

part, using a very small quantity. Pressure by means of a graduated series of bougies is a valuable mode of treating those cases in which the membrane is much thickened.

EPISTAXIS—NASAL HÆMORRHAGE.

Causes.—The Schneiderian mucous membrane is abundantly supplied with blood-vessels and bleeds easily. *Epistaxis* may be caused by ulceration of the membrane, by vascular tumors, by traumatism, by a constitutional state—the hæmorrhagic diathesis—by irritation of the mucous membrane, and by mechanical causes, as valvular disease of the heart, and the pressure of an intra-cranial growth, etc.

Symptoms.—There may be a sense of fullness of the head, headache, noises in the ears, vertigo, precede the epistaxis, and be relieved by it, or the bleeding may occur without any previous symptom to indicate its approach. The blood may at first be observed on the handkerchief; a sense of moisture about the nares suggests the necessity of blowing the nose, and then blood is seen coming drop by drop, and from a single nostril. The blood may be discharged by the posterior nares and be expectorated. On inspection of the fauces, it will be seen trickling down the soft palate and uvula, which will prevent the mistake of supposing it comes from the lungs. The quantity of blood discharged varies greatly. In most cases an ounce or two is lost, when the flow spontaneously ceases; again, many ounces—a pint, a quart even—may be lost, completely blanching the patient, and only ceasing because of the faintness. If the bleeding occur in a subject of the hæmorrhagic diathesis, it may continue to faintness and be resumed again as soon as the circulation regains its force. Under these circumstances epistaxis may endanger life. Again, epistaxis may occur periodically, as a manifestation of malaria, or take the place, vicariously, of the menstrual or hæmorrhoidal flux. Those cases due to the pressure of a tumor on the cavernous sinus, or pterygoid plexus, are accompanied by swelling of the eyelids, injections of the eyes, retinal changes, and the symptoms proper to tumor of the brain.

Diagnosis.—There can be no difficulty, if the inspection is made when the blood is flowing, in determining the source of the hæmorrhage. When, however, the bleeding occurs in sleep, from the posterior nares, and is swallowed, there may be, if vomiting of the blood occurs, much difficulty in ascertaining the true source. But the absence of any evidence of stomach ulcer and the occasional occurrence of nose-bleed will suggest the means of differentiation. The same method of analysis will be equally applicable to the apparent expectoration of blood, for the absence of pulmonary disease and the occasional occurrence of epistaxis will decide the probability in favor of bleeding at the nose.

Treatment.—The application of cold, in the form of ice, small pellets of which may be introduced into the nares, while a block of ice hollowed out to fit the nose may be put on outside, will often be sufficient to arrest the bleeding. Pressure on the artery supplying the anterior nares may be easily effected by passing the little finger under the lip, near the middle line where the artery may be felt. Simply pressing the nares together, to enable the blood to coagulate, may often suffice. If pressure and cold fail, a solution of tannic acid, or of alum, or of acetate of lead, may be thrown into the nares, and, if these fail, a solution of Monsel's salts. The measures above advised may be supplemented by the hypodermatic injection of ergotin, if necessary, and by the stomachal administration of arterial sedatives, as *veratrum viride* and *digitalis*. All other expedients failing, the posterior nares must be plugged.

DISEASES OF THE KIDNEY.

THE URINE—ITS COMPOSITION AND PATHOGENIC RELATIONS.

Organic and Inorganic Constituents.—The urine is a complex fluid which represents the waste of certain organic and inorganic constituents of the body. Full knowledge of its composition is, therefore, necessary to comprehend the metabolism of the tissues. Also, as the urine contains the products of the pathological changes occurring in the kidney, it is obvious that, to know these processes aright, it is imperative to ascertain the variations from its normal composition and character.

