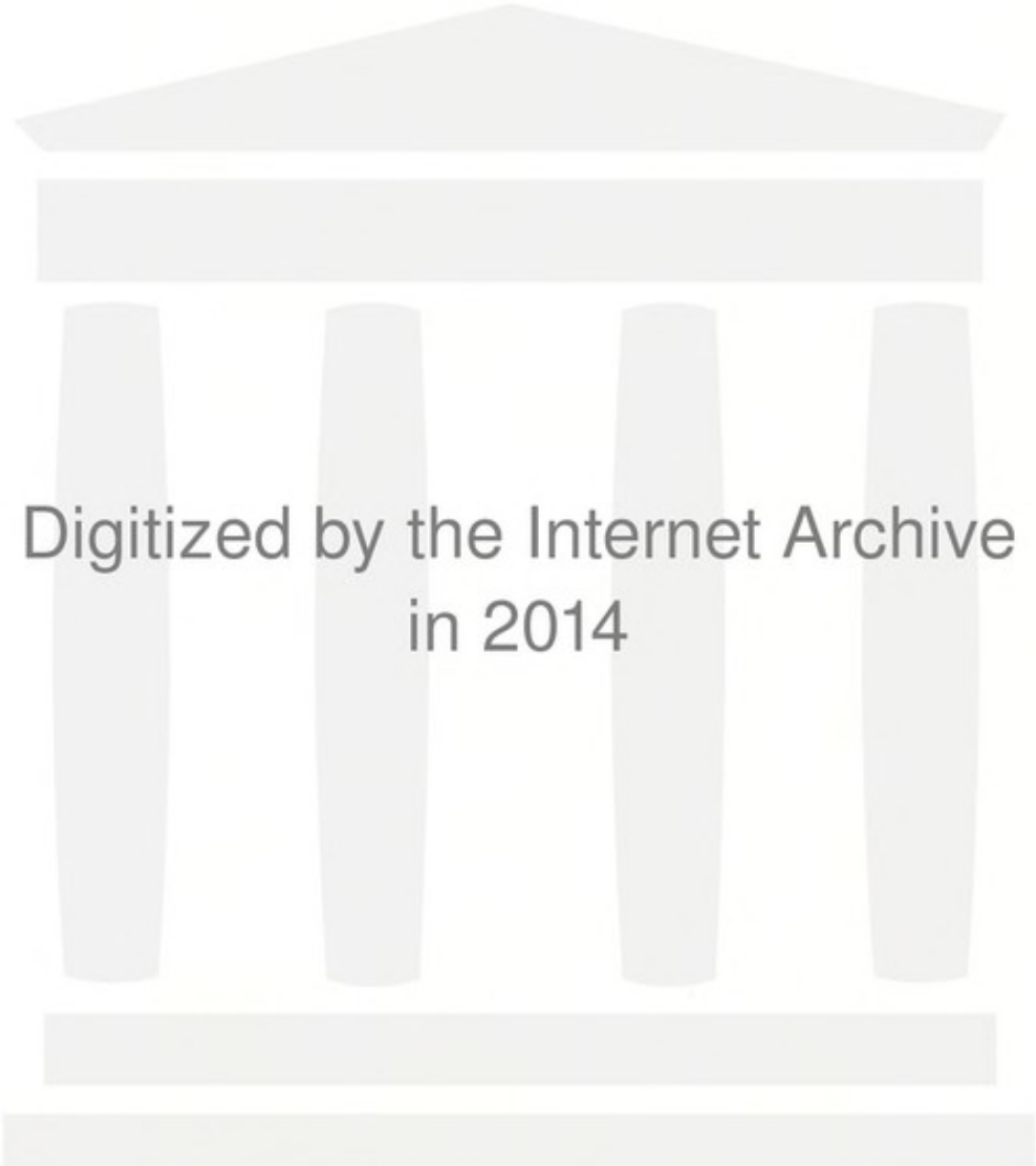
A guide to urine testing : for nurses and others / by Mark Robinson.


22500481788



L. W. Scammell.

Asst Surg. Hospital

Barcelona.

GUIDE TO URINE TESTING.

A GUIDE TO
URINE TESTING:

FOR NURSES AND OTHERS.

BY

MARK ROBINSON, L.R.C.P., L.R.C.S. ED.

BRISTOL: JOHN WRIGHT & CO.
LONDON:
SIMPKIN, MARSHALL, HAMILTON, KENT & CO., LIMITED.

