

tympanitic distention of the abdomen is a common, and indeed almost invariable, concomitant of the disease.

The peritoneal inflammation which attends epidemic puerperal fever is, I have no doubt, of an *erysipelatous* description, and the inflammation of the uterus, in all probability, *phlebitic*. This view of the nature of the local inflammation, corresponding to the symptoms and phenomena of the disease, has been corroborated by necroscopic examinations, and by the circumstance of persons who have washed the linen of patients suffering under this form of puerperal fever having become the subjects of erysipelas in its worst and most malignant aspect. Erysipelas, too, has prevailed at the same time that puerperal fever has been epidemic, so that the same constitution of the atmosphere would seem to predispose to one disease as well as the other, and hence a fair presumption arises that the two maladies are of the same nature.

In more than one instance of this disease which have occurred in my practice, I have noticed a fallacious appearance of amendment, and a remission of the symptoms, which led me to indulge a hope of recovery which the event did not warrant. In these cases the lochial discharge and the milk from the breasts have flowed more freely, and there has been less local pain and general fever. This improved aspect of things has seldom been of more than a few hours' duration, and the circumstances of the case have proceeded in *pejus ruere*.

Though delirium and mental wandering frequently occur in the course of the disease, yet the patient, in the intervals between these fits of incoherency, maintains a calm and collected demeanour, and this till a very short time previous to the fatal issue.

I wish that I had something more satisfactory to communicate as to the treatment of this formidable malady, which in my practice, I must acknowledge, has been too generally fatal, and yet this unhappy result has not obtained, from the want of prompt and well-considered application of remedial agents. Bleeding, both general and local, blistering, emetics, calomel and opium, the exhibition of turpentine, have been tried in turn, and too frequently without avail.

If bleeding be practised, it should be had recourse to very quickly after the commencement of the seizure, or it will too frequently hurry rather than avert the fatal issue. In one case, the patient, of a very delicate and apparently fragile constitution, after two bleedings from the arm, and a free evacuation from the bowels, which was obtained with difficulty, was, in all probability, rescued from the grasp of the destroyer by the timely exhibition of quinine, in small doses, very frequently repeated. If I recollect aright, a grain was given hourly. It was administered in combination with opium, which the supervention of troublesome diarrhoea rendered almost imperative, and also with camphor, though this latter drug was subsequently omitted, on account of the profuse diaphoresis which it appeared to occasion. The local pain and tenderness were evidently relieved by the application of a large blister to the abdomen, which, after the cuticle had been removed, was dressed with mercurial ointment. This application served to keep up the discharge, though it did not affect the mouth.

The patient's strength, which appeared every now and then ready to succumb under the pressure of the malady, was sustained by the liberal administration of wine and brandy, with arrow-root, and similar articles of nutriment. At one time the supervention of nausea and vomiting threatened seriously to embarrass the treatment, but this untoward symptom was opportunely relieved by an occasional dose of creosote. From the time of the seizure, two days after delivery, till about the twelfth day, the patient remained in a state of imminent danger, though the appearances became now and then more favourable. The pulse, from the third to the twelfth day, was seldom less than 130, and sometimes mounted to 150 beats in the minute. Her convalescence was somewhat tedious, but she was at length restored to her usual measure of health and strength.

During her recovery, an oedematous swelling of the lower extremities came on, which yielded to diuretics; and a chronic enlargement of the uterus remained for several weeks subsequent to delivery, but which also gradually subsided. The lady has since given birth to another, her fourth child, after an unusually quick and easy labour, and recovered without a single unfavourable symptom or untoward occurrence.

Three other cases of the same kind, similarly treated, and with a favourable result, have been communicated to me by two physicians of extensive practice and well-deserved reputation.

Should a case of the same description occur again in my practice, I should be strongly inclined to try the combined effects of bleeding, blistering, and quinine, given in small and quickly repeated doses.

The third form of puerperal fever which has come under my

notice I have designated as the remittent, because it has always, in my practice, been attended with a distinct remission and exacerbation once in twenty-four hours. I think it right to mention, that fevers of a remittent type, both in children and in patients, at an adult and more advanced period of life, are of rather frequent occurrence in this city and its vicinity. This I attribute to the circumstance of several streams passing through the lower tracts, near to the lower suburbs of the city, and the adjacent meadows being in consequence, especially in a rainy season, frequently covered with water. I know no malady of more frequent occurrence in these localities than the remittent gastric fever of children. Fever of a remittent form may, I think, fairly be accounted as an endemic in Oxford and its neighbourhood.

The febrile disorder which I have designated as puerperal remittent has appeared to me intermediate, between what I have termed the phlegmonous, on the one hand, and the erysipelatous lying-in fever on the other. The symptoms of inflammation are not so acute as in the former, nor have they that tendency to rapid and sudden collapse and typhoid degeneration which has been observable in the latter.

The remittent puerperal fever commences usually with rigor, which is followed by the usual symptoms of fever. There is a certain degree of pain and tenderness, on pressure, in the hypogastric or abdominal regions, but not so marked and severe as in the phlegmonous and erysipelatous forms. The lochial discharge is generally diminished in quantity and paler in colour than in a healthy puerperal condition, but is seldom entirely suppressed. The pulse is quick, hard, and contracted in its diameter, and generally ranges from 100 to 120 in a minute. The tongue is covered with a white fur, and the skin is hot. There is often acute pain of the head, which I have suspected to be of meningeal origin, though I have rarely met with instances of severe delirium. This pain of the head has generally occurred where the mammary secretion has been suspended.

To the best of my recollection, every instance of this kind of febrile malady, occurring in the puerperal condition, has done well, though they have caused me at times considerable anxiety, and the duration of the febrile disturbance has been generally somewhat more protracted than in what I have called the phlegmonous puerperal fever.

The *modus medendi* which I have adopted in this disease has been strictly, though moderately, antiphlogistic. It seldom requires copious depletion, and I do not remember more than one case in which I have had to bleed a second time, though I have now and then found it necessary, even after venesection, to apply leeches to the temples, and a blister to the nape of the neck, in order to relieve the pain of the head. After the exhibition of an ipecacuanha emetic, and a brisk mercurial purgative, I have usually trusted to the milder forms of diaphoretic and relaxant remedies, such as grey powder and ipecacuanha in pills, and washed down with a solution of the citrate and nitrate of potash, combined with hydrocyanic acid. Attention to the state of the bowels should be kept up, for I have generally found them inclined to a torpid rather than a relaxed condition. Under such treatment the patient has, to the best of my recollection, uniformly done well. When the febrile symptoms have been fairly subdued, quinine may be given with good effect. This, or medicines of a similar kind, should be continued till the strength of the patient shall have been thoroughly recruited.