A healthy, fully developed adult passes from forty to fifty ounces of urine in twenty-four hours. But the quantity must always be considered relatively to the quality, or the urinary water must stand in a certain ratio to the urinary solids. In round numbers, the quantity of solid matter contained in normal urine is about 4 per cent. A simple rule for approximately determining the amount of solids in any given sample consists in doubling the last two figures of the specific gravity. Thus, if the specific gravity be 1,020, by multiplying 20 by 2, we have 40—or 40 parts in 1,000, which is 4 per cent. The whole amount of urinary solids excreted in twenty-four hours is, hence, merely a question of proportion: for example, if 40 parts of solids be contained in 1,000 parts of urine, how much in the daily quantity of urine discharged in the case under consideration?

The solids of the urine consist of organic and inorganic matter. The following are the constituents of the organic matter: *urea*, *uric acid*, *hippuric acid*, *kreatinin*, traces of *phenylic*, *oxalic*, *lactic*, and other acids of the *aromatic series*, and *coloring matters* (urobilin or uro-hæmatin, or urochrom; uroxanthin or indican).

The inorganic constituents consist of *phosphates* (alkaline and earthy), *sulphates*, and *chlorides*. Minute quantities of unoxidized sulphur and phosphorus are, also, present in normal urine.

In the examination of urine the following points are to be considered: the *quantity* passed in twenty-four hours relatively to the *solids* contained in it; the *color*, clearness or cloudiness; the *odor*; the *reaction* (acid, alkaline, or neutral); the *specific gravity*; the presence or absence of visible *solid matters* (uric acid, urates, mucus, blood, etc.).

The quantity of urine passed in twenty-four hours should be accurately measured, and a specimen of the whole should be reserved for examination.

In every case, whenever practicable to do so, the morning urine—that passed on rising—and the evening urine—that passed several hours after the principal meal of the day—should be submitted to examination.

The *quantity* in the normal individual is from forty to fifty fluid-ounces. The *color* is that of straw, of amber, or is pale yellow. Urine should be completely transparent, or at most cloudy only after cooling, in consequence of the precipitation of the urates. The *reaction* of urine is acid. The diet may affect this strictly within normal conditions, as for example under a vegetable diet, exclusively, the reaction becomes neutral or even alkaline. The *specific gravity* ranges from 1,004 to 1,030, according to the age of the subject, the character of the diet, and, especially, the temperature of the air, for when the cutaneous transpiration is abundant, the amount of urinary water is proportionally lessened.

The composition of the urine in disease varies in respect to the proportion of its normal constituents, and by the appearance of new substances. Both require some consideration.

The Organic Constituents—Urea.—Normal urine contains about three per cent. of urea, and the average daily excretion of a medium-sized adult is somewhat more than one ounce—about five hundred and forty grains. The amount present is increased in febrile affections. In diseases of the liver, with alteration of its structure and especially with considerable loss of the substance of the organ, the quantity of urea excreted is considerably less than normal. In cases of albuminuria, also, the percentage of urea is low, because the secreting structure of the kidney is damaged, but it is found in the fluid of dropsy, and in other fluids, in considerable quantity, although the amount produced is below the normal.

Several processes for the quantitative determination of urea have been proposed, but only those capable of ready adaptation to clinical purposes need be mentioned here. Heretofore the process of Liebig has been most generally employed. This method is based on the fact that urea is precipitated by nitrate of mercury from its solution—an insoluble compound of mercury and urea being formed. The phosphates, sulphates, and carbonates are first precipitated by means of a saturated solution of baryta; then, on slowly adding the mercuric nitrate solution, a compound of this reagent and the urea is thrown down. With standardized solutions, the proportion of urea can be readily estimated.

A still more convenient process for ascertaining the quantity of urea, at least approximately, is that devised by Dr. Squibb, of Brooklyn. It is known as the "hypochlorite process," and consists in decomposing the urea by the official solution of chlorinated soda (U. S. Pharmacopœia) and collecting the escaping nitrogen, from the quantity of which can readily be determined the amount of urea present. Although not absolutely accurate, this method affords a sufficiently close approximation for all practical purposes. Another comparatively convenient method is called the "hypobromite," and is, as the Squibb process, based on the decomposition of the urea and collection of the nitrogen. A very simple apparatus for carrying out this method has been devised by Dr. W. H. Greene,* of Philadelphia, and a similar arrangement has since been proposed by Dr. Doremus,† of New York. The liquid to effect the decomposition of the urea, and separate the nitrogen, is a solution of bromine in caustic soda. For exact and detailed descriptions of these several processes, the reader is referred to the recent works treating of the composition and chemistry of the urine.

