Manual of urine testing : including the physical characters, qualitative and quantitative examination of the urine together with the clinical information to be derived therefrom / by John Scott.

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OF
URINE TESTING

SCOTT.

THIRD EDITION—ENLARGED.

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INCLUDING

THE PHYSICAL CHARACTERS, QUALITATIVE AND QUANTITATIVE EXAMINATION OF THE URINE;

TOGETHER

WITH THE CLINICAL INFORMATION TO BE DERIVED THEREFROM.

BY

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PREFACE TO THIRD EDITION.

THE favourable reception already accorded to this work encourages the publisher to place it, revised and considerably enlarged, once more before the Student and the busy Practitioner of Medicine.

A special feature of the present edition is the prominence given to the fallacies connected with the various tests—an important item to the Student preparing for his examination, as well as to the Practitioner.

For greater detail in connection with the four Cardinal Symptoms of Urinary Disease—*Hæmaturia, Frequent Micturition, Pain, Abnormal characters of stream of Urine*—advantage has been taken of a recent work on the subject by E. Hurry Fenwick.

CONTENTS.

THE URINE.

A.—INTRODUCTORY REMARKS.

The Urine is the excretion by which the products of nitrogenous waste, excess of water, salts, &c., are eliminated from the body. The nitrogenous waste-products are eliminated as Urea, Uric Acid (as Acid Urates of Sodium), Hippuric Acid, &c.

Authorities differ as to whether or not Uric Acid exists in a free state in normal urine.

Chemical Composition (roughly) :—

Water.....48 ozs.
Solids..... 2 ozs. :—

Urea	1 oz.
Uric Acid	8 grains.
Hippuric Acid	15 grains.
Extractives	traces.
Pigments	
Mucus and Epithelial Cells	

Salts :—
Inorganic—Sulphates, Bi- or Acid Phosphates, and Chlorides of *Sodium*, *Potassium*, *Ammonium*, *Lime* and *Magnesium*.
Organic—Oxalate of *Lime*, &c.

The urine is usually examined to some extent in all hospital cases on admission as a matter of routine. In private practice the examination of the urine is called for on the detection of any suspicious symptons likely to be associated with urinary disturbances; and the beginner will do well to examine it in all cases where the diagnosis remains doubtful.

Collection of Urine for Examination purposes :—The urine must be separated, in the act of passing, by the patient into two parts, and put into separate vessels (bottles)—the first ounce into a 1-oz. bottle, the next four ounces into a 4-oz. bottle; the remainder may be thrown away. The 1-oz. specimen may by thrown away, or examined in connection with diseases of the Urethra—it having in its passage washed away any morbid urethral products; the 4-oz. specimen is the one we examine in

connection with diseases of the Bladder, Kidney, and other organs (see SCHEME). When more accurate results are required, a sample of the entire urine passed during 24 consecutive hours should be examined. But it may be necessary to obtain urine free from admixture with even the products from the bladder—*i.e.*, an absolutely pure renal secretion—to obtain this, you pass a medium-sized catheter (preferably a flexible one) into the bladder, the patient standing—draw off the urine, carefully wash out the viscus by repeated small (1-oz.) injections of *warm* water; then allow the urine to pass drop by drop through the catheter into a test-tube or other suitable vessel. The urine is then to be examined in the ordinary way.

Too much care cannot be taken in securing the purity of the samples, both as regards the cleanness of the vessels into which the urine is originally passed, and of the bottles and urine glasses in which the samples are preserved—for dirty vessels promote speedy putrefaction, and give rise very readily to ammonical odour, and to the development of vibriones. The presence of syrups and the like in imperfectly washed bottles used for samples may give rise to serious mistakes.

Important Rules to be attended to:—

1. Always, where possible, use two or more tests for any substance.
2. Do not forget that more than one substance may be present.
3. Let your diagnosis be the result of not one but several and *successive* examinations—*i.e.*, if on your first examination you find, say, Albumen in the urine, do not conclude that the patient has Kidney disease, unless you again find it a week or so afterwards (3 days afterwards in case of Bile).
4. Be on your guard when testing urine, for sometimes various abnormal substances are added to norminal urine for purposes of deception. N.B.—In Life Insurance cases, the urine to be examined must be voided by the patient in your presence—in the case of females it may be necessary, as I have suggested, to appoint a reliable substitute of the same sex, or to use other means to protect against deception.

Always use about a drachm of urine in a test-tube (which should be *chemically* clean) for examination purposes; and if heating or boiling be required, heat or boil upper part of urine—for sake of contrast.

B.—EXAMINATION (QUALITATIVE).

I.—The Physical Characters are first to be noted:—

1. *Transparency.*—Normal urine is transparent only on passing; on standing, clouds of Mucus and Epithelial Cells form in it, these sink after twelve hours: or else, as in highly concentrated urine—especially that of fevers—clouds of Urates form in it *on cooling.*

A hummocky-white and sharply-defined upper surface indicates the presence of crystals of Oxalate of Lime in the cloud.

If the urine be turbid on passing, *i.e.*, *before it cools*, the turbidity is usually due to Earthy Phosphates, Mucus, or Pus; other causes are Blood, Fat, Spermatozoa. The Earthy Phosphates clear up on the addition of an acid (*e.g.*, Nitric); for distinction between Mucus and Pus see further on. Blood, Fat, and Spermatozoa may be recognised by their tests as detailed in later part of this work.

Contamination with *Semen* may make the urine turbid, but as reported by patients this is usually imaginary—*Phosphates* from alkalinity being the usual explanation. N.B.—To convince such patients of their error and to allay their fears, it may be necessary to demonstrate to them per microscope the essential difference between Spermatozoa and Phosphates in urine.

In *Jaundice* the urine is often somewhat turbid, not from the bile-pigment, but from an excess of *Mucus.*

Turbidity *from decomposition* is diffused through the fluid; it does not settle down as a sediment leaving the fluid above clear, nor is it cleared by ordinary filtering.

Ehrlich's Test, or the Diazo Reaction.—The urine in Typhoid fever yields the following reaction:—

Add, 1. Saturated solution of Sulphanilic Acid in dilute (1 in 20) Hydrochloric Acid—*excess.*

2. 0·5 per cent. solution of Sodic Nitrite in Distilled water—*defect.*

3. Strong Ammonia—*until Alkaline.*

Equal to ruby-red colour, with pink froth on shaking.

N.B.—1 and 2 must be fresh, especially 2, which cannot be depended upon more than a week.

Fallacy.—The reaction is got in other diseases, especially Acute Tuberculosis.

2. *Colour.*—Normal urine is of a golden-yellow colour.

Very Pale (straw-yellow)—After imbibition of much water, or exposure to cold. It is found also in Granular Kidney, Diabetes (Mellitus and Insipidus), Anæmia, and Chlorosis ; after Hysterical fits, Asthma, or other forms of nervous excitement.