1899.

JOHN WRIGHT AND CO.,
PRINTERS AND PUBLISHERS, BRISTOL.

PREFACE.

It having been suggested to me by the Nursing Superintendent of a large Provincial Poor Law Infirmary that a small guide to urine testing for the use of Nurses would be acceptable, I have issued this compilation of the simpler tests and facts concerning Urine, in the hope that it may prove useful to those for whom it is intended.

For the information contained in this little handbook I am indebted to the works of Drs. Wickham Legg, F. Taylor, J. Scott, and others.

M. R.

London, *August*, *1899*.

CONTENTS.

INTRODUCTORY.

A few preliminary remarks upon the organs concerned in the secretion and excretion of urine, are necessary to the better understanding of its examination.

The excess of moisture in the body must of course be eliminated, and the organs utilized in the process are :—

(1,) **The Skin,** which gives off the moisture through its sweat glands.

(2,) **The Lungs,** which give it off in the form of vapour or breath.

(3,) **The Kidneys,** which secrete the urine.

Without going deeply into the anatomical structure of the kidneys, we may explain that they are two glandular bodies,

situated at the back part of the abdominal cavity, one in each lumbar region, extending from the eleventh rib to near the ilium of the pelvis, and usually surrounded by a considerable quantity of fat. Each kidney is about four inches in length, two in breadth, and one in thickness.

The urine, having been secreted by the kidneys, finds its way through the ureters into the bladder.

The **Ureters** are two membranous tubes, measuring from sixteen to eighteen inches in length, and are of the diameter of a goose-quill. They are attached at their upper ends to the kidneys, at the entry to which each ureter becomes dilated into a wide membranous sac, called the "pelvis" of the kidney. From this point they pass downwards, forwards and inwards, to the base of the bladder, into which they open by small orifices.

The **Bladder** is the reservoir which contains the urine until such time as it becomes necessary to empty itself, which it does by the contraction of the muscular fibres surrounding it in all directions, thus forcing the urine through the **Urethra**, which is the tube extending from the neck of the bladder to the outer urinary opening.

URINE.

URINE may be described as being a watery product of the body, holding in solution certain solids, of which the principal are **Urea** and **Salt** (Sodium Chloride), in the following proportions: one half, urea; and one quarter, salt.

Urea is the most important constituent of the urine. In health from 300 to 500

grains of urea are excreted in the twenty-four hours. This amount is increased by a high meat diet, and decreased by a purely vegetable one.

The Normal Amount of Urine passed during the twenty-four hours is from two pints to two pints and a half—about fifty ounces. The quantity, however, varies, according to the amount of fluid imbibed, and the amount of perspiration given off through the skin. Therefore, the temperature of the atmosphere, or the amount of exercise taken, has its proportionate effect upon quantity. There is consequently a more frequent desire to pass water in cold weather than in hot, owing to the extra work imposed upon the kidneys.

The urine, in addition to being the excretion which eliminates excess of water and certain salts, possesses the further important property of being the means of

conveying from the body the nitrogenous waste material produced by the wear and tear of the human machinery, and which, if not eliminated, would act with poisonous effect upon the system. The nitrogenous waste products consist chiefly of urea, acid urates, hippuric acid, etc.

COLOUR.

HEALTHY urine varies from straw colour to a reddish yellow, but several causes may affect its colour. For instance, the drinking of a large quantity of water or other fluid will cause the urine to become pale (urina potûs). This paleness also occurs in the urine of persons suffering from anæmia or diabetes, in certain nervous diseases, and during recovery from severe illness.

In some forms of disease the urine assumes a brownish black colour (porter-coloured urine).

A peculiar smoky appearance denotes the presence of blood, derived from the kidneys; if present in large quantity the urine is rendered blood-coloured, and in this case the hæmorrhage does not usually proceed from the kidney, but from some other portion of the urinary passages.

A yellowish green is indicative of the colouring matter of bile. This is best seen by slightly tilting a white vessel containing urine, and looking through the edge of the fluid at the wall of the vessel.

Certain drugs, such as rhubarb, saffron, and santonin, will impart a reddish tint to urine, while sometimes carbolic acid applied to wounds, or injected into the vagina, becomes absorbed, and turns the urine a dark olive green.

The urine becomes dark in tint after a full meal, or strong exercise, and in cases of fever, with its accompanying high temperature.

CONSISTENCE.