#### ON THE CHANGES IN THE URINE EFFECTED BY DISEASE, AND THE TESTS TO DISTINGUISH THEM.

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(Read at the Sheffield Medical Society, March 20, 1845.)

BEFORE it is possible to ascertain the effect of disease upon the secretion of urine, it is necessary to become acquainted with the nature of healthy urine; and this will be best understood by studying the changes which the food undergoes in omnivorous animals, from its introduction into the stomach, to its excretion from the body in the different forms of respiration, perspiration, urine, and faeces. In concisely drawing your attention to this subject, it will be impossible to overlook the manner in which animal heat is kept up.

Our aliment is composed of carbon, nitrogen, hydrogen, and oxygen, with small quantities of soda, lime, potash, magnesia, and iron, together forming animal and vegetable albumen, fibrine, and casein. After mixing with the animal secretions of the mouth and stomach, it is called chyme; the bile unites with it in the

duodenum, from whence it proceeds into the small intestines, where it becomes chyle and excrement: the chyle is taken by the lacteals and receptaculum chyli into the thoracic duct; then into the right side of the heart, where it mixes with the venous blood. In the right side of the heart we have, then, the proteine of the venous blood, (consisting of albumen, fibrine, and casein,) with an additional quantity of these three substances added; together with the salts, converted by the hydrochloric acid of the gastric juice (derived from common salt) into hydrochlorates; and the red globules of the blood, which contain the carbonate of the protoxide of iron. There is an *excess of carbon* in our food. The venous blood is now conveyed by the pulmonary artery into the lungs, surcharged with this carbon, a combustion of part of which takes place with the oxygen of the atmosphere, and is respired in the form of carbonic acid gas, the rest being carried by the arteries to form fat and bile. Another portion of oxygen combines with some of the hydrogen, and is respired in the form of watery vapour. The carbonate of protoxide of iron of the red globules of the blood unites with another portion of oxygen and hydrogen, and is converted into hydrated peroxide of iron. This chemical decomposition disengages caloric, and thus accounts for the animal heat of the lungs. The blood is now called arterial, is conveyed into the left side of the heart, from thence to the arteries, and from thence to the capillaries, in which vessels the hydrated peroxide of iron of the red globules of the blood gives off its oxygen to the carbon and hydrogen of the metamorphosed or decayed tissues which they meet with in the capillaries, forming carbonic acid and water, and are reconverted into carbonate of protoxide of iron, thus disengaging a sufficient quantity of caloric to keep up the animal heat all over the body; the animal fibrine and albumen (or, if you please, the proteine of the blood,) replacing those parts of the decayed tissues which require it, by the vital force; and the nitrogen, hydrogen, and carbon of the decayed tissues filling up the vacuum in the capillaries caused by that organism. The blood now again becomes venous. It is charged with carbon, hydrogen, and nitrogen, from the decayed tissues, and a great portion of it goes, by the vena portæ, to the liver, from which is secreted the carbon and soda, which forms the bile; the nitrogen being conveyed again into the lungs with a fresh supply of albumen, fibrine, &c., from the thoracic duct. The same process goes on again. The renal arteries convey the blood to the kidneys in very large quantities, which secrete from it the extra quantity of nitrogen brought into it by the decayed tissues, in the form of urea and uric acid in the urine.

The above is the theory of Liebig, which easily accounts for animal heat. But since this has been before the scientific world, Professor Mulder, of Utrecht, has produced another very beautiful theory, not depending upon the chemical changes iron is supposed to undergo by Liebig. His theory is, that the iron is in the same state in both venous and arterial blood; that the proteine of the blood, when in the capillary vessels of the lungs, combines with oxygen, and is converted into oxy-protein; changing the blood corpuscles of the venous blood from transparent convex bodies into semi-opaque, double-concave lenses, by which means they reflect more light, and make the blood look lighter—arterial blood. This combination of oxygen produces the caloric in the lungs. The blood being then circulated through the arteries, is conveyed into the general capillary system, where this oxygen of the arterial blood-corpuscles is given off to dissolve the old tissue; and the protein supplies its place. The blood-corpuscles lose their concave lens figure, and become again convex and more transparent, and give a darker colour to the blood, becoming again venous. This change of oxygen also gives off caloric sufficient to keep up the animal heat of the whole body.

Which of these theories is correct is not for me to determine; they both account for animal heat very satisfactorily.

We thus see that the kidneys are the organs destined to purify the blood of its decayed nitrogen, as the liver and lungs are of its decayed carbon; and the natural healthy secretion from the kidneys is urea and uric acid, combined with some of the salts which have been introduced into the blood by the food.

Oxygen is absorbed by the skin, combines with some of the hydrogen of the decayed tissues, and forms water, which is given out, along with the nitrogen gas taken with the food, in the form of perspiration; and the rest of the carbon of the decayed tissues is excreted in the fæces, with the insoluble salts, &c.

It is quite impossible, in a short paper, to enter fully into this very important and interesting subject, but I have endeavoured to bring a few striking facts together, in order to induce some of you, more able than myself, to follow up the investigation; and I propose to do so under the four following divisions:—

1. To show what healthy urine is, and how produced.
2. To draw your attention to a number of diseases generally accompanied by a certain abnormal state of the urine.

3. To point out the easiest modes of detecting these diseased conditions.

4. Shortly to recapitulate those parts of the subject most frequently met with in practice.

#### 1. Nature of healthy urine, and how produced.

The kidneys are the organs destined to remove from the system any excess of fluid, any mal-assimilated food, and the whole of the nitrogen, with some carbon of the decayed tissues. The amount of tissue metamorphosed in a given time may always be measured by the quantity of nitrogen in the urine. That condition of the body which is called *health* involves the conception of an equilibrium among all the causes of waste and supply. If the kidneys cease to secrete, the nitrogen and water are then absorbed into the blood, and produce disease of a very serious nature.