High-Coloured (reddish-yellow to reddish)—After ingestion of much food, or when secretion is diminished by profuse perspiration. It is found also in Fevers and in disorders of Liver.

The difference in tint in pale and high-coloured urines is mostly dependent upon the amount of water contained in them.

Dark (reddish-brown to black)—Due to presence of Bile (brown or green), or of Blood, or Hæmoglobin (smoky, blood-red, or coffee colour).

As a rule, with an equal quantity of Blood, acid assumes a deeper tint than alkaline urine.

i. A pinkish-red pigment—*purpurine*—is found in the urine of patients when feverish, and when suffering from severe organic disease (especially of Liver); it has a strong affinity for Uric Acid and Urates, hence their familiar brick-red colour.

ii. When taken internally, Santonin, Rhubarb (containing Chrysophanic Acid), and Senna render the urine dark yellow (see Bile-pigments); Logwood, reddish (see Blood); Carbolic Acid, or Creasote, extensively used either internally or externally, renders the urine greenish-black ; the external use of Tar may also cause darkening of the urine.

iii. In threatened poisoning from absorption of Corrosive Sublimate in the antiseptic treatment of wounds, a warning of danger will be given by the precipitation of an orange deposit when the urine is treated with Sulphide of Ammonium.

iv. On adding Nitric Acid to urine containing Iodide of Potassium, or Bromide of Potassium, free Iodine or Bromine is liberated ; these darken the urine and are distinguished by their penetrating odours, and may be separated by treating the urine with Chloroform and then gently evaporating.

v. In cases of Melanotic Cancer, the urine, though of a normal colour when voided, may become black after standing ; this darkening is accelerated by adding Nitric Acid, or other oxydising agent (the pigment present is Melanin).

vi. The use of Quinine, Antipyrin, &c., also colours the urine deeply.

3. *Odour.*—The odour of normal urine is peculiar, and is said to be due to traces of Phenylic, Taurylic, and Damoluric Acids.

Ammoniacal—Indicates an Alkaline reaction.
Sweetish—Diabetes Mellitus.
Offensive—Decomposition of Bloodor of Pus. Normal urine kept for some time becomes offensive.

4. *Froth.*—Whether permanent (indicating Albumen) or not; or if tinged with Bile.

5. *Amount secreted daily.*—50 ozs. (21,875 grains). This amount, which varies directly with the arterial tension in the glomeruli of the Kidneys, is

Diminished (*Oliguria*)—In all cases of *increased* specific gravity (except Diabetes)—*e.g.*, Febrile conditions, Congestion of Kidneys, and Acute Bright's disease, Dropsy (early stages). A profuse discharge from the bowels or skin naturally lessens the urine.

Increased (*Polyuria*)—In all cases of *diminished* specific gravity—*e.g.*, Hysteria (usually), Chronic Bright's disease, Dropsy (when receding), exhibition of Diuretics.

i. *There is often a great difficulty in preserving the whole urine passed by a patient on account of the great tendency the urine has to be passed at stool and so lost.* By getting the patient to pass water before going to stool, this loss may often be prevented ; and in males a wide-mouthed bottle can be used simultaneously. It is well to date the period from 8 A.M. of one day till 8 A.M. next day, and to use a graduated vessel, so that amount may be easily read off. In cases of Incontinence it may be necessary to catheterise hourly; and in cases of Paralysis of Bladder, the use of a permanent receptacle is indicated.

ii. *The amount should be known for two reasons*—(1)—Because deviations from the normal are alone often indicative of disease; (2) because without a knowledge of the quantity no reliable conclusions can be drawn from a knowledge of the specific gravity.

iii. *The rate at which urine is excreted during the twenty-four hours varies, e.g.*—Roberts has shown that the solid and fluid constituents of urine are much increased after meals and diminished during fasting and sleep. *Two practical deductions are*—(1) The urine, like the fæces, may be reduced by a sparing solid as well as liquid diet in cases where it may be thought necessary ; (2) Where urine has to be repeatedly drawn off by the catheter, the meal hours might be so planned to suit the practitioner's time, that his visits an hour or so later would relieve the bladder after the increased flow has occurred.

iv. *Oliguria* is always of serious import in disease.

v. *Polyuria* occurs early in Waxy Kidney, late in Cirrhotic Kidney. NOTE.—The urine in Diabetes Insipidus is said to contain an *excess* of Urea; in other polyurias a *defect* obtains.

The Frequency of Micturition should always be noted, as, taken along with other symptoms, it is an important aid in diagnosis. Frequency above the normal may be—

i. Cerebral.

The vesical irritability during University and other Examinations is cerebral in origin.

The bad habit of frequently emptying the bladder can be easily acquired by unconscious imitation. *Treatment:* An exercise of will, the habit can be gradually broken by resisting the call. Sir James Paget says, "The bladder is a good servant but a bad master." Drugs: Codeia, small doses of Opium or Nux Vomica, Digitalis, and Bromide of Potassium. Injections of a solution of cocaine.

ii. Extra-Urinary.

The large gut is usually to blame, *e.g.*, constipation; worms; ulcerated piles; anal fissure, or eczema; the generative organs come next, *e.g.*, boys with long prepuces, or with hardened smegma under uncovered foreskins; girls with foliaceous papillomata around urethral orifice, or with vaginal discharges. E. H. Fenwick says, " . . . before treating routinely a *painless irritable bladder* . . search for sources of irritation outside urinary tract."

iii. Urinary Proper.

"If the renal secretion is greatly increased, the bladder must of necessity expel its contents more often. It is obviously necessary, therefore, to distinguish between a hypersecretion of urine, which causes the bladder to evacuate as often as it is filled (frequency of quantity), and some abnormal stimulus which excites the bladder to contract frequently upon a small quantity of urine (frequency of irritability). The former is usually the result of a pure physiological stimulus; the latter is most often the outcome of some organic change in the lower urinary tract."

E. Hurry Fenwick gives the following tables :—

A. The Frequency of Quantity.

(Much urine which is passed often.)

Persistent Excess.	High S.G.	Sugar.	Diabetes mellitus.
	Low S.G.	No sugar, but extreme thirst.	Diabetes insipidus.
		Albumen with casts but without pus, or residual urine	Chronic Bright's disease, such as granular kidney, amyloid kidney of advanced scrofulous or syphilitic affections.
		No Albumen, but with residual urine,	Back renal pressure from prostatic atony or direct renal irritation of prostatic origin.

- Transient Excess (usually diurnal).
  - Low S. G. Clear.
    - (*a*) Sexual excess or debility (without inflammation). Dietetic idiosyncrasy—tea, beer, &c.
    - (*b*) Hypochondriasis, hysteria, nervousness.

B. The Frequency of Irritability.

(Little water which is passed often).

