alkalinity of the blood and of the urine.

That the excessive elimination of these carbonates and the consequent more or less persistent alkalinity of the urine may be explained entirely by such digestive troubles, is not probable, for there seem to be cases in which the phosphatic deposit is dependent solely upon nervous causes. In fact, cases of this sort are by no means uncommon. For example: Two or three years ago a middle-aged man living in Newfoundland, came to the writer complaining that for the last two years he had been suffering from frequent micturition and severe neuralgic pains in the abdomen and loins. He looked somewhat emaciated, and was nervous and depressed about himself and his personal affairs. There were no gastric symptoms, no venereal history, and a most careful examination revealed no lesion of the urethra or bladder. The urine was normal except for its lack of acidity and the almost constant presence of a phosphatic cloud. The man said that whenever he got into this nervous, worried condition, this same set of symptoms appeared. He was readily cured for the time being by a few hygienic suggestions, a tonic pill and some benzoate of soda. A second attack was brought on a year later by the excitement and worry he went through at the time of the great fire in St. Johns. The same treatment gave relief very quickly. This seems to be a purely nervous case, and such cases are common enough. The writer has seen several similar cases lasting often for months, in healthy but nervous men, after operations upon the penis and adjacent parts.

This deposit of phosphates has been studied by many eminent men, both clinicians and chemists, and has been found to occur in a great variety of diseases, for example, in acute brain diseases, acute mania, in pleurisies and pneumonias, in rheumatic fever towards the end of the attack, at certain periods of a typhoid fever, etc.; but the cases are rarely of much severity or duration, and practically take care of themselves, as

the general nervous and physical condition improves under proper care. That is to say, if the local cause be removed — be it digestive or nervous — the so-called phosphaturia disappears, as a rule; although sometimes it has existed long enough to leave behind it a mild degree of inflammation of the bladder or urethra, which may prove annoying enough to demand local or systemic treatment.

There are, however, many of these cases in which the condition persists for months or years; the urine gradually increases in amount and the patient's condition becomes really very serious, the general debility and nervous depression becoming extreme and the anæmia and emaciation marked. The general mental and physical condition of these patients seems sometimes quite beyond any help which the physician can offer, and the cases are most trying ones to care for. It is when we come to a study of this class of cases that we find the greatest confusion of belief in the minds of medical men. As the disease advances it often presents a clinical picture so similar to that commonly met with in cases usually described under the name "diabetes insipidus," that confusion both as to the terms descriptive of these conditions and of the conditions themselves is a most natural result.

"Cases characterized by increased thirst and excessive discharge of a watery urine of low specific gravity, free from sugar and albumen are grouped together under the general designation of 'diabetes insipidus'" (Roberts); and therefore these cases should properly be included under that definition. Other terms often used in describing similar cases, are polyuria, diuresis, polydipsia, hydruria. These terms are often carelessly used in medical writings, without much reference to the relationship which exists between the water and the solid constituents of the urines in question.

Some writers, however, — notably Willis (who was the pioneer in this direction), Tessier and Ralfe, — are much more careful in their use of terms, and have made many attempts at classifying cases characterized or accompanied by excessive excretion of urine, according to the relationship existing between the solid and fluid constituents. For example, Willis calls the cases of excessive amount of a watery urine deficient in solids — hydruria; those of excessive amount with the urea diminished, anasoturia; and again those of excessive amount with excess of urea, azoturia. Several other similar classifications have been made, and among them one by Dr. Tessier, of Lyons, who describes a series of cases resembling diabetes mellitus in the thirst, emaciation, increased amount of urine, neuralgic pains, etc., but the urine, instead of containing sugar, had the phosphates so largely increased in amount that the daily excretion was often as high as fifteen or twenty grammes, instead of in the neighborhood of three grammes, as it should be. To these cases Tessier gave the name "phosphatic diabetes." Ralfe reports other similar cases. So these writers make a distinct class of the cases which eliminate phosphoric acid in excess.