Uric Acid and Urates.—The whole amount of uric acid excreted in twenty-four hours does not exceed twelve grains, and may be as low as five grains, and between these extremes it oscillates in healthy adults. It is extremely insoluble in water, and is precipitated as the urine cools. The forms assumed by uric acid are so characteristic that it is readily recognized on microscopic examination. (See *post*.) In a normal condition uric acid is not found in the blood, but in gout it is either produced in excessive amount, or fails to be oxidized into urea and thus excreted. The source of uric acid remains obscure. The most widely entertained theory regards it as a substance intermediate between albumin and urea, and when present in quantity signifies deficient oxidation. When the urine is highly acid, and concentrated, uric acid is in excess.

The word *urates* signifies a cloudiness or sediment composed of combinations of uric acid with various bases. The most common are

* The Philadelphia "Medical Times," January 12, 1884.

† The "Medical News" (Philadelphia), May 30, 1885.

the urate of soda, urate of ammonia, and urate of calcium. The least abundant is urate of potassium. Even when abundant, the urates are usually held in solution at the temperature of the body, to be cast down when the urine cools, then forming an abundant milky or chalk-like deposit, which may indeed have a brick-dust appearance, especially should uric acid be in excess. On heating such urine, the deposit or sediment clears up—a reaction which serves to distinguish between the urates and albumin, or phosphates, both of which are increased by boiling. The appearance of the urates under the microscope is shown in Fig.

Hippuric Acid.—The amount of hippuric acid varies with the diet, and certain unknown conditions of the assimilation. From ten to fifteen grains are excreted in the urine of a healthy adult in twenty-four hours. It is increased in diabetes, and by the use of such fruits as cranberries, blackberries, etc.

The other acids of the aromatic series have but little clinical significance at present.

Kreatinin.—The source of kreatinin is kreatin, one of the products of retrograde changes in muscular tissue. It is an alkaloidal substance of considerable power, but its clinical relations are unknown. The amount excreted in twenty-four hours ranges between eight and twenty grains, it is supposed.

Urine Pigments or Coloring Matters.—These have considerable importance. There are two—urobilin; indican. The former is derived from *hæmatin*, the coloring matter of the blood, by the action of the bile acids; the latter from *indol*, a substance produced in the course of the pancreatic digestion of the proteids. Indol, after absorption into the blood, is converted into indican, and is thus excreted by the urine. Urobilin, or a substance corresponding to it, is variously named by different observers. By George Harley it is called *urohæmatin*; by Heller, *urophain*. It is the most important urine pigment, if not the sole coloring matter. The quantity normal to the urine is increased in certain diseased states—in liver diseases, in fevers, and in certain disorders of the vascular system.

Indican is probably a normal constituent of the urine, but by some it is held to be a pathological product. It is Heller's uroxanthin, and is supposed to be derived from *indol*, a product of pancreatic digestion, and this is converted by the alkaline constituents of the blood into indican. A high temperature of the atmosphere, a meat diet, and other conditions increasing the acidity and density of the urine, raise the proportion of indican above the ordinary level, and in such pathological states as diabetes, cancer of the stomach, obstruction of the intestines, etc., it is so much greater than in health as to have some value as a means of diagnosis.

The presence of indican in the urine may be demonstrated as fol-

lows: Warm one drachm of strong nitric or hydrochloric acid in a test-tube; then gently pour on the surface of the acid about the same quantity of urine (which must be free from albumin), and at the point of contact there will form a ring of color—violet, if but little indican is present; and blue, if there be much. The indican may be separated by chloroform. The acid and urine are well incorporated by shaking them up in the test-tube, a little chloride of lime solution added until a greenish tint appears, and then the whole is agitated with two and a half drachms of chloroform. If allowed to stand undisturbed for a time, the chloroform will separate of a violet or bluish color, according to the quantity of indican dissolved in it.