- 1. Without obstruction to the stream.
  - (*a*) Without pus, → Blood; lithiasis, phosphaturia, oxaluria; dyspepsia.
  - (*b*) With pus. → Various irritants in renal pelvis and ureter stone tubercle. Movable kidney. Cystitis of all grades, Catarrhrl or tubercular ulceration of the bladder. Hard cancer.
  - (*c*) With prostatic "threads" of pus. → Micturition reflex, excited by inflammation or congestion of the prostatic mucous membrane, *e.g.*, Gout. Catarrhal prostatitis. Masturbation. Prostatic tubercle and stone.
- 2. With obstruction to the atream.
  - Diurnal. → Stone, stricture (6*f* gauge), prostatitis, muscular atony (low degree), vascular growths of urethra in female.
  - Nocturnal. → Enlarged or congested prostate without much residual.
  - Diurnal and Nocturnal. → Enlarged prostate with residual. Cancer of prostate.

The subject of undue frequency of micturition would be still incomplete without a few remarks upon the frequency of capacity and overflow. These are mere physical conditions. In the former the bladder is so contracted and its capacity for retaining urine so small that it must empty itself often; frequency of micturition, therefore, will vary with the activity of the kidney. The frequency of overflow is the voluntary but repeated ejection of a small amount of urine from the over-distended bladder. Both conditions may be tabulated thus :—

C. Physical Irritability.

- The frequency of incapacity.
  - Frequency at night nearly as bad as in day.
    - Non-inflammatory contraction. → Contraction due to habit.
    - Inflammatory contraction.
      - Obsolesced or advanced tubercle of the bladder.
      - Advanced interstitial cystitis following :—
        - Gonorrhœa.
        - Stone.
        - Enlarged prostate.
        - Perimetritis.
- The frequency of overflow.
  - Age 30-35; onset first noticed in morning. → Early spinal atony, *e.g.*, Tabes; advanced stricture.
  - Age 45-70; onset first noticed at night. → Advanced atony of prostatic enlargement.

Any Association of Pain with Micturition should be inquired for.

In connection herewith should be noticed—(1) The amount and character of the pain; (2) The locality of the pain; (3) The reflex neuroses induced by the pain.

(1) The Amount and Character of the Pain.

Kidney—It may be said of the kidney that if the capsule be not suddenly put upon the stretch, the secreting tissue may be gradually destroyed without any noticeable pain.

Ureter—Of all the suffering that man is heir to, renal colic is perhaps the worst.

Bladder—If we omit the extreme pain of muscular spasm, the intensity of pain in bladder disease is in direct proportion to the grade of the co-existing inflammation. It is important to remember this, for the pain in vesical disease is intermittent in severity, and ebbs or flows with the tides of cystitis.

Prostate—The suffering of prostatic disease is, for the most part, made up of the different pains which are excited by the disorder in the neighbouring organs—in the bladder by obstruction, in the rectum by extension, in the pelvis and inferior extremeties by nerve compression.

Urethra—Situated at the termination of the urinary tract the penile urethra is often the seat of referred sensations. Local pain is this region, unless it is due to an inflamed stricture, impacted stone, or a hypersensitive granular patch or ulcer, is rare.

(2) The Locality of the Pain.

The following tables are given by E. Hurry Fenwick :—

***A*. Supra-pubic Pain.**

- Diffused suprapubic pain.
  - Constant.
    - Unrelieved advanced atonies; Chronic prostatitis; Carcinoma of posterior wall and base (advanced).
    - All extra-vesical inflammation, *e g.*,
      - Abscess, pericysitis, perforating apical carcinoma.
    - Rare primary ureteral disease.
  - Transient.
    - Started by micturition.
      - Prostatic enlargement without much residual.
    - Relieved by micturition.
      - Cystitis of all grades.
      - Ulceration of female bladder, tuberculosis of bladder in both sexes.
      - Certain forms of prostatic inflammation.
      - Onanitic prostate.
    - Increased by micturition.
      - Sarcoma of prostate?
      - Cramp of a semi-toneless bladder of stricture.

***B*. Perinæal Pain.**

- Constant perinæal pain.
  - Chronic prostatitis.
  - Commencing senile enlargement of the prostate.
  - Encysted calculus at base of bladder.
  - Carcinoma of prostate.
- Transient perinæal pain.
  - Relieved by micturition
    - Acute prostatitis.
    - Tubercular disease of bladder base and tubercular prostate ("quiescent" stage).
  - Increased by micturition.
    - Calculus, either encysted in base or low down on posterior wall, or pouched in a depression behind an upraised prostate.
    - Catarrhal or tubercular ulceration of bladder behind trigone ("active.")
    - Local conditons : suburethral abscess, inflamed stricture, impacted stone, carcinoma of bulb.

C. Glans Pain.

- **Constant glans pain.**
  - Prostatorrhœa.
  - Catarrh of the prostatic canal; swollen verumontanum; cracks?
  - Enlarging median or lateral lobe of the senile prostate.
- **Transient glans pain.**
  - Before micturition.
    - Clot retention.
    - Senile prostatic obstruction.
  - During micturition.
    - Local lesions—inflammation and granular patch.
    - Inflamed congenital fold, ulceration, wart, narrow meatus.
    - Stone in the bladder.
  - After micturition.
    - Tubercular and other ulceration of posterior or lateral walls of the bladder.
    - All forms of acute localised cystitis in any part of the bladder.
    - Cystitis of neck.
    - Vesical growth engaging or impinging on urethral orifice.
    - Acute prostatitis.
    - Inflamed onanitic prostate.
    - Inflamed senile prostate
    - Severe vesical spasm of renal origin.
    - Sudden ureteral block.
    - Renal colic.
    - Sudden ureteral kink, as in floating kidney.

In women all the symptoms of that rare female disorder, stone in the bladder, can be induced by disease in the pelvic organs affecting the bladder by contiguity. Most marked of all the symptoms thus produced is the pain at the meatus *after* micturition.

E. Hurry Fenwick says, "Permit me again, therefore, to impress upon you the following fact, which is, I know, contrary to accepted teaching, but the truth of which I can sustain by very many cystoscopic examinations. *Glans pain after micturition does not necessarily point to trouble about the neck of the bladder. The symptom can be evoked by disease of any part of the bladder, ureter or pelvis.*"

(3) **The Reflex Neuroses induced by the pain.**

This subject is beyond the scope of the present work.

Abnormal Characters of the Stream of Urine.

In connection herewith should be noticed—(1) Abnormal Urination, (2) Impossible Urination, (3) Uncontrollable Urination.

(1) **Abnormal Urination.**

So much can be learnt by watching the act of urination that it is unwise to neglect this item of examination. It is also better not to trust to the size and strength of the stream which is so often volunteered by the patient himself.