The excessive elimination of phosphoric acid is undoubtedly a factor in some cases of polyuria. That it is not present in all such cases is, I believe, definitely proven by many analyses. Then, before we can recognize a definite disease characterized by this phosphaturia, we must know in what cases of polyuria it occurs, and must try to know the explanation of its presence. We do not know these things. Our knowledge of the part which phosphorus plays in the

body, as well as our knowledge of its elimination in diseased conditions, is very small; although during the last twenty years good work has been done in this direction, both experimentally and clinically in Germany and England. Dr. Golding Bird associated some of his spinal cases, many of which were functional, with phosphaturia. Its presence has been noted in many cases of head-injury, in acute inflammations of the cerebral membranes, in acute attacks of mania, in anæmia (and especially in its pernicious forms). It occurs in cases of diabetes mellitus; and sometimes the sugar will disappear from the urine in such cases, and be replaced by phosphoric acid. The explanation of this undoubted fact may perhaps be that the sugar in the tissues changes to lactic acid, which attacks bone tissue and dissolves out the earthy phosphates. This is Benecke's theory, I believe. Others have been suggested for an explanation of phosphaturia when sugar is not present in the urine; for example, an increased metamorphosis of nervous tissue, the irritation of some co-ordinating chemical centre, the influence of a disturbed condition of the nervous system upon the general bodily nutrition.

That these cases of polyuria accompanied by an excessive elimination of phosphoric acid have been carefully and accurately reported, is beyond question, and therefore their existence may be taken as proven; and they represent the only class of cases which is entitled to the name phosphaturia. But these cases are extremely rare, and when they do occur, present no well-marked clinical picture which will distinguish them from other similar cases of polyuria unaccompanied by an excess of phosphoric-acid elimination. Such a case, then, can only be recognized by careful quantitative analyses of the urine; and the term phosphaturia will have little interest for most of us in a clinical sense, as we may never encounter such a case in the practice of a life-time. All that we know of such cases is that they do rarely occur, that they are generally associated with grave physical disorder, and that they usually accompany nervous disturbances in which the blood and general nutrition of the patient are in bad condition.

Of the treatment of these stubborn cases there is but little to say. Annoying symptoms must be treated as they arise, and every effort made to better the general condition of the patient by careful hygienic and dietetic suggestions and suitable tonics. Alcohol always increases the flow of urine, and should be avoided. The administration of phosphorus or its compounds seems of little avail as far as experience has taught us, for as Ralfe says, "There appears to be no lack of these constituents in the system; the difficulty seems rather to lie in the want of power of the tissues to retain them."

To recapitulate the points which these notes attempt to emphasize; we have considered two conditions, both of which are commonly discussed under the name phosphaturia:

(1) The less important class of cases of digestive or nervous origin, in which the phosphatic cloud in the urine is merely an indication of a lack of acidity in the urine, which in its turn is usually traceable to some derangement of the stomach and duodenum or to some temporary nervous cause. These cases have no right to the name phosphaturia, are usually of comparatively short duration, and are cured by the treatment of the local cause and the consequent improvement of the general condition of the patient, which may closely

simulate the condition we commonly speak of as diabetes insipidus, and which should probably be classed as cases of this disease. The fact that some such cases are associated with an increased elimination of phosphoric-acid in the urine does not at present furnish sufficient evidence to justify our making a definite clinical condition of it and calling it phosphaturia, phosphatic diabetes or anything else. The term phosphaturia, then, although perfectly proper in a chemical sense, as descriptive of a urine which habitually contains too much phosphoric acid, has in the writer's belief no clinical significance in so far as there is no well-marked set of symptoms constantly occurring as an accompaniment of this sort of urine.

(2) The rare cases of severe type and long duration which closely simulate the condition we commonly speak of as diabetes insipidus, and to which Tessier gave the name phosphatic diabetes, probably because the condition occurs occasionally in a case of true sugar diabetes. These cases are so very uncommon, and present such variable groups of symptoms when they do occur, that it seems scarcely worth while to give the name phosphaturia to any definite clinical condition, although, used as descriptive of these rare cases when the urine habitually contains too much phosphoric acid, the term phosphaturia is a perfectly proper one.

Before closing, a few words relative to phosphatic calculi seem appropriate. In many of the long-continued cases, the alkaline urine is often accompanied by a more or less persistent deposit of earthy phosphates for a period covering many months. This deposit may be very considerable in amount; and such patients usually bring to you samples of it which they have collected from the urinary sediment. Yet primary phosphatic concretions are by no means common; and such cases often recover completely, with no further bad result than a vesical irritability which the presence of the phosphatic deposit in the urine has created. This may perhaps be accounted for by the fact that the deposit is usually a fine, powdery precipitate, non-crystalline in structure, and with very little tendency to form masses or concretions of any size. Certain it is, that most phosphatic calculi, the so-called fusible calculi, are of secondary formation, made up of mixed phosphates.

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