Healthy urine, then, consists of water impregnated with urea and uric acid *always*; often with hippuric acid, phosphate of soda and ammonia, magnesia, potash, and chloride of sodium; sometimes with sulphates; the mucus of the bladder and debris of epithelium, with the colouring matter.

Urea and uric acid are composed of carbon, hydrogen, nitrogen, and oxygen, and are formed by the re-arrangement of the atoms of water, nitrogen, and carbon, sent to the kidneys by the renal arteries.

In a healthy adult, from thirty to forty ounces of acid urine are secreted in twenty-four hours, of the specific gravity of 1.020 or thereabouts, containing about eight grains of uric acid, 255 grains of urea, 138 of fixed salts, and 160 of organic matters; and is of a pale amber colour, owing to a substance called hæmaphæcin.

Urine passed soon after drinking water (*urina potus*) is about 1.005; secreted soon after a hearty meal, (*urina chyli*), 1.025; after a night's rest, (*urina sanguinis*), 1.020. To be quite sure of the gravity, these three specimens should be mixed. Urine always contains more water, and is lighter, after drinking freely of water; and contains less, and is heavier, after copious perspiration, and in hot weather.

In order to ascertain the quantity of solid matter in urine of any specific gravity, Dr. Christison has invented a table, by which you see, in a moment, the solid contents in 1000 grains of urine, first finding the specific gravity. And if you save the whole urine of a patient for twenty-four hours, weigh it, and take the specific gravity, you have then, by a simple rule of proportion, without further trouble, the whole solid contents in twenty-four hours.

The urine of carnivorous animals is acid, but the urine of herbivorous animals is alkaline. The natural state of the human urine is acid, but becomes alkaline by living entirely on vegetable food.

Urine, left to itself, is converted into a solution of carbonate of ammonia. The carbon of the urea combines with the oxygen of the water, and is converted into carbonic acid; the nitrogen combines with the hydrogen of the water, and is converted into ammonia.

#### 2. Certain diseases accompanied by abnormal condition of urine.

Excessive indulgence in animal food, with too little bodily exercise, dyspepsia, and want of perspiration, are always attended by increase in the quantity of uric acid and urates.

Uric acid is frequently produced in great quantity in the bladder, by the hydrochloric acid formed in the stomach from disease of that organ; which, being absorbed into the blood, and secreted by the kidneys, forms hydrochlorate of ammonia, and deposits the uric acid.

In fever, and all diseases accompanied by rapid emaciation, the urine is of a high specific gravity, a dark brown-red colour from excess of urea, uric acid, urate of ammonia, and sometimes blood and purpurine. The lateritious sediment is urate of ammonia. And in extreme cases of acute rheumatism and hypertrophy of the heart, very large quantities of uric acid and urate of ammonia are commonly found.

In all acute diseases attended by great emaciation, inflammation, or disorganization, with unhealthy digestive organs, as long as the kidneys remain healthy, uric acid is secreted in abundance; but if the kidneys become diseased, as in morbus Brightii, diabetes, &c., then the secretion from the kidneys is perverted; part of the nitrogen remaining in the circulation, and the carbon, hydrogen, and oxygen, assuming the forms of albumen, sugar, hippuric and oxalic acids, &c. In diabetes mellitus, when starch, sugar, &c., do not undergo the changes required to be converted into carbon or fat, the starch is converted into grape-sugar by oxygen, and the sugar is excreted by the kidneys.

In gout and rheumatism, urate of soda is found both in the urine and deposited in the joints and sheaths of the tendons.

When pressure on the renal veins exist to such an extent as to prevent the return of blood to the cavæ, as from a tumour,

pregnancy, or diseased viscera, the elements of the blood are often poured out by the kidneys; and, on examination, we find albumen, blood-discs, and the colouring matter of the blood, (hæmotosine.) And in granular disease of the kidneys, and anasarca after acute disease of the skin—as scarlatina and extensive burns—albumen in large quantities is detected; but when the kidneys and skin regain their natural functions, uric acid and urea are again secreted in the place of albumen.

In all diseases of an anæmic or chlorotic nature, attended by languid circulation and extreme debility, independent of acute disease, a deficiency of urea and uric acid is found, and no deposit takes place unless there is a very small secretion of urine. In hysteria, there is a large flow of limpid urine, of low specific gravity, and of a green colour. In chlorosis, the urine is also of a low specific gravity, and green; and this green colour is owing to the mixture of cystine with hæmaphæin.

When the functions of the skin are impaired only, an excess of urea and urate of ammonia is always the result; and if, in this case, profuse perspiration occurs, the fluid goes off by that process instead of the kidneys, the specific gravity of the urine becomes increased, and deposits frequently take place in the bladder in consequence, forming calculi, owing to deficiency of fluid; but, if the skin is imperspirable, then the kidneys carry off the extra quantity of water, and the urine becomes lighter; but the animal acid (lactic or butyric) which ought to go off by the skin, is secreted by the kidneys, and, combining with the ammonia or soda of the urates, produces uric acid.

When the functions of the liver are deranged, carbon is eliminated with hydrogen and cholesterine from the kidneys, which gives the peculiar colour to the urine in all cases of jaundice.

In organic mischief in the liver and spleen, or great congestion of the vena portæ, the urine is very red, purple, or copper-coloured, owing to purpurine and urate of ammonia; but when bile is circulating in the system from disease of the gall-ducts &c. the urine is very brown, and easily shows bile by the proper tests. In contracted, hobnail, or cirrhotic liver, the extent of the disease may generally be measured by the quantity of purpurine in the urine; and usually in ascites from diseased liver, we find purpurine; but in ascites from peritoneal disease we find none. The purpurine appears to proceed from the altered condition in the portal circulation.

When the liver and lungs are both so diseased as to prevent the proper quantity of carbon being carried off by their functions, hippuric acid is sure to be found in the urine.

In cases where organic mischief exists in the kidneys, the urine is frequently semi-solid when cold, and of a dark colour, like a mass of black currant jelly. And when hæmorrhage from some part of the urinary organs takes place, the urine is red, and shows quantities of blood-discs under the microscope. In fungus hæmotosides of the kidney, the urine looks like infusion of roses while warm, and like red currant jelly when cold, taking the form of the vessel.