By watching the patient's face and naked belly as the stream of urine is being ejected, you are able to reckon roughly the amount of assistance the patient derives from his diaphragm and abdominal muscles in urination. Again, an opportunity is also afforded you of learning the position usually assumed by the patient in micturition. Some with calculus can pass water best when lying on their backs. Those with floating vesical growth often lie upon their side. Tabetic patients sometimes squat, as if at stool. Stricture patients often lean forward. . . . Although no position is pathognomonic of any form of urinary disease, yet a ready hint is often gleaned whilst watching the patient's manœuvres.

E. Hurry Fenwick gives the following table :—

- **Abnormal urination.**
  - **Alterations in the volume of the stream (size of efflux); (compare retention).**
    - *(a)* Sense of obstruction developing suddenly.
      - Gonorrhœa.
      - Acute prostatitis.
      - Impaction of stone in urethra.
      - Congested senile prostate.
      - Onanitic prostate
    - *(b)* Sense of obstruction developing gradually.
      - Chronic prostatitis.
      - Stricture.
      - Chronic lesions of spinal chord.
      - Stone in the bladder.
      - Orificial valves of mucous membrane.
      - Stone in urethra.
      - Senile enlargement of prostate
      - Pelvic tumours.
  - **Alterations in the continuity of the stream (interruption of efflux.)**
    - *(c)* Efflux arrested suddenly.
      - Stone, clot, pedunculated growth, foreign body.
      - Spasm.
    - *(d)* Efflux arrested intermittently
      - Atony, muscular or nervous.
      - Muscular enfeeblement of fever or old age.
  - **Alterations in the direction of the stream (the parabola).**
    - Stream bifid.
      - Stricture.
    - Stream vertical.
      - Enlarged prostate.

(2) Impossible Urination.

The stream may be altogether absent, and no urine may be passed, either from *suppression* or from *retention*. (*a*) In the former case there is rarely any pain or distress. The patient is depressed, listless, drowsy, the pulse is hard, the skin hot and dry; vomiting is often present. There is no vesical distension (as estimated by percussion and bimanual examination), and the catheter proves the bladder to be empty. (*b*) With retention there is great tensive pain, situated in the hypogastrium, There is also tenderness and swelling of the lower belly, flatness on percussion in the region of the distended bladder, which may sometimes be noticed bulging under the abdominal wall as high as the umbilicus. The patient is in great anxiety and distress of mind, and makes futile efforts to urinate; there is no fever.

E. Hurry Fenwick gives the following table :—

- **Impossible urination (no urine passed).**
  - **Suppression of urine.**
    - Non-obstructive.
      - Renal disease.
      - Shock.
      - Septicity.
      - Hysteria
      - Reflex causes.
    - Obstructive.
      - Injury to one kidney.
      - Ureteral obstruction.
  - **Retention of urine.**
    - Peritonatis.
    - Fevers.
    - Pressure on bladder neck :—
      - Rectal collections.
      - Pelvic growths; hydatidads.
      - Soft malignant prostatic growth.
    - Unrethral obstruction.
      - Acute prostatitis.
      - Congested stricture.
      - Impacted stone in children.
      - Ruptured urethra.
    - Reflex spasmodic action.
      - Anal and hernial operations, &c.
    - Nerve lesions.
      - Acute myelitis.
      - Tabes (7 per cent.).

(3) Uncontrollable Urination.

When the bladder evacuates its contents either partially or completely in a brusque or sudden manner, despite the sphincteric efforts of the patient to prevent it, we have to deal with a case of irrepressible urination and an imperious call. When a portion or all of the urine dribbles away involuntarily, our patient is said to be suffering from involuntary urination.

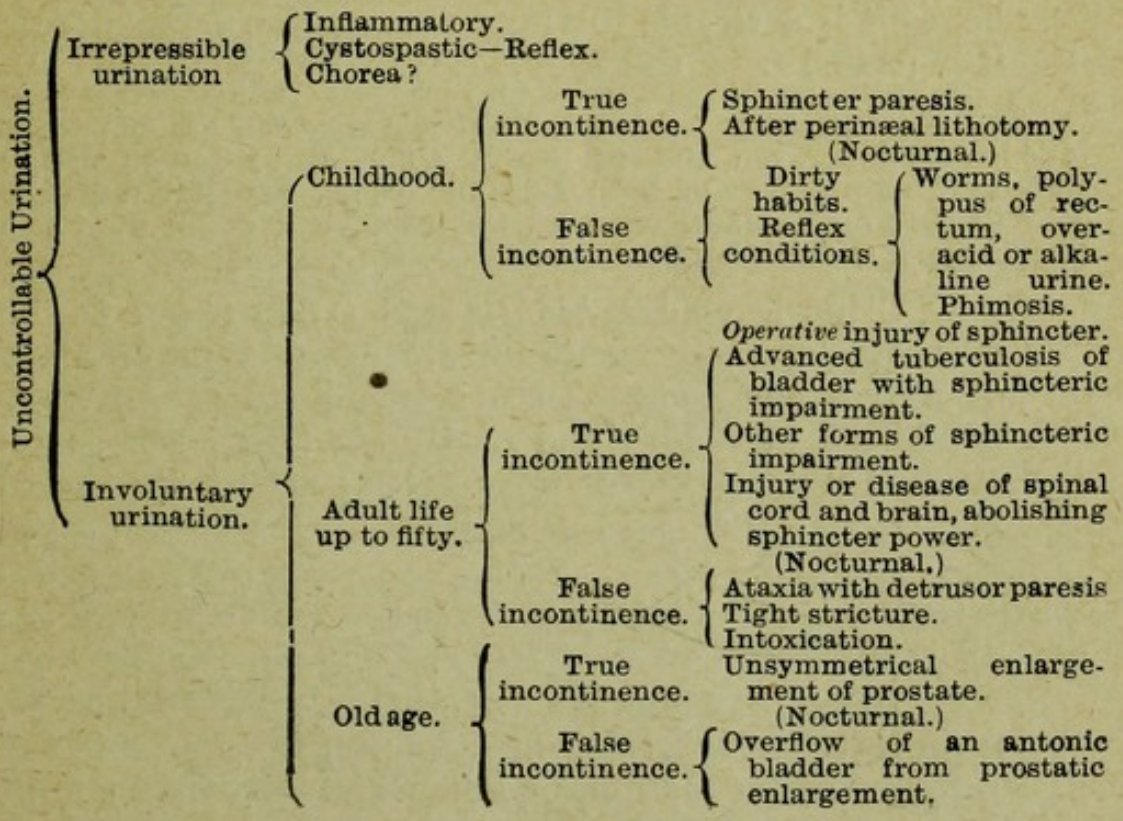
E. Hurry Fenwick says, "Before considering the subject permit me to warn you against accepting, without cross-examination, the statement usually made by the young adult that 'he cannot hold his water, it runs from him,' and of labelling such a condition as this as incontinence."