URINE should be clear, but there is generally a slight cloud to be seen after it has been at rest for about an hour. This is caused by **Mucus**, derived from the mucous lining of the passages through which it has flowed.

Sometimes, after cooling, a thick deposit is formed in the urine. This is due to the presence of **Urates.** If this thickened condition is caused thus, the urine will again become clear on the application of gentle heat. The urates are those of soda, ammonia, or, more rarely, lime.

In feebly acid, or alkaline urine, a grey deposit of **Phosphates** is sometimes seen.

Urine that is thick when first passed is unhealthy, and this condition is generally due to the presence of **Pus.**

Urine should flow freely from one vessel into another, but if ammonia has been formed as the result of decomposition, it acts upon the contained pus, rendering the urine thick and ropy, and it is then difficult to pour.

The froth upon the urine when first passed should soon disappear ; if it lingers for some time, the presence of albumin or bile may be suspected.

ODOUR.

THE peculiar odour of urine is well known. It may, however, be noted that it some-

times smells strongly of ammonia, this being the result of decomposition. In inflammation of the bladder (cystitis) this frequently happens, as also in paralysis of the lower half of the body (paraplegia).

Drugs, again, such as cubebs and copaiba, will affect the odour; also vegetables, such as asparagus; while turpentine imparts the odour of violets.

In diabetes the odour is said to resemble that of new-mown hay.

REACTION.

THE urine of flesh-eating animals is acid, and therefore turns blue litmus paper red (acid reaction), and leaves red litmus paper unchanged, unless there be an excess of acid, in which case it causes the red litmus paper to assume a deeper tint. On the

other hand, if the urine be alkaline, it turns red litmus paper blue, and leaves the blue unchanged (alkaline reaction). In certain conditions, which, however, are of rare occurrence, the urine has no effect upon either blue or red litmus paper. It is then said to be neutral. Yellow turmeric paper is turned brown by alkaline urine. If this brown colour disappears on exposure to air, or to gentle heat, it is due to the presence of ammonia. If the turmeric paper remains permanently brown, it is due to potash or soda.

SPECIFIC GRAVITY (S.G.).

By the specific gravity of urine is meant *its weight as compared with that of an equal volume of water*, the S.G. of water being 1000.

The specific gravity of healthy urine varies between 1015 and 1025, and is estimated by means of the urinometer.

A low S.G. is to be observed after a large quantity of fluid has been taken, also in chronic Bright's disease, after an attack of hysteria, in anæmia, or after exposure to cold. Under any of these conditions it may be below 1010.

An abnormally high S.G. is symptomatic of disease.

FALLACIES IN TESTING.

THIS term is derived from the Latin word "*fallacia*," signifying "that which misleads the eye or mind."

It is important to recollect that many fallacies occur in the process of testing urine; that is to say, an appearance may

follow the application of a test that apparently indicates a certain morbid condition, which, as a matter of fact, does not exist. For this reason it is necessary to apply two or more tests, in order to verify or disprove the result of the first.

The fallacies will be noted beneath the description of each test.

URINE TESTING.

THE ordinary apparatus required for the purpose of testing urine consists of:—

URINE GLASSES—to contain about six ounces
URINOMETER—graduated from 1000 to 1060
BLUE and RED LITMUS PAPER
YELLOW TURMERIC PAPER
TEST TUBES—various sizes
SPIRIT LAMP
SMALL BOTTLE of NITRIC ACID
SMALL BOTTLE of ACETIC ACID

LIQUOR POTASSÆ or SODÆ
SOLUTION OF SULPHATE OF COPPER — ten grains to the ounce
SOLUTION OF FERRO-CYANIDE OF POTASSIUM
SOLUTION OF CITRIC ACID
PAVY'S or FEHLING'S TEST SOLUTION
PICRIC ACID — saturated solution
TINCTURE OF GUAIACUM and OZONIC ETHER
GLASS FUNNEL and FILTERING PAPER

Additional :—

PAVY'S PELLETS for albumin and sugar
OLIVER'S TEST PAPERS for albumin, sugar and bile
ESBACH'S ALBUMINOMETER
GANS'S QUANTITATIVE SACCHAROMETER

USE OF THE URINOMETER.

BOTH the urinometer and the urine glass should always be thoroughly **cleaned** and **dried** before being used.

A quantity of not less than two ounces of urine is required for the use of the urinometer.