During the progress of pneumonia, less carbon will be eliminated from the lungs, and therefore more will be in the urine and liver; consequently, hippuric acid is often found. And in confined situations, where animals are obliged to breathe impure air, the globules of the blood are not sufficiently supplied with oxygen, carbon cannot be converted into carbonic acid in the lungs, and life could not go on unless the kidneys secreted more nitrogen and carbon in the forms of urate of ammonia and hippuric acid.

In hepatitis, the carbon is not converted into bile; and, as long as the other secretions are going on properly, the carbon which ought to form the bile is converted into fat and oil, and is found in the blood and urine.

We often meet with melancholy, highly-nervous, emaciated patients, simulating diabetes mellitus, but even more depressed in spirits, who merely complain of great debility and exhaustion, with some little pain in the back or loins, for which we find it very difficult to prescribe effectually. Dr. Golding Bird (to whom I am greatly indebted for much of the contents of this paper) has clearly shown that most of these cases are owing to imperfect assimilation in digestion, converting the urea of the nitrogenous part of the food into that state which is secreted by the kidneys as oxalic acid and ammonia instead of sugar, which, combining with the lime of the phosphates, produces the oxalate of lime diathesis; and it is to the derangement of the stomach, duodenum, and liver, that we must look for success in the treatment of these cases. I have met with two patients of this description latterly, whose cases would have puzzled me very much before I read Dr. Bird's paper.

**Alkaline Urine.**—When, from any cause, as the consequence of wear and tear in old age, excess of study, or great excitement of the brain, an injury to the spine, or stone in the bladder, the kidneys or bladder are deprived of their natural supply of nervous power, the elements of urea combine with the elements of water,

and are converted into carbonate of ammonia, which, by irritating the mucous membrane, and neutralizing the solvent phosphoric acid, throws down the triple phosphates, and phosphate and carbonate of lime, and renders the urine alkaline. Thus we find, in almost all cases of long-continued calculi in the bladder—let the calculus be composed of what it may—that the urine is strongly alkaline, ammoniacal, and deposits phosphate of lime, which sticks to the bottom of the vessel like birdlime. The fusible calculus is composed of the ammonio-phosphate of magnesia and phosphate of lime.

In persons who are confined to very sedentary habits, with great mental exertion, for a length of time, and then obliged to use violent muscular exercise for a few days, as clergymen with small livings, lawyers, and schoolmasters, alkaline urine, with abundance of earthy phosphates, is usually the consequence; and this unnatural secretion brings on a degree of debility not easily accounted for in any other manner.

In irritative dyspepsia in gouty habits, the urine often contains the phosphates in abundance; and whenever the triple phosphates, with alkaline urine, are deposited for a length of time together, both in the night and morning urine, accompanied by emaciation, there will always be found organic disease, either in the digestive organs, kidneys, or bladder, if not in the spine.

Dr. Golding Bird gives the following rule respecting the phosphates, which will be found very useful in practice:—That where the presence of phosphates is only found in the evening urine, organic disease is rarely the cause of it; but where they are found equally in the morning and evening urine, you may be sure organic disease exists.

In bad cases of typhus fever, the urine is frequently ammoniacal towards the close of the disease, the nervous system of the kidneys being too depressed to secrete urea, and its elements being converted into carbonate of ammonia, just as they would be in common chemical decomposition out of the body.

During retention of urine from diseased prostate gland, stricture of the urethra, or where a catheter is obliged to be worn, the urine is always alkaline, owing to irritation in the mucous membrane.

These observations might be carried to an almost indefinite extent, but enough has been remarked to convince any one of the value of observing the chemical nature of urine in disease. To arrange these cases scientifically would take up too much time on this occasion.

3. We will now endeavour to point out the easiest modes of detecting the contents of diseased urine, under the following divisions—viz., 1. Crystalline contents; 2. Colouring matters; 3. Organic deposits.

The only necessary apparatus for these experiments are, a urinometer, test tubes, watch glasses, spirit lamp, and a good achromatic microscope. The re-agents are well-known to the profession.

#### CRYSTALLINE CONTENTS.

**Urea.**—When this is in excess, the urine is of a high specific gravity, and generally of a reddish colour. By adding an equal quantity of nitric acid in a watch glass, it crystallizes at the bottom very soon as nitrate of urea; when the urea is in excess, it soon becomes solid. By combining with two atoms of water, urea is converted into carbonate of ammonia; and this accounts for urine becoming alkaline and pungent soon after it has cooled. A little excess of mucus aids this process.

**Uric acid or Lithic acid** is the substance of which the greatest number of urinary calculi is composed. The urine is high-coloured; specific gravity generally above 1.020, and contains an excess of urea. Uric acid, acting on the phosphate of soda and ammonia, (or microcosmic salt,) existing in urine, is decomposed; urate of ammonia is formed, and phosphoric acid set free, which is the cause of the acid re-action of urine. So that uric acid is usually found in the form of urate of ammonia. To detect it, warm the urine containing urate of ammonia in a watch glass, and the uric acid becomes deposited at the bottom of the glass, and when viewed by the microscope is seen crystallized in red rhombic prisms. It is familiarly known by the names of yellow and red sand. Heat does not dissolve it. Pure uric acid is only soluble in 10,000 parts of water at 60°, and is insoluble in alcohol. Liquor potassæ dissolves it, forming urate of potass. Hydrochloric and acetic acids have no action. It is dissolved by nitric acid; and by evaporation, a pink colour (becoming a rich purple on being held over the vapour of ammonia) is produced. This is purpurate of ammonia. Exposed to heat in a platinum spoon, it burns, evolving an odour of bitter almonds, and leaving phosphate of soda and lime behind.

**Hippuric acid.**—This is rich in carbon, and found plentifully in the horse and cow. Evaporate the urine to a syrup, add excess of hydrochloric acid; uric acid and hippuric acid will then be separated and fall to the bottom; pour off the supernatant

fluid, and wash in cold water; boil the residue in alcohol, in which hippuric acid is soluble, and uric acid is not, from which it gradually crystallizes in delicate coloured needles, very visible under the microscope. It is soluble in four hundred parts of water at 60°.