Young men after an attack of gonorrhœa frequently apply for relief, stating that their urine drips from them; but a little inquiry will elicit the fact that this only takes place *after micturition;* that after the penis has been replaced and the trousers buttoned, half a drachm to a drachm of urine will trickle out of the urethra and soil the shirt.

Lastly, I may remind you that in all cases of incontinence in females a vesico-vaginal fistula must be excluded by careful examination with a Sims' speculum, used in the knee and elbow position, and, if need be, by injecting sterillised milk or some coloured solution—such as indigo or cochineal—into the bladder.

In old women the sphincter often becomes weak, and a little urine is expelled by coughing or sneezing.

E. Hurry Fenwick gives the following table :—



II.—**The Reaction** is to be noted secondly, using litmus paper.

Normal urine is *faintly* acid [from presence of Acid Phosphate of Sodium, derived from the basic Phosphate of Sodium of the blood, "owing to the Uric, Hippuric, Sulphuric, and Carbonic Acids taking up part of the Sodium, so that the Phosphoric Acid forms an Acid Salt" (Landois and Stirling); although the recent investigations of Thudichum attribute it to a free acid discovered by him—Krytophanic Acid (Da Costa). It is not due to *free* Uric acid, for the urine does not give a pp (precipitate) with Sodium Hyposulphite (Voit; Huppert); nor to free Hippuric Acid, for the urine does not give a violet or inky colour, with a solution of Congo-red (Brücke)].

On standing, it undergoes certain fermentative and putrefactive changes. At first it becomes more acid, a result due to lactic acid fermentation; but after a variable period—usually at least twenty-four hours—it becomes Alkaline, from the conversion of Urea into Carbonate of Ammonia:—

$$CO(NH_2)_2 + H_2O = 2NH_3 \div CO_2$$

hence it is desirable to know the reaction immediately it is passed from the body.

The reaction may be *Amphoteric* or *Amphogenous*, *i.e.*, turns blue litmus paper, red, and red litmus paper, blue; due to (1) the simultaneous presence of both acid and basic phosphates, (2) the commencing ammoniacal changes, (3) insufficient delicacy of the litmus paper (Krukenherg).

1. Urine is voided *highly* acid (1) in acute febrile diseases, especially Acute Rheumatism—from presence of a free acid, other than Kryptophanic; (2) after exhibition of Acids [and of Opium (*Harrison*)]; (3) after prolonged muscular exertion; after a prolonged fast (*Acid Tide*), *e.g.*, urine before breakfast.

The acidity of the urine varies inversely with the secretion of the Gastric Juice—when there is much acid in the Stomach, a less quantity is excreted by the Kidneys, and *vice versa*.

2. Urine may be voided *Alkaline*. This occurs (1) after a full meal (*Alkaline tide*); (2) from presence of a fixed Alkali (Sodium, or Potassium Carbonate), indi-

cating Cystitis; (3) from presence of a volatile alkali (Ammonia Carbonate), indicating Flatulent dyspepsia, Debility, Melancholia, and some forms of Spinal Paralysis, &c.

i. The blue colour imparted to red litmus paper by an alkaline urine, disappears on heating when due to a volatile alkali, but remains when due to a fixed one.

ii. Alkalinity of urine is sometimes a point aimed at in treatment by administration of potassium or other alkaline medicine, *e.g.*, Rheumatism, Lithiasis, Gout; the reaction must be determined frequently in such cases, as the urine rendered alkaline by remedies readily becomes acid, unless the doses are frequent and sufficiently strong. On the other hand, medicines seem to have little chemical power in rendering an alkaline urine acid—Benzoic Acid and Carbonic Acid seem to have some influence in this respect.

iii. The reaction of urine is of value in the recognition of urinary deposits (see farther on): thus (1) a bulky deposit which forms soon after the urine is passed may usually be pronounced to consist of Uric Acid, or of Urates—if the reaction be acid; if, on the contrary, such a deposit forms in an alkaline or neutral urine, it is probably phosphates—since the addition of an alkali to normal urine precipitates the phosphates; again (2) the persistence of pus in an acid urine points to a renal origin: pus from the bladder *if persistent* tends to render urine alkaline—the samples in such cases must be fresh, as urine with much pus rapidly decomposes.

III.—**The Specific Gravity (S.G.)** is next to be noted.

By Specific Gravity of urine is meant "its weight, as compared with that of an equal volume of water at a temperature* of 0°C. and a pressure of 760 M.M. of Mercury."

In taking the S.G., the urine of twenty-four consecutive hours should be collected and a sample selected from it, for the S.G. varies directly as the amount of solids in the urine, inversely as the quantity of water (*i.e.*, of the urine itself) and the excretion of both solids and water varies with the period of the day.

Place a clean dry Urinometer in the urine, but do not allow it to touch the side of the vessel. (Some recommend total immersion, for a moment, of the Urinometer). Remove any air-bubbles by blotting-paper, or by filling the vessel to the brim, when they may be blown off. The surface of the urine forms a *meniscus* (concavo-convex lens); the reading must therefore be taken at the lower edge of the meniscus—the eye being on the same level.

As Urinometers are graduated for a temperature corresponding to that of an ordinary room, observations should

not be made on urines until they have cooled to the same temperature*—practically 60° F. (15·5° C.).

The S.G. is found more accurately by actual weighing.

If the quantity of urine is too small to float a Urinometer, then (1) it may be diluted with one, two, or more equal volumes of water as may be required, and the S.G. will be obtained by multiplying the last two figures by the number which represents the dilution, *e.g.*, a sample of urine diluted with three volumes of water which gives a S.G. of 1010, has really a S.G. of 1040 (*i.e.*, $10 \times 4 = 40$); or (2) *Oliver's* graduated test-tube, and glass bead (which sinks in urine of S.G. 1008) may be used—if it floats the urine is gradually diluted until it sinks, the mark reached by the diluted urine showing the original S.G.

1. Normal S.G. averages 1020 (water=1000). Limits range betwetn 1015 and 1025 usually.

2. S.G. below 1015 indicates Excess of Water, *e.g.*, (1) Chronic Kidney Disease (and possibly Albumen). NOTE.—*Even where no Albumen can be detected, a persistently low S.G. should always make a practitioner anxious.* (2) Obstructed Ureter—since when pressure within ureter is increased, the excretion of solids is lessened before the current of fluid is affected. (3) Diabetes insipidus (Polyuria). (4) Hysteria. NOTE.—The S.G may fall to 1002, after large potations, in healthy people.

3. S.G. above 1025 indicates Excess of Urea (urine dark), or Excess of Sugar (urine pale)—see Urea and Sugar further on. NOTE.—The S.G. may reach 1040, after great sweating, in healthy people.