The Mineral Constituents—Phosphates.—The combinations of phosphoric acid with the mineral bases of the body are of two kinds: alkaline and earthy—of potassium and sodium; of calcium and magnesium. The alkaline phosphates are soluble, and do not, therefore, form a sediment; on the other hand, whenever the urine becomes alkaline, the earthy phosphates are precipitated. The acid reaction of normal urine is due to the presence of the acid phosphates of sodium and potassium. Under certain conditions, not well understood, these phosphates are not converted into acid salts, and then the urine becomes neutral in reaction. When the urine is distinctly alkaline on excretion, this reaction is due to the presence, in excess, of the alkaline carbonates, and then the urine effervesces on the addition of an acid.

We owe to Dr. Gee* the demonstration of the remarkable fact, that in cases of ague the phosphoric acid disappears from the urine, or is greatly reduced in amount. In chronic albuminuria the alkaline phosphates are below the normal considerably.

The *earthy phosphates* of systemic origin consist of calcium and magnesium phosphate. The ammoniaco-magnesium phosphate is present in large quantity in certain diseases of the genito-urinary tract, and it is then of local origin, or from the inflamed mucous membrane. Phosphate of lime is found in the urine in two forms: as amorphous granules, and as needle- and star-shaped crystals—the former in much greater quantity. When acid urine is boiled, the phosphates being in excess, a cloud appears, which is dissolved, and the urine made clear by the addition of a few drops of nitric acid. If the urine is alkaline, the phosphates may be sufficient to give it a turbid appearance, or even to make it thick and white. It sometimes happens that an abundant precipitate of the phosphates takes place in the bladder, and the urine last passed is then thick, white, and ropy, and voided with difficulty. This condition of things is alarming to the patient, and may be perplexing to the physician, until, on the addition of nitric acid, the whole sediment disappears. If effervescence is produced by the addition of

* "St. Bartholomew's Hospital Reports," vol. viii.

acid, it may be concluded that the bicarbonates of potassium and sodium are present in excess.

The *ammoniaco-magnesium phosphate*, or *triple phosphate*, is found in the urine when it has been rendered alkaline by ammonia. The ammonia is a product of the decomposition of urea, the mucus present playing the part of a ferment. The crystals of triple phosphate are triangular prisms, and are readily recognized under the microscope. Like the other phosphates, this is dissolved by a mineral acid.

Phosphorus, unoxidized and in combination with organic substances, as lecithin, appears in the urine. The quantity present is estimated by converting it into phosphoric acid by an oxidizing agent. In health the amount excreted by the urine is very minute, but in certain diseases characterized by destructive changes in the brain substance, in phthisis, in pernicious anæmia, etc., it is greater.

The Sulphates.—The sulphates consist of combinations of sulphuric acid with potassium and sodium, and, to a much smaller extent, of calcium. In health the amount of sulphates excreted is largely influenced by diet, especially animal food. In disease they are increased by the inflammatory process, notably pneumonia, meningitis, etc.

The Chlorides.—The chief chloride salt is chloride of sodium, and the quantity of this excreted is much affected by the amount of common salt taken with the food. A portion of the salt eaten is, however, converted into chloride of potassium. From one to two drachms is excreted in twenty-four hours. The test for chlorides is nitrate of silver. The urine to be examined is first acidulated with nitric acid to keep the phosphates dissolved, and then solution of nitrate of silver is added, whereupon an abundant white, curd-like precipitate of chloride of silver falls. This precipitate is not soluble in excess of nitric acid, but is dissolved by ammonia in excess.

It has been ascertained that the chlorides disappear from the urine, or are, at least, greatly reduced in amount, during the progress of an acute inflammation. In pneumonia this change in the quantity of chlorides becomes a prognostic indication of some value, for disappearing as the lung becomes hepatized, they suddenly reappear with the occurrence of the other critical phenomena.