*Urate of ammonia.*—This is the *lateritious sediment*, soluble in 480 parts of water at 60°. The colour of this urine is from pale to crimson; specific gravity from 1.012 to 1.025; it often contains floating masses. The deposits are from fawn colour up to purple; they never appear until the urine has cooled, and disappear by heat. Liquor ammoniæ and liquor potassæ dissolve them. The floating masses disappear by heat, contrary to albumen. When it becomes turbid from a drop of nitric acid, the microscope will show crystals of uric acid. A drop of urine containing urate of ammonia examined on glass by the microscope shows an amorphous powder, composed of myriads of minute globules; but add a drop of hydrochloric acid, the muddiness disappears, and crystals of uric acid will be seen, the ammonia having deserted the urate to combine with the acid. The colour of urate of ammonia is always owing to its union with purpurine. It is quite white when pure.

In examining numerous large deposits of urate of ammonia under the microscope, I have always found, on the addition of weak nitric acid, an appearance of globules so like pus, but more coloured, that I cannot avoid mentioning it particularly, for I have never seen it named by any author; and it is so constant in its appearance, that I am led to conclude it depends on some chemical combination of the animal matter of the urea with the nitrogen of the nitric acid.

*Urate of soda.*—Very rare, except in gouty diathesis, and fever treated by carbonate of soda. Heat does not dissolve the deposit so quickly as it does urate of ammonia.

*Uric oxide, xanthic oxide.*—Very rare, supposed to have some connexion with the yellow colouring matter of the urine, (hæmaphæin.) It resembles uric acid if noticed inattentively. Colour is salmon or cinnamon tint, not so red as uric acid. The deposit caused by uric oxide is a grey powder to the naked eye but under the microscope resembles small particles of yellow wax. It is insoluble in solution of carbonate of potass, whereas uric acid is soluble. Ignited in a tube, it does not yield urea, and uric acid does.

*Cystine.*—This is very rare, and contains 26 parts in 100 of sulphur. This urine looks like diabetic urine; but it is of a very low specific gravity. It smells of sweet brier when fresh, but soon putrefies, and evolves sulphuretted hydrogen. It is usually found in scrofulous habits. Cystine forms a deposit like the pale variety of urate of ammonia; but, unlike that deposit, it is unaffected by heat, and it very slowly dissolves on the addition of nitric or hydrochloric acids. It is soluble in the mineral, and insoluble in the vegetable acids. Soluble in ammonia, the fixed alkalies and their carbonates, but insoluble in carbonate of ammonia. By heating on platinum foil, it burns with a disagreeable odour. An evaporated solution of cystine in ammonia under the microscope, crystallizes in six-sided laminæ very distinct. It requires caution to distinguish this from chloride of sodium in urine, which naturally crystallizes in cubes, but when combined with urea assumes an octahedral shape. The ammoniacal solution stains a white glass-bottle black, from the combination of the sulphur of the cystine with the lead of the glass.

*Oxalate of Lime.*—This salt was considered very rare in the urine, but Dr. Golding Bird has proved, in his lectures in the *Medical Gazette*, that it is even more common than the earthy phosphates. The urine is acid, has a naturally healthy appearance, the specific gravity from 1.015 to 1.025, generally with some epithelial scales, and always with a large quantity of urea, uric acid, or urates. To discover the oxalate of lime, set aside the chylous urine for many hours in a glass vessel; decant the upper eight-tenths of it; pour a little of the bottom into a watch-glass, warm it, and the oxalate will fall to the bottom; remove the top part of the fluid with a pipette, and under the microscope we find the beautiful transparent octahedral crystals of oxalate of lime; collect and ignite the crystals on platinum foil, oxalic acid is decomposed, and carbonate of lime left, which dissolves in dilute nitric acid, with effervescence. These crystals are unaltered by boiling in acetic acid, or solution of potass. They dissolve without effervescence in nitric acid.

*Ammonio-phosphate of soda, or microscopical salt.*—This is usually decomposed by uric acid in the bladder: urate of ammonia is formed, the phosphoric acid being set at liberty, which becomes the source of the natural acidity of the urine. The very small proportion of soda combines with uric acid, forming urate of soda.

*Ammonio-phosphate of magnesia, or triple phosphate, and the phosphate of lime,* are nearly insoluble in water, unless it contains a very small proportion of any acid, or hydrochlorate of ammo-

nia; consequently, in healthy urine these earthy phosphates are held in solution by the phosphoric acid. This urine is generally pale, wheylike, plentiful, and of low specific gravity, 1.005 to 1.015. When the urine is alkaline from disease, these salts deposit, and are always white, unless coloured with blood. They are soluble in weak hydrochloric acid, and insoluble in ammonia and liquor potassæ. Heat agglomerates the deposit into masses, but produces no other change. By adding a small quantity of ammonia to urine containing any earthy salts, deposits of triple phosphates take place, which, under the microscope, are seen either in minute white triangular prisms, stellæ or acicular prisms, or foliaceous crystals, and are very easily detected. These disappear on adding a drop of any acid. When the urine is alkaline these deposits are abundant.

*Phosphate of lime* is never found in crystals. It is a very opaque sediment, and a drop examined by the microscope between plates of glass, appears white by reflected, and yellow or brown by transmitted light.

To distinguish the deposits of the triple phosphates from pus and blood, nothing but their appearance under the microscope can be depended upon. From mucus, add hydrochloric acid, which will dissolve the phosphates, but *not* the mucus. From albumen, add nitric acid, which dissolves the phosphates, but deposits the albumen.

*Carbonate of lime* is sometimes met with as a deposit in alkaline urine. It is formed from the decomposition of phosphate of lime by the carbonate of ammonia. To discover it, wash the deposit well with water, which dissolves the carbonate of ammonia, and add any dilute acid, which will dissolve the carbonate of lime with effervescence. Examined by the microscope, they appear beautiful small transparent spheres, like globules of glass, and strongly refract light.

*Silicic acid* has very rarely been found as a deposit in urine, but it is often used by impostors, which it is necessary to be aware of.