1. As a rule, diminished S.G. means less Urea, and increased S.G. means more Urea, *i.e.*, in the absence of Sugar. *To be more exact*, it may be stated that "in urine free from Albumen and Sugar, and containing a normal amount of Chlorides, the S.G. is in a certain way an index to the amount of Urea present."

ii. Urine of *low* S.G. (even 1010) may contain Sugar—this would be likely to occur in cases of Granular Kidney accompanied by Glycosuria.

iii. An abnormal S.G. is a fact of great importance in disease, but S.G. must as already explained, be considered in relation with the amount of urine passed, and is then a direct indication of the activity of the Kidney-substance and of the quantity of solids excreted.

As a rule, when the quantity of urine is diminished in disease, its S.G. is raised. A considerable departure from this rule implies one of two things—Either tissue-changes are notably suspended and their products Urea, Uric Acid, &c., formed in smaller quantities, or these processes remaining active, such products fail to be removed by the Kidneys. To the first of these causes is to be assigned that

rapid decline in the S.G. of the urine, which sometimes precedes a fatal termination in Acute Fevers. Of still more serious import is a sudden fall in S.G. in Nephritis, unattended with any alteration in the quantity of urine passed; the phenomenon in this instance points to the failure of the diseased Kidneys to separate the Urea and salts elaborated within the system. *Jaksch* has had many opportunities of observing that such a fall in the S.G. is apt to precede, usually by several days, the oliguria and suppression which herald an attack of Uraemia; and it often affords a valuable warning of what is impending at a time when all other symptoms are wanting. Moreover, the symptoms of Uraemia may develop while the urine remains but little diminished in quantity, and in such cases we shall always find that its S.G. is greatly lessened

As the urine is secreted and accumulates gradually in the bladder, it becomes arranged in layers according to its S.G.—the heaviest layers being lowest. If the person remains quiet, so as not to mix the layers, and passes the urine in successive portions into different glasses, their S.G. may be found to differ.

NOTE.—**To determine the amount of Solids in Urine:—**

1. *Accurately.*—By evaporating a sample of urine (collected during twenty-four consecutive hours), and weighing the residue.

2. *Roughly.*—Since the S.G. is in proportion to the Solids, we can calculate the latter from the former:—The average yield of Solids on evaporation is about 4 per cent., the average S.G. is about 1020. Now if the last two digits (20) are multiplied by 2 (TRAPP'S co-efficient) we get 40, *i.e*, the amount per 1000, and this corresponds to 4 per cent. Hence the rule—*Multiply the last two figures of its S.G. by 2* (TRAPP'S co-efficient)—thus 20 × 2=40, *i.e.*, there are 40 *parts* of solid matter in every 1000 *parts* of urine; then, if 1000 *grains* of urine contain 40 *grains* of solid matter, how many *grains* of solid matter will 21,875 *grains* (*i.e.*, 50 ozs.) of urine contain?—1000 : 21875 : : 40 : 2 ozs. (roughly).

Trapp's co-efficient = 2; Loebisch's = 2 2; Haeser's and Christison's = 2·33; either of the latter gives more accurate results than Trapp's.

IV.—**Warm** (not boil) **a small portion of the urine** (decanted if necessary from any sediment).

If the urine previously

Turbid—becomes clear = Urates (lithates). See later.

Clear—becomes turbid = Phosphates (sol. in Nitric Acid), or Albumen (insol. in Nitric Acid).

If Urates and Albumen are present together, heat redissolves the Urates, and as the boiling point is approached, a cloud of Albumen will appear if present. A long column of such urine may be warmed in its upper two-thirds to clear it from Urates, and then heated to boiling in its upper one-third to precipitate the Albumen, when the three strata of Urates, clear Urine, and Albumen may be compared.

Urates, inference from = same as Urea (which see).

When visible continuously for some time, they indicate Liver derangement, and being premonitory of Gout and Uric Acid formation require treatment (MURCHISON). If co-existing with Piles, improve the hepatic circulation.

Phosphates, inference from = Phosphates are most abundant in the alkaline muco-purulent urine of Chronic Cystitis; common in Dyspepsia.

It was formerly held that "Phosphatic Urine" indicated an undue waste or disintegration of nervous tissue, and that it was specially to be met with in those who undergo a great amount of brain-work. Such persons, however, take but little exercise, and the urine is, as a rule, diminished in acidity, which explains the precipitation of the Phosphates. When exercise is taken, the Phosphates disappear. Though excess of Phosphates in urine is often of trivial moment, still the occurrence of Stellar Crystals of Phosphate of Lime in quantity in the urine is, according to Roberts, of grave import, indicating serious disease of some kind or other, although a few such crystals may occur in normal urine.

As a rule, phosphatic urine is associated with chronic as distinguished from acute affections.

NOTE.—In all cases alkalinity of the urine is the immediate cause of the precipitation of Phosphates.

Albumen, inference from = Structural diseases of Kidney, Renal Congestion, presence of Blood or of Pus in urine.

"*In forming an opinion as to whether Albumen is the result of organic renal disease we should be mainly guided by the amount and duration of the Albuminuria, and the associated presence of renal epithelium and tube-casts*"—(CARTER).

"*Certainly the amount of Albumen in the urine is no measure of the amount of renal mischief; and my experience induces me to say that very often its appearance gives no occasion for alarm, and its absence in other cases confers no comfort. The simplicity of testing the urine for Albumen, and so settling the question of the presence or absence of Kidney disease, is so alluring, that many forget that it is only one symptom of renal disease; and that, too, a symptom about whose value there is the greatest variety of opinion. . . . Albuminuria is a valuable symptom when carefully appraised, but it will not settle the question of renal disease. . . . . The man who would make the diagnosis of chronic renal disease turn on the presence or absence of Albumen, is a man whose patient I should not like to be.*" —(FOTHERGILL).

Physiological (functional) Albuminuria :—

Definition :—The transient occurrence of Albuminuria in persons apparently in good health and in whom is no other evidence of renal disease.

Symptoms :—The leading clinical features are—(1) Its occurrence at particular times and its complete absence in the samples passed on rising from bed ; (2) Small quantity ; (3) Absence of tube-casts; (4) Normal heart and good general health.

Etiology :—"It is most commonly caused by the application of cold to the surface" (Nixon). After making due allowance for certain cases in which such Albuminuria may be the result of long antecedent organic renal disease thought to have been cured, and where it forms the initial symptom of organic renal disease as yet attended with no other symptom or sign, there still remains a certain proportion in which it is clearly due to *functional* causes. Of these the most important are—(1) Digestive derangements ; (2) Nervous debility from any cause, *e.g.*, masturbation ; (3) Muscular *fatigue* ; (4) Certain altered conditions of blood, *e.g.*, a mild paroxysmal hæmoglobinuria. NOTE.—Intermittent Albuminuria is met with in connection with (1) Maleria and (2) Contracting Kidney.