If a smaller quantity only is obtainable, it may, for testing purposes, be diluted with water in the following proportion :—

Suppose but one ounce of urine to be available, add three ounces of water, and take the S.G. of the mixture. We will imagine this to be 1005. Multiply the unit figure 5 by 4 (3 oz. water—1 oz. urine), and this brings the **real** S.G. of the urine to 1020. Remember always to dilute the quantity of urine used with **three times** its bulk of water.

In using the urinometer the urine should be poured into a cylindrical glass, and the **froth**, if any, **removed** with blotting paper, or by overfilling the glass. The urinometer should then be gently lowered into the urine, and allowed to

float without touching either the side or bottom of the vessel.

The urine should be kept in the room in which it is to be tested, long enough to become of the temperature of the surrounding air.

The number on the stem of the urinometer should be read off at the level of the fluid, **looking through the fluid.** If this precaution is not taken the S.G. will appear lower than it actually is.

The urinometer should be pushed down into the fluid and allowed to rise again **after** the number is **first** read, in order to confirm the accuracy of the first reading.

It is considered, for all tests, to be advisable to use a mixed sample taken from the whole of the urine passed in the twenty-four hours, but this is not always possible, and need not be absolutely insisted upon.

ALBUMIN.

THE urine should be invariably tested for albumin before anything else is searched for, and this test should never be omitted.

Heat Test.—The ordinary method of testing for albumin by heat, is to fill a test-tube about two-thirds full of urine, and, holding its lower end between the finger and thumb in a slanting direction over the flame of the spirit lamp, **boil** the **upper half** of the fluid. The upper and lower halves can then be better compared when held against a light or a dark surface.

If an opaque cloud appears after boiling, it may be due to the precipitation of either albumin or phosphates. To decide this point, a drop or two of nitric acid should be allowed to trickle down the side of the test-tube into the urine. If the cloud is due to phosphates it will disappear as soon as reached by the acid. On the other

hand, if it be due to albumin the cloud will remain unaltered.

Another good method is to add the nitric acid before boiling the urine, thus using heat and nitric acid simultaneously.

If the urine happens to be turbid owing to the presence of urates, it should be warmed (not boiled) by passing the test-tube containing it a few times through the flame, when the urine will become clear—a condition which is obviously necessary for the application of the heat test.

Fallacies.—Should the urine be **Alkaline** or **Neutral**, albumin, though present, may not be precipitated. It will be necessary, therefore, to slightly acidify the urine with a few drops of acetic acid.

Again, albumin, though present, may not become visible on boiling if the urine be **strongly acid.**

There may be no albumin present, although a white precipitate, resembling

it, appears on boiling. This is due to phosphates. Add a little nitric acid, as previously directed.

Cold Nitric Acid Test. — This test for albumin consists in placing a small quantity of nitric acid in the bottom of a small sized test-tube, and allowing some urine to gently trickle down the side of the test-tube, taking care to avoid mixing the two fluids. A pipette is useful for this purpose. If albumin is present it will appear as a narrow opaque band at the junction of the two fluids. This is called Heller's method, and is preferable to that of first placing the urine in the test-tube and pouring the nitric acid upon it.

Fallacies.—If only a trace of albumin be present, it may not appear for twenty or thirty minutes, and then only in the form of a slight cloud, which may be distinguished from urates by warming. If the patient is taking copaiba or cubebs,

a cloud may result on the application of this test, but these drugs will be detected by their smell.

Picric Acid Test.—This is a very delicate test. Rather more than half fill a test-tube with urine. Pour some of the saturated solution of picric acid gently on to the urine, taking care that the fluids do not mix more than can be helped. At the line of junction a thin white line will form.

Fallacies.—In addition to albumin and mucin, picric acid precipitates urates, alkaloids and peptones. The latter, however, disappear on applying heat, while albumin, of course, does not.

To distinguish between the precipitates of albumin and mucin, it may be noted that whereas the white line of albumin forms **at once**, that of mucin is delayed in its appearance.

Ferro-cyanide of Potassium and Citric Acid Test.—Add some solution

of citric acid to the urine in a test-tube, and further add some solution of ferro-cyanide of potassium. If albumin be present, a whitish cloud will result.

Pellets composed of the above substances have been devised by Dr. Pavy, and are very convenient. First add a citric acid pellet, and then one of ferro-cyanide of potassium. A white precipitate is the result.

Oliver's Papers.—First add a citric acid paper, then a potassium ferro-cyanide paper or a potassio-mercuric iodide paper. A white precipitate is the result.