#### COLOURING MATTERS.

*Purpurine.*—This is a substance of great consequence to become acquainted with, as its presence always indicates serious functional or organic mischief in some of the organs connected with the portal circulation. It has been considered as the same substance as purpurate of ammonia, or the murexid of Liebig; but Dr. G. Bird has clearly proved it to be a substance *sui generis*. Purpurine is quite soluble in alcohol; purpurate of ammonia is insoluble. It always combines with urate of ammonia, causing that deposit to vary in tint from a mere flesh colour to the deepest carmine, and is often mistaken for blood. To distinguish it, solve the purpurine in alcohol, examine the rest under the microscope, and the absence of blood-discs will prove it. Of course, the appearance under the microscope is that of amorphous red urate of ammonia. If a small quantity is suspected, add hydrochloric acid to the warmed urine, and a colour, varying from lilac to purple, will immediately be produced, if purpurine be present. By evaporating urine containing it to a syrup, and digesting it in alcohol, we obtain a purple tincture, which colour is heightened by acids and diminished by alkalies. The specific gravity of urine containing this substance varies from 1.015 to 1.030; it is not altered in colour by boiling; nitric acid added to it often produces a copious deposit of uric acid, often mistaken for albumen.

*Cyanurine* gives a blue colour to urine; it deposits as a blue powder, which may be separated by filtering; freed from mucus, urates, and phosphates, by washing with water, and digested with hot sulphuric acid, from which it must be carefully precipitated by magnesia; or it may be obtained by boiling the blue deposit in alcohol, and evaporating it to dryness. It is insoluble in water; moderately soluble in boiling alcohol; soluble in diluted acids, which become brown or red. The solution, in sulphuric acid, leaves, by evaporation, a carmine-red extract, soluble in water. It is precipitated, unchanged, from an acid solution by ammonia, lime-water, and magnesia. It forms a red colour by dissolving in a hot solution of alkaline carbonates, and a brown one in pure alkalies. Distinguished from indigo by not sublimating when heated in a tube, and from percyanide of iron by not yielding sesquioxide of iron, when treated with carbonate of potass, very rare.

*Indigo* gives a dark-blue colour, which deposits by repose in urine, and may be collected on a filter. It dissolves in strong sulphuric acid, forming a purple solution. Nitric acid converts it into nitro-picric acid; carefully heated in a tube it sublimes in purplish red crystals. The best test is, to heat the deposit in a tube, with a little grape-sugar, in a mixture of equal parts of alcohol and liquor potassæ; the blue colour disappears and it becomes yellow. By agitation and exposure to the air it becomes red, and at last green—from the reproduction of blue indigo. This also is rarely met with.



*Percyanide of iron*, or prussian blue, now and then occurs when iron has been taken some time as a medicine, by combining with cyanogen—the result of the re-arrangement of the atoms of urea. It consists of a blue powder, insoluble in water and alcohol. Digested with liquor potassæ its colour is destroyed, sesquioxide of iron being liberated, and a yellow solution of ferrocyanide of potassium being formed. This solution is precipitated blue by sesqui-salts of iron, and brown by sulphate of copper.

*Melanourine and melanic acid* are rarely found in urine; their chemical composition is not yet sufficiently known.

*Hæmaphæin* is the yellow colouring matter of the urine, which gives to urate of ammonia its yellow colour.

*Cholesterine* is a substance very rich in carbon, is supposed partly to give the colouring principle to the bile, and is often detected in urine in the form of bile.

#### ORGANIC DEPOSITS.

In addition to the former substances found in urine, the elements of blood, albumen, hæmotosine, and blood-discs, pus, mucus, organic globules, epithelium, milk, fat, sugar, bile, spermatozoa, and vibrones, are often discovered. Very few remarks on each of these substances may suffice.

*Blood*.—Urine containing blood coagulates into blackish masses, like currant jelly, and often comes from the urethra in pieces like leeches. The urine containing the liquor sanguinis coagulates spontaneously, and looks like blanc-mange, owing to the fibrin in it. To detect blood, boil and filter the urine; brown coagula of hæmotosin and albumen will remain on the filter. Add liquor potassæ, and if blood be present, a greenish solution will pass through, from which white coagula of protein may be precipitated by hydrochloric acid.

Urine containing blood becomes darker in colour by boiling, but not so if the colour is owing to purpurine. Uric acid is not affected by heat, and is distinguished by the microscopic character of the deposit; bile, by its characteristic tests; hæmatoxylin, by the dark precipitate produced by sulphate of iron, and absence of coagulation by heat.

The blood-corpuscles, particles, discs, or globules, are shown most distinctly by the microscope, as little rings; but, by minute examination, are really double concave discs, of a uniform size, and yellow colour.

*Albuminous urine* is clear, straw-coloured; sometimes a dingy red, from blood, and then it contains less albumen. Its specific gravity ranges from 1.008 to 1.012. It may be detected by heat, nitric acid, bichloride of mercury, ferrocyanuret of potassium with acetic acid, and caustic potass.

1. Put the urine into a test tube, hold it over a spirit-lamp, and, if the urine is acid, and contains albumen, it will become opaque without boiling; and the more albumen it contains, the more solid will the urine become as the heat is increased. If the precipitate is owing to the earthy phosphates, it disappears by adding any acid. Sometimes heat, long continued to ebullition, will produce a deposit from urate of ammonia, but this only occurs from the long-continuance of the ebullition. If the urine is alkaline, heat will not deposit albumen, but nitric acid will.

2. By adding *strong nitric acid* to albuminous urine in a test tube, an immediate coagulation of albumen occurs; but this happens sometimes in patients under the influence of copaiba, cubebs, and other resinous drugs; and is distinguished from albumen by not being deposited by heat.

3. A saturated solution of *bichloride of mercury* precipitates albumen a dense white.

4. *Ferro-cyanuret of potassium* gives a flocculent precipitate (white) with albuminous urine, to which a few drops of acetic acid has been added.

5. A solution of *caustic potass* produces a white precipitate of gelatine.

*Pus*.—This urine is generally acid or neutral, and slow to become putrid; by repose, pus falls to the bottom, like cream, of a greenish colour, not hanging in ropes like mucus, and mixing with the urine on agitation, acetic acid having no effect on it. On mixing the deposited pus with an equal quantity of liquor potassæ, a dense, semi-opaque, gelatinous mass is formed, which can scarcely be got out of the tube. Albumen can always be detected in the urine containing pus. Agitated with æther, fat is dissolved; which, on evaporation, is found in globules. Alkaline urine requires great care in detecting pus. Phosphatic deposits sometimes resemble pus very closely; but by microscopic examination the pus particles are distinctly seen floating in liquor puris, which is coagulated by heat and nitric acid; they are white, round, roughly-granulated outside, and much more opaque than blood-corpuscles. By adding a drop of acetic acid to them while under the microscope, the interior of the particle becomes visible, and is found filled with several transparent nuclei. The earthy phosphates give their usual crystalline appearance.