Pathology :—Egg-albumin and pro-peptones readily pass through the Kidneys. It has, however, been recently found by Stokvis that if Egg-albumin is made to pass through the Kidneys for a length of time, the Kidneys themselves undergo structural change, Glomerular Nephritis being induced. These observations confirm the idea, founded on clinical observations by Dr. G. Johnson, that Albuminuria with structural Kidney-change may be secondary to continued indigestion.

Recent German authorities are disposed to hold that it depends upon a congenital deficiency in the power of the Glomerular Epithelium to resist the passage of Albumin through it. Certain pathologists hold that it depends upon (1) Abnormal diffusibility of Albumen ; (2) Increased pressure in the Glomeruli; (3) Vaso-motor paralysis ; (4) The hæmoglobin is broken up into hæmatin and globulin—due to an increased hæmolytic action of the Liver.

NOTE.—It is not an uncommon thing to find that persons of a gouty habit—if indiscreet in living, especially as regards the taking of wine—pass for some days after the indiscretion, urine containing a small quantity of Albumen. It is not certain that in such cases the Kidney is at fault—it may be exuded from the vessels of bladder, just as a similar exudation may take take place as a result of the irritation produced by Cantharides. If the urine be examined it will be found that it contains most Albumen when bladder is nearly empty, or that the last part of the urine passed is most albuminous.

Inference :—While we may admit the existence of Albuminuria independent of renal disease, it seems certain that some of these cases ultimately lead to renal disease ; and until it is possible to discriminate functional from organic cases more surely than at present, Insurance Societies will probably continue to reject *all* cases of Albuminuria.

NOTE.—Physiological Albuminuria is usually discovered by accident, *e.g.*, in Life Insurance examinations, and in cases where the urine is examined when the diagnosis is obscure.

Confirmatory **Tests for Albumen** (*i.e.*, Serum-Albumin).

NOTE.—*In confirmatory testing for Serum Albumin—which for practical purposes is the only form whose presence is important—the urine should previously be rendered clear (by warming—not boiling—filtering, or, &c.), and slightly acid (by dil. Aceatic Acid if alkaline or neutral; by Liquor Potassæ if strongly acid.) Even though the urine possess its natural acidity, it is better to add one drop of dil. Acctic Acid.*

1. **Boil**=white pp. (precipitate) insol. in Nitric Acid (*a trace of*)—distinction from Phosphates (if both are present simultaneously, there will be a partial clearing up on adding the acid); and insol. in Alcohol—distinction from Copaiba.

   "*A dilution of the urine with one-sixth of its volume of saturated soln. of Sulphate of Magnesia renders the test absolutely trustworthy and very delicate.*

Fallacies—

. *Albumen may be present and yet no pp. be got on boiling.*
This may occur if the urine be alkaline, or *strongly* acid *; because **Alkali-Albumin,** or **Acid-Albumin,** which are sol. in water, may be formed from the Serum-Albumin. Hence the reason for rendering the urine *slightly* acid before boiling.

ii. *Albumen may be absent and yet a pp. be got on boiling, like that of Albumen, e.g.—*

(*a*) When the acidity of the urine is too slight to hold the **Earthy Phosphates** in soln. without the aid of the CO_2 which it usually contains; when such urine is boiled the CO_2 is driven off and the Phosphates are precipitated. The two precipitates are distinguished by Nitric Acid. If excess of Nicric Acid be used, an Albumen cloud may also clear up, for Albumen coagulated by heat is slightly sol. in strong Nitric Acid.

(*b*) **Copaiba or Cubebs.**—For distinction, see above.

* *Rees has shown that this might occur if the urine to be boiled were placed in an unwashed test-tube containing a trace of Nitric Acid from a previous examination.*

2. **Nitric Acid:**——Add HNO_3 (about ¼ of amount of urine—too little will fail to coagulate the Albumen, and too much will, if *mixed* with the urine, redissolve it—allowing it to trickle slowly down side of tube so as to form a layer below the urine without mixing)= white pp. (often in the form of a cloud or haze at

junction of the two liquids, which if only a trace of Albumen be present may not appear for twenty or thirty minutes), insol. on *warming*—distinction from **Urates.**

NOTE —" This is a delicate test, and to be used first in all cases, except when urine is turbid from Urates."

Heller's method of putting the acid in the test-tube first, and then gently pouring the urine unto it, is to be preferred.

" *A dilution of the Nitric Acid with five vols. of a saturated soln. of Sulphate of Magnesia lessens the corrosive properties of the acid, which are so objectionable, without impairing seriously the delicacy of the test.*'

Fallacies—

i. *Albumen may be present and yet no pp. be got with Nitric Acid.*—For reason, see above.

ii. *Albumen may be absent and yet a pp. be got with Nitric Acid, like that of Albumen, e.g.—*

(*a*) **Urates** (see above). Again—(2) Albumen begins to coagulate immediately above stratum of acid and the turbidity spreads upwards, but the urates first appear at or near the surface of the urine and the opacity spreads downwards. (3) Further confirmation of such a pp. being due to Urates may often be obtained by getting a similar reaction on adding a drop or two of Acetic Acid to another sample—as this acid does not precipitate Albumen in cold urine (4) The microscope may also assist us NOTE—*It is in concentrated urines, especially febrile, that urates are apt to be precipitated by Nitric Acid.*

(*b*) **Copaiba** (especially the **Resin** of) **and Cubebs** behave like Urates, but are distinguished by their smell.

(*c*) **Fat** or Saponified **Fats** (rare).—The pp. of fats is sol. in Ether, that of Albumen is not.

(*d*) **Urea,** when present *in excess* gives on adding Nitric Acid a crystalline pp. of Urea Nitrate, after the fluids have been some time in contact (see Urea). It is distinguished from Albumen by being crystalline and readily sol. at a gentle heat.

A haze of **Mucin** quite above the level of the acid, and sometimes in the form of a ring, seldom leads to confusion with Albumen. A red ring merely, without turbidity, at the junction of the fluids does not indicate Albumen, it depends on the action of the acid on the **Chromogens** (see PIGMENTS) of urine. A green ring indicates **Bile-pigments;** a reddish-brown colour occurs sometimes when the patient is taking **Iodide of Potassium;** and a darker colour still in some cases of **Melanosis.**

Occasionally the addition of Nitric Acid is followed by the evolution of Air-bells; these are usually plain enough and can be seen rising in the urine. They are sometimes so numerous and minute and remain so long in the vicinity of the acid as to resemble the haze of coagulated Albumen—close scrutiny, and time to allow bubbles to rise and dissipate, will prevent mistake.