Fallacy.—Citric acid may precipitate mucin and urates.

QUANTITY OF ALBUMIN.

To roughly estimate the quantity of albumin, half fill a long narrow test-tube with

urine, add a drop or two of nitric acid, boil the whole of the fluid, and set the tube aside for twenty-four hours. The coagulated albumin will then have subsided to the bottom of the tube, and, according to the height at which it stands in the urine, it is called "a half," "a third," or "an eighth," as the case may be. If but a very minute quantity is observable, it is called "a trace."

It may be here mentioned that leucorrhœa ("whites") is a frequent source of error in testing for albumin in women, and if this condition exists it is advisable to draw off the urine about to be tested with a catheter.

Esbach's Albuminometer.—With the aid of this apparatus the quantity of albumin can be simply and accurately estimated.

A test solution is prepared, consisting of one part of picric acid and two of

air-dried citric acid in one hundred parts of water. A graduated tube from six to eight inches long, and half an inch in diameter, is filled for two and a quarter inches of its height with urine, and for a further distance of an inch and a half with the picric solution.

In the Esbach tube the height to which the urine should reach is denoted by the letter "U," and the height to which the picric solution should be added by the letter "R," signifying "Reagent."

Close the tube with the finger, and mix the two fluids by reversing the tube three or four times, but do not shake.

The precipitated albumin is allowed to settle for twenty four hours, and then the space it occupies in the tube is compared with a series of marks which represent the number of grammes of albumin for each litre of urine; or in other words, the amount of albumin per thousand of urine.

SUGAR.

A SPECIFIC gravity of over 1030 may point to the presence of sugar.

In diabetes mellitus the S.G. may rise to 1045, or even more, and the quantity of urine passed, to ten, fifteen or more pints a day.

Before testing for sugar, the tests for albumin should be employed, and if any be present, the urine should be acidulated with a few drops of acetic acid, and the mixture **boiled** and **filtered.**

The urine should also be filtered if thickened by the presence of urates.

The sugar of diabetic urine is grape sugar (dextrose).

Moore's Test.—Equal parts of urine and liquor potassæ should be mixed in a test-tube, and the upper portion of the fluid boiled. If sugar be present, the heated portion becomes reddish brown, dark brown, or black—according to the amount of sugar present.

Fallacies.—High-coloured urines, and those containing excess of phosphates, will darken on boiling with liquor potassæ; and if the urine contains albumin the colour will deepen, though no sugar be present.

If liquor potassæ has been kept for some time in white glass bottles it absorbs lead from the glass. If this be the case urine will darken when boiled with liquor potassæ, though no sugar be present, owing to the formation of sulphide of lead.

Trommer's Test.—Pour about a drachm of urine into a test-tube, with an equal quantity of liquor potassæ or sodæ. Add a little solution of sulphate of copper.

A precipitate will at first form, which will re-dissolve on shaking the test-tube.

Continue to add the copper solution drop by drop, shaking the tube after each

addition, until the mixture becomes of a blue or green colour, but it should be quite clear, and free from any precipitate.

Boil the mixture, when, if sugar be present, an orange red precipitate is thrown down, which afterwards becomes reddish brown (suboxide of copper).

Fehling's and Pavy's Test Solutions.—With these solutions the test is best applied by placing forty to sixty minims in a test-tube, heating them to boiling point, and then adding some of the suspected urine.

If heat be continued, a yellow precipitate shows itself at the upper part, and if enough urine be added, the test solution will at length lose its blue colour altogether.

It is important that these solutions should be fresh. They must be boiled before adding the urine, as they may give the precipitate alone when stale.

Bottger's or Bottcher's Test.—This test was formerly much used in Germany.

The urine is heated with a little sodium carbonate and a few grains of subnitrate of bismuth.

The mixture becomes black if sugar be present.

Fallacies.—The presence of albumin or of the principles of rhubarb may give black precipitates by their action on the bismuth (Scott).

Picric Acid Test.—Boil some liquor potassæ in a test-tube with a saturated solution of picric acid. The urine is then added, and the boiling continued.

If sugar be present a dark claret-red colour is developed, the intensity of which is proportionate to the amount of sugar.

Fallacy. — High-coloured urines will sometimes give a similar result.

Pavy's Pellets.—These pellets are composed of potassio-tartrate of copper, and each pellet is enclosed in a separate cover.