*Mucus*.—Urine depositing mucus is generally alkaline; it soon putrefies; becoming almost ammoniacal in the bladder. It is very viscid and tenacious, forming a continuous rope when poured from one vessel to another. If the upper stratum of urine is acid, the mucus is always alkaline. Mucus will not mix with urine as pus does.

*Acetic acid* corrugates the mucus into a thin, semi-opaque membrane, which at once distinguishes it from pus. Mucus urine contains no albumen. Æther dissolves scarcely any trace of fat. When the urine contains a large quantity of earthy phosphates, it is difficult to distinguish between pus and mucus, except by the microscope. The microscopic appearance of mucus granules is very like pus, but they float in a viscid glairy fluid, (liquor mucii,) which does not coagulate by heat or nitric acid.

*Organic globules*, large and small, can only be detected by the microscope; they are larger than pus and mucous granules, and have a darker colour. They are very common in albuminous urine.

*Epithelium*.—These are a part of the mucous membrane of the genito-urinary organs. Under the microscope, they appear like oval or angular flattened cells, with a centre nucleus.

*Milk*.—In utero-gestation, I have found milk in the urine; and Dr. G. Bird gives very clear and satisfactory proofs of its frequent occurrence. To detect it, allow the suspected urine to repose in a cylindrical vessel, exposed to the air, for several days, and the milk (kiestein) will rise to the surface in a fat-like scum, remaining permanent for three or four days.

*Fatty urine* has the appearance of diluted milk; it often spontaneously gelatinizes, like blanc-mange, on cooling. This is called chylous urine by Prout. On agitating the fresh urine with an equal bulk of æther, the fat is dissolved, and when the æther is evaporated in a watch-glass, it leaves globules of oil. The urine always contains albumen.

*Spermatozoa*.—When in the acid urine of a man there exists a cloud, which is not cleared by nitric acid or heat, this may be suspected. Allow the urine to subside in a conical vessel; decant the top, and view a drop of the bottom under the microscope. These minute beings will be easily detected as minute ovate bodies, with a bristle-like tail; which is more distinct when viewed dried on the glass.

*Bile* often tinges the urine a deep-brown colour. In addition to the old method of dipping in a bit of linen, and drying it, the following are the best modes of detecting bile:—

Pour a small quantity of urine on a white plate, so as to form a very thin layer. Carefully add not more than a couple of drops of nitric acid in the centre; an immediate play of colours, in which green and pink predominate, results.

Add to a few drops of the urine, on a white plate, a little strong sulphuric acid; when the mixture becomes hot, add a drop of saturated solution of lump sugar. It immediately assumes a fine purple colour.

*Sugar* is the principal ingredient in the urine of diabetes mellitus. It is generally clear, of a lemon colour, secreted in large quantity, and of the specific gravity of from 1.030 to 1.055. When this urine is left in a warm place, a scum forms on its surface, which, if examined by the microscope, consists of what are called torulæ; and if put into syrup, grow so quickly as to be seen under the microscope almost increasing. The sugar of this urine is like the grape sugar. The following are the best tests:—

1. Evaporate the urine to an extract; digest it in hot alcohol; when cold, allow the tincture to evaporate spontaneously in a cupping glass, when white granular masses of sugar will crystallize on the sides of the glass.

2. *Trommer's Test*.—Add to the suspected urine, in a large test tube, just enough solution of sulphate of copper to make it a faint blue, a deposit of phosphate of copper falls; add liq. potassæ in great excess, hydrated oxide of copper first falls, which redissolves in the excess of alkali, forming a blue solution like ammoniuret of copper. On gently heating the mixture to ebullition, a deposit of red oxide of copper falls.

3. *Capezzuoli's Test*.—To the urine in a conical glass vessel add a few grains of blue hydrated oxide of copper, and render it alkaline by the addition of liquor potassæ. If sugar be present it assumes a reddish colour, and in a few hours the edge of the deposit of oxide becomes yellow, which gradually extends through the mass, from a reduction of the oxide to the metallic state.

4. *Moore's Test*.—Add to ʒij. of the suspected urine in a test tube, half its bulk of liquor potassæ; heat it over a spirit lamp, and keep it boiling for a minute or two; the pale urine will become an orange brown, or bistre, according to the proportion of sugar present.

*Vibrones* are minute animalcules, occasionally developed in urine, which is pale, neutral, and of a low specific gravity, and speedily becomes putrid. Under the microscope these animals

appear minute linear bodies, not so long as the diameter of a blood-disc; they are alive, and move, in an oscillatory manner, in fresh urine.

#### 4. To recapitulate.

Gentlemen, I will only detain you another moment, while I beg to assure you that it is a very easy task, after a very few trials, to discover, in a few minutes, the contents of almost any ordinary specimen of urine; and, without this knowledge, it is quite impossible to become acquainted with the changes which are constantly occurring in the urinary organs.

For instance, you are called to a patient complaining of excruciating and deep-seated pain in the abdomen, shooting down the thigh, which resists the usual soothing mode of treatment. Examine the urine, and you may there find blood, pus, oxalate of lime, uric acid, or phosphates. This at once explains the nature of the malady, and you can confidently tell your patient that he has a small calculus of a certain description in the ureter, and your treatment is no longer empirical. Or you may be consulted by a person with various anomalous symptoms of a cachectic nature, which you would find it impossible to give a name to unless you examine the urine chemically, when you discover either albumen, sugar, or oxalate of lime excreted; and this at once explains the case.

A patient consults you, much reduced in strength, depressed in spirits, and emaciated, his appetite being good, and digestive organs healthy, as far as you can discover, there being no evident cause for such a state. Take the specific gravity and quantity of the urine. If it is high, without deposit, and the quantity not great, add nitric acid to it in a watch-glass, and you will most likely discover a large quantity of urea, sufficient at once to account for the symptoms; or if the quantity of urine be large, you may discover sugar.

During the course of febrile and inflammatory diseases, urate of ammonia is generally deposited. But if the symptoms increase, instead of diminish, under this deposit, examine it, and perhaps you may find the deposit to consist of phosphates and purpurine, and the urine alkaline. This will at once warn you to be watchful of your patient, and cautious in your prognosis.