Adventitious Substances.—Diagnostic, prognostic, and therapeutic indications of great value are obtained from the examination of certain adventitious materials which may be present in the urine.

Albumin.—Many tests have been proposed for serum albumin, but it is quite certain that none of them are as accurate as the application of heat. Much depends on the mode of employing it. The following method is the best:

Half fill a medium test-tube with the suspected urine. Heat it to the boiling-point. If the urine is decidedly alkaline in reaction, and no cloudiness appears, add sufficient nitric acid to change the reaction

to acid, and then boil again. If now no cloud appears, the urine does not contain albumin. If the urine is neutral or acid in reaction, and on boiling a milky cloudiness becomes manifest, add some nitric acid, drop by drop, by means of a pipette. If the urine clear up, the precipitate is not albumin, but most probably phosphates. When the urine under examination is cloudy from the presence of mucus, it should be filtered; if from urates, heating will redissolve them, and the urine become clear before it gets cloudy again from coagulation of the albumin.

Heller's *nitric-acid test* is very convenient, but its value is impaired by several possible fallacies. It consists in the coagulation of the albumin by nitric acid. Thirty minims of pure acid are put in a test-tube, and about the same quantity of urine is allowed to flow gently on to the surface of the acid, where, if albumin be present, a whitish coagulum appears, which is not dissipated by heat. Hydrated uric acid, and amorphous urates, may furnish a similar zone to that made by albumin, but these disappear on heating.

Johnson's *picric-acid test* is delicate, and, if confirmed by the action of heat, is certain. It is applied as follows: A saturated solution of picric acid is made by dissolving six to seven grains in an ounce of boiling distilled water, and this solution is poured on some of the suspected urine contained in a test-tube. If the resulting yellowish coagulum is not dissolved by heat, it consists of albumin.

Probably the most sensitive of all the tests for albumin is *Tanret's potassio-mercuric iodide*. It consists of the following ingredients: corrosive chloride of mercury, 20 grains; iodide of potassium, 50 grains; acetic acid, 6 drachms; and sufficient distilled water to make up to 2½ pints. This precipitates albumin, and also peptones, alkaloids, and urates; but heat dissolves all these, except albumin.

The albumin ordinarily present in urine in disease is serum-albumin—the albumin of the serum of the blood.

Acid-albumin, or syntonin, is occasionally encountered when the urine is highly acid. It is not precipitated by heat until the acidity of the urine is lessened, which may be effected by the careful addition of sodium-carbonate solution. *Alkali-albumin*, or casein, also fails to be precipitated on boiling, unless some drops of acid are added to neutralize the urine.

Paraglobulin is found in albuminous urine associated with serum-albumin, and may indeed be in excess of the latter. Very rarely it appears alone in the urine, and is mistaken for albumin. In cases of albuminuria due to amyloid degeneration, and of scarlatina nephritis, and in temporary albuminuria caused by derangement of the digestive organs, paraglobulin may be in excess. It is separated from serum-albumin by treating the urine with sulphate of magnesia to the point of saturation, when the paraglobulin is cast down.

Peptones are also often found, usually with albumin, but may be

present without it. The most delicate and convenient reaction for distinguishing peptones in the urine is that devised by Dr. Randolph, of Philadelphia, and is based on the fact that, when acid mercuric nitrate is added to a solution of iodide of potassium, red mercuric iodide is precipitated; but if peptones or bile be present, the precipitate is yellow. It is necessary, then, to determine whether the bile acids are present by the appropriate tests.

Peptones are present in the urine in cases of acute septic diseases, such as diphtheria, variola, and cerebro-spinal meningitis, and when pus or inflammatory exudates are absorbed, as, for example, in cases of croupous pneumonia, pleuritis, and rheumatic effusions.