Having removed its cover, place a pellet in a test-tube with a drachm of water, and apply heat until the solution becomes clear and of a deep blue colour. Add an equal quantity of urine, and boil the upper half of the mixture. If sugar be present, a red precipitate will result.

The apparatus for estimating the quantity of sugar has already been referred to. Both it and Esbach's albuminometer can be obtained from Down Bros., St. Thomas's Street, Borough, London.

BLOOD.

THE only test for blood with which the nurse need concern herself is the *Guaiacum Test.*

To the urine, in a test-tube, are added a few drops of tincture of guaiacum, and then about half-a-drachm of ozonic ether

According to the quantity of blood present, a blue colour forms at the junction of the fluids more or less quickly, and diffuses through the ether which floats on the surface.

Its appearance may be hastened by shaking the mixture.

Fallacy.—Sulphate and chloride of iron may give similar reactions, and in the urine of a person taking iodide of potassium a certain blueness may also appear (Scott).

BILE.

Gmelin's Test.—This is the test most commonly used. A few drops of urine are

placed upon a plate, and a little strong nitric acid is dropped close by, when the fluids are gently run into each other.

At the line of contact the colour of the urine changes, becoming green, blue, violet, red, and lastly, yellowish or brown.

PUS.

Pus forms a thick sediment at the bottom of the urine glass.

Urine which contains pus rapidly decomposes after being passed and becomes alkaline.

Urine which is thickened by pus does not become clear on the application of heat, this fact distinguishing it from urine which is thickened by urates only.

On adding about half its quantity of liquor potassæ to the deposit of pus in the

urine it becomes gelatinous and ropy, and cannot be poured freely from one vessel to another.

Mucus, on the other hand, becomes more fluid on the addition of liquor potassæ.

Causes of Pus in the Urine.—Leucorrhœa (in women), gonorrhœa, abscess of kidney, inflammation of bladder, or any abscess which may have burst into any of the urinary passages.

URIC ACID.

Uric acid, commonly termed gravel, is generally seen as a deposit resembling the grains of cayenne pepper in clear and very acid urine, but it is frequently accompanied by a considerable amount of urates.

URATES.

A DEPOSIT of urates is very common, and is comparatively unimportant.

Any feverish condition is conducive to this formation.

On the addition of a drop of hydrochloric or strong acetic acid to this deposit the typical cayenne pepper crystals of uric acid will be formed, which will disappear on the addition of liquor potassæ.

MICROSCOPICAL EXAMINATION.

THE microscopical examination of urine does not come within the province of the nurse, her duty being merely to report to the medical officer the condition in which she finds the urine from the simpler tests here given. It is for him to decide whether

he considers it necessary to make a more searching investigation with a view to confirmation, or otherwise, of her report.

Some examples of Tables for the systematic testing of urine are appended, and may be found useful in drawing up a report.

NORMAL.

Quantity passed in twenty-four hours	50 ounces
Colour	Normal
Odour	Normal
Consistence	Clear
S. G.	1020
Reaction	Acid
Deposits (Urates, Uric Acid, Phosphates)	None
Pus	None
Albumin	None
Sugar	None
Blood	None
Bile	None

Tests applied:—

1.—Heat and Nitric Acid

2.—Cold Nitric Acid

3.—Pavy's Solution for Sugar

TABLE
CONTAINING ALBUMIN.

Quantity passed in twenty-four hours	20 ounces
Colour	Normal
Odour	Normal
Consistence	Clear
S. G.	1010
Reaction	Acid
Deposits (Urates, Uric Acid, Phosphates)	None
Pus	None
Albumin	$\frac{1}{8}$
Sugar	None
Blood	None
Bile	None

Tests applied:—

1.—Heat and Nitric Acid

2.—Cold Nitric Acid

3.—Picric Acid Test for Sugar

TABLE CONTAINING SUGAR.

Quantity passed in twenty-four hours	10 pints
Colour	Pale
Odour	Of Hay
Consistence	Clear
S. G.	1045
Reaction	Acid
Deposits (Urates, Uric Acid, Phosphates)	None
Pus	None
Albumin	None
Sugar	Yes
Blood	None
Bile	None

Tests applied:—

1.—Heat and Nitric Acid

2.—Moore's Test

3.—Pavy's Solution

4.—Picric Acid Test for Sugar

INDEX.

3110.99 JOHN WRIGHT AND CO., BRISTOL.

Riley Dunn & Wilson Ltd

EXPERT CONSERVATORS & BOOKBINDERS