Suppose you have a surgical operation to perform on a patient apparently out of health, but with no decided disease. If, on examining the urine, you find albumen, oxalate of lime, or the ammonio-phosphates of magnesia in abundance, you may feel assured the person is in an unfit state to bear any operation; and by waiting, and attending to his general health, you will feel more confidence in the successful event of such an operation.

Although Sir B. C. Brodie, Dr. Prout, and other late writers on diseases of the kidneys, have laid great stress on the cachectic state of the system, accompanied by alkaline urine, it was reserved for the splendid discoveries of Bright and Bird to elucidate the real value of these pathological changes.

The little that I already know of this subject has convinced me that, when properly studied by medical practitioners, they will find in it as true a diagnosis to the diseases of the abdominal and extra-abdominal viscera, as percussion and auscultation are to the diseases of the chest.

The various deposits of a great number of specimens of urine were then successfully exhibited to the members.

## BRITISH MEDICAL JOURNALS.

In a late number of the *Medical Gazette*, Mr. Pooley describes the following

#### CASE OF POISONING BY HYDROCYANIC ACID.

"On the evening of the 23rd of January, I was summoned to the aid of Mr. H—, a medical gentleman of Stratton, near Cirencester, who was reported to have poisoned himself. I found him lying on his back on the hearth-rug, his head supported by a folded shawl. His countenance was placid, and free from all contortions, his eyes closed, and the pupils not largely dilated; a fresh healthy colour was on his cheeks. His limbs were quite supple, and his body warm. Life had been extinct about ten minutes. From the statement made to me in the room, and which afterwards appeared in evidence at the inquest, I learnt that he had returned home from a long round of visiting, much fatigued, and feeling a pain in his chest, took the bottle of acid from its place in the surgery, and went into the parlour adjoining, for the purpose of taking a minim dose to relieve it—a remedy he had more than once had recourse to before, for the same purpose. While there he was heard to stagger, and as the house-keeper rushed into the room, he fell, and an ounce phial, about half full of hydrocyanic acid, of Scheele's strength, corked, dropped from his hand. She rang the bell violently, and gave

the alarm, and in five minutes, his brother, who is a medical man, was on the spot. He was then breathing, and his pulse was distinctly perceptible at the wrist. Notwithstanding every means tried to counteract the effects of the poison, he expired in a few minutes without any scream, and quite tranquilly.

"*Appearances twenty-two hours after death.*—Weather very cold. The body was cold and rigid. All the depending parts, as the back, shoulders, bend of elbows, &c., were of a mottled purplish colour. On opening the chest, the right lung presented a dark dusky purple appearance, was not much collapsed, and contained air. On being cut into, a frothy dirty-brown semi-mucous fluid exuded, tinged with blood. There was no odour of prussic acid from it. In the cavity of the right pleura were about eight ounces of thin serum; the surface of the pleura was not marked by any evidence of inflammation. The left lung was of a pale colour, quite exsanguine, contained but little air, and poured out only a whitish frothy mucus on being cut into; it was firmly adherent in its whole extent to the costal pleura of the same side, and, posteriorly, the adhesions were so strong as to defy my strength to separate them. The pericardium was natural; it contained perhaps a little more fluid than usual in its cavity. The heart was small, and firmly contracted, and the vessels on its surface distended with fluid blood. On cutting into it, about three ounces of dark-coloured fluid blood trickled out, without the least appearance of coagulation having been attempted. It exhaled no smell of prussic acid. The parietes of the ventricles were a little thicker than usual. The liver was large and healthy. The spleen soft and easily broken down, resembling mulberry jam. The kidneys were firm, rather large, and slightly coagulated. The stomach contained about fifteen ounces of half-digested food, that gave out the peculiar smell of food undergoing digestion, with which also could be satisfactorily recognised the well-known odour of bitter almonds. The mucous coat of the stomach was healthy, and smelt strongly of prussic acid after the stomach had been emptied of its contents. The intestines were healthy. The brain and its coverings were healthy, but its vessels and its sinuses were filled with dark-coloured fluid blood. It was quite free from any smell of prussic acid.

"In this case, 1st, he had power to cork the bottle after having taken the poison; indicating its paralyzing effects on the sensorium not to have been instantaneous. 2nd. The placid state of his features, unmarked by any act of expiring. 3rd. There was no scream, but he died tranquilly and silently. 4th. The congested state of the right lung might more reasonably be referred to the effects of chronic pneumonia than to the poison. 5th. The blood was everywhere dark coloured and fluid. 6th. The odour of bitter almonds was satisfactorily recognised in the stomach, and nowhere else. 7th. He lived nearly ten minutes after having taken the poison."

#### REMARKS ON A CASE OF POISONING BY HYDROCYANIC ACID.

A subsequent number of the *Medical Gazette* contains another case of poisoning by this acid. The subject is of so much importance, and the remarks from which the principal facts connected with the history of the case, detailed by Messrs. Hicks and Waterworth, may be gathered, are so appropriate, that we transfer them, only slightly abbreviated, to our pages:—

"The history is in every respect complete: the poison was accidentally swallowed in the presence of a person who was able to observe and give a good account of the symptoms to Mr. Hicks. This gentleman arrived ten minutes before the death of the deceased, and noticed for himself some of the most striking symptoms;—a complete inspection of the body was made; the post-mortem appearances were accurately noted, and lastly, the exact quantity of poison swallowed by the deceased was most satisfactorily determined by a chemical examination of the lotion of which she swallowed a portion.

"In respect to the symptoms, it would appear, from the father's statement, that he first heard a gasping noise, but there was no shriek or scream. This case puts an end to the theory that poisoning by prussic acid is always accompanied by a 'death-scream' or 'shriek,' a subject of discussion at the recent trials. There was the slow, laborious breathing, at long intervals, foaming at the mouth, protrusion of the eyes, dilated pupils, pulselessness, and insensibility. Mr. Hicks states that there was no stertor; that during the convulsive fits the head and neck seemed to be spasmodically drawn down into the chest. The convulsions do not appear to have been so great as to affect the trunk. Emprostotonos and opisthotonos were absent, a fact which may account for the want of evidence of a distorted or convulsed state of the body, with disturbance of the clothes, in persons who have been found dead in bed, and who had taken prussic acid. The most remarkable part of the case is, that the