In the sections devoted to diseases of the liver, the reactions due to the presence of *bile* pigment and acids are given. It is necessary, however, to say something of *leucin* and *tyrosin*. These are found together in the urine when the liver-structure has undergone extensive injury, as in acute yellow atrophy, in phosphorous poisoning, and in malignant typhus. These substances take the place of urea. For the methods of their detection and appearance under the microscope the reader is referred to works on urinary analysis.

Sugar.—It is now commonly held that sugar is present in very minute quantity in normal urine. Nevertheless, any amount above the merest trace must be regarded as pathological. The tests most in use are three: Trommer's, Fehling's, and fermentation.

As in the application of Trommer's and Fehling's the results may be vitiated by the action of the urates, it is necessary to remove them before applying the reagents. This is accomplished by precipitating them with acetate-of-lead solution, and then filtering. In using Trommer's test, the following method is pursued: To the urine in a test-tube is added a few drops of the solution of cupric sulphate, or a pellet of the same. The sulphate is converted into the oxide by liquor potassæ, which is poured in until the first precipitate is redissolved. If sugar be present, the oxide of copper is reduced to suboxide on warming the liquid, and this reaction is manifest by the appearance of a reddish precipitate. If the reduction of the copper does not take place on warming the liquid, sugar is not present, although on prolonged boiling the reaction may occur.

Fehling's differs from Trommer's test in that the potassio-tartrate of sodium (Rochelle salt) is added to the alkaline copper solution. If the solution be kept for any considerable period, it becomes so changed as to be unreliable, and should be boiled before using as a test, since the copper may be reduced thus. Pellets of copper sulphate and of sodic tartrate of potassium are now prepared separately, and are added to a solution of caustic soda when required for use. Solutions may also be kept separately, and mixed when needed. When a given specimen is to be examined, Fehling's solution is heated to the boiling

point, and a drop of the urine is added, when a yellowish precipitate occurs if sugar be present in quantity, or greenish if the proportion of sugar be small; but the yellowish tint is produced by putting in a few more drops of urine.

URÆMIA.

Definition.—The retention in the blood of those excrementitious substances which it is the function of the kidney to remove is known as *uræmia*. Strictly speaking, this term signifies urea in the blood; but, as urea is not the most offending substance, the extractives, and even the potash salts, according to Feltz, and other ingredients of the urine being poisonous when retained in the circulation, the term *uræmia* has, by common consent, been extended to include the complexus of symptoms due to the presence of the urinary constituents in the blood.

Pathogeny.—The retention of the urinary constituents may be due to insufficient secretion or to imperfect excretion; in the former, the materials which go to make up the urine are not separated from the blood; in the latter, after the urine has been duly formed, its excretion is prevented, and resorption into the blood occurs. In the various forms of albuminuria, *uræmia* is due to insufficient secretion, and imperfect excretion results from obstructive disease of the ureters, of the bladder, of the urethra, and from exterior pressure, as in the case of tumors encroaching on the urinary passages.

The diminution of the urine, which is concerned in the production of *uræmia*, consists in the lessened excretion of the solids. The urinary water may, in respect to bulk, be fully up to, even exceed, the normal, and yet symptoms of *uræmia* occur, because of the insufficient depuration of the urinary excrement. Great differences of opinion have existed, since the time of Bright's discovery, in regard to the particular urinary constituent causing the secondary disturbance. Christison was the first to express the idea of a connection between certain nervous phenomena and the condition of albuminuria, and he referred these phenomena to blood-poisoning caused by the retention of urea, but he also held that there was an excessive excretion of the coloring matter to which the disturbance was in part due. Hammond, and subsequently Richardson, maintained that the retention of urea is the real cause. Frerichs then brought forward his carbonate-of-ammonia theory. He showed, what subsequent observers have confirmed, that urea itself injected into the veins is not injurious, and hence suggested that the real poisonous principle is carbonate of ammonia, since convulsions are produced when this substance is thrown into the veins, and it is found in the blood in *uræmia*. Against Frerichs's theory were opposed the insuperable objections that ammonia is a natural constitu-