NOTE.—*In testing for Albumen it is a good plan to use both Heat and Nitric Acid simultaneously, thus, add* HNO_3 *and then boil = white pp.*

3. **Picric Acid.**—Add a saturated soln. of Picric Acid (*excess*), allowing it to trickle down side of tube to form a layer on *surface* of urine = white pp. (at junction of the two liquids *at once*—distinction from **Mucin;** and insol. on heating—distinction from **Urates, Quinine,** and **Peptones**—(JOHNSON'S TEST).

4. **Citric Acid** and **Potassium Ferrocyanide** = white pp.

4*a*. **Pavy's pellets.**——Add a Citric Acid pellet and a Potassium Ferrocyanide pellet = white pp.

4*b*. **Oliver's papers.**—Add a Citric Acid paper and a Potassium Ferrocyanide paper, or a Potassio-mercuric Iodide paper = white pp.

Fallacies.—Citric Acid alone may precipitate **Mucin** and **Urates.**

If **Mucin** is precipitated--This sample is set aside and compared with a fresh sample treated with both reagents—the difference between these two deposits will show the presence of Albumen.

If **Urates** are precipitated—A fresh sample of urine should be diluted with an equal vol. of water, and then tested.

5. **Heynsius' test.**—Add dilute **Acetic Acid** (*excess*), and a saturated soln. of **Sodium Chloride** (*defect*) and boil = a flocculent pp.

6. **Hindenlang's test.**—Add a little solid **Metaphosphoric Acid** = A pp. or turbidity. NOTE—This test sometimes succeeds when all others fail.

NOTE.—*When but a trace of Albumen is present, the white pp. or turbidity obtained by the various tests is with difficulty observed. The writer in such cases adopts the expedient of holding the test-tube up to the light, and passing it alternately from the light to the shade, using his other hand as a screen.*

Peptonuria may be briefly mentioned here.

Tests for—1. Peptones are precipitated by **Picric Acid** and **Mercuric Iodide,** but the pp. is dissolved on heating. By separating the Albumen by heat and filtration and then

applying these reagents and seeing if the application of heat clears up the resulting opacity, we may discover Peptones if abundant.

2. Saturate the urine (slightly acidified with Acetic Acid) with **Ammonium Sulphate**—this salt precipitates *deutero-proteose* (the proteid most likely to be mistaken for Peptone), and leaves Peptones in soln. Any proteid that remains in soln. after filtering off the pp. produced by thorough saturation with Ammonium Sulphate must be Peptone. This is, in fact, the only method, according to *Haliburton*, by which Peptone can be identified with certainty. A soln. of Peptone so obtained gives no pp. with HNO_3, $CuSO_4$, or with heat; it is precipitated, but not coagulated, by **Alcohol.** It is also precipitated by **Tannin, Potassio-Mercuric Iodide, Phospho-Molybdic Acid, Prospho-Tungstic Acid,** and **Picric Acid.** It gives a well-marked **Xantho-Proteic reaction** (yellow colour on boiling with HNO_3, turned orange or brown with NH_3) and **Biuret reaction** (rose-red colour with $CuSO_4$ and KHO).

Inference.—Usually suppurative changes in some part of the system, *e.g.*, Pneumonia, resolution stage; Pleurisy, empyema stage; Tubercular Cerebro-Spinal Meningitis (distinguishing this from the epidemic variety). N.B.—Again, in the condition called "Sepsis Occulta," and which is commonly so difficult to recognise, Peptonuria is an important symptom; by its aid especially it will be possible to distinguish the symptoms of Septicæmia from those of latent disseminated Sarcoma, which present a similar clinical character (high fever, rigors).

V.—Examine now the remainder of the Urine (decanted if necessary from any sediment).

(A)—For its Normal Constituents.

Urea—Tests for—

NOTE.—*Before testing for Urea remove any Albumen by boiling and filtering.*

1. **Nitric Acid.**—Evaporate the urine to one-third of its bulk (normal urine is too dilute for a precipitate of Urea to form), add an equal vol. of strong Nitric Acid —or of **Oxalic Acid**—and place test-tube containing the mixture in cold water=Crystals of Urea Nitrate—or Urea Oxalate—form. (See Nitric Acid test for Albumen);

Or, evaporate the urine to one-third its bulk, and put one-half of a small piece of ordinary white sewing thread into a drop of urine on an object glass, cover the drop and the half of the thread in it with a cover-glass; moisten other half of thread with strong Nitric Acid. The whole is then put under the microscope, and hexagonal

plates of Urea Nitrate are seen forming alongside the half of thread under the cover-glass.

NOTE.—Warm some Crystals of Urea Nitrate and Biuret is formed, add now a few drops of Liquor Potassae and a drop of Copper-Sulphade soln. and a red-rose colour is produced.

2. Add three parts of an **Aqueous Soln. of Furfuraldehyde** and a few drops of **strong Hydrochloric Acid** and warm=rainbow-like play of colours, settling finally into a brown resinous mass.

3. **Quantitative test** (see later). This may be used *qualitatively*.

Urea, inference from=Fevers (up to crisis), Ague (during paroxysms), Diabetes; exhibition of Quinine (large doses), Phosphorus, Arsenic, &c.; Muscular *fatigue* (when in *excess*)—Fevers (during convalescence), Chronic Organic diseases (*e.g.*, Anæmia, Syphilis, Phthisis, Dropsical affections, &c.), Diabetic Coma, Degenerative changes of the Liver (especially Acute Yellow Atrophy); exhibition of Quinine (small doses)—(when in *defect*).

NOTE.—*A sudden diminution of Urea occurring in the course of Bright's disease (the diet being constant) usually portends an attack of Uræmia, and is of far more dangerous import than an increase of Albumen.*

Urea is derived from the destructive metamorphosis of the nitrogenous elements of the food and tissues, and may be regarded as the ash of these substances. The variations due to the food are so great that unless the amount of nitrogen in the food consumed be kept rigidly the same from day to day, or food be altogether withheld, they mask the variations due to tissue change.

The late Dr. Murchison pointed out these two facts :—(1) That in *functional* disorder of the liver, lithates (urates) are found in considerable quantity in the urine; (2) That when a large portion of the liver is destroyed, as by cancer, for instance, the amount of urea is largely diminished.

Azoturia may be briefly mentioned here.

A condition in which the excretion of Urea is excessive, in proportion to the weight of the body—in some people, this is associated with an increased secretion of water, so that the *percentage* (*i.e.*, *relative* amount) of urea remains normal; in others the water is not increased, so that the percentage of urea rises (such urine at once yielding crystals of Urea Nitrate on adding HNO_3).

Usually associated with gastro-intestinal derangements and nervous symptoms—the patient complaining of acidity and flatulence (but not of thirst or excessive appetite), languor, fatigue after slight exertion (bodily or mental), nervousness, restlessness at night, dull

pain in the back, and sometimes irritation at neck of bladder with constant desire to make water.

It is probable that in some individuals, the nitrogenous tissue-change goes on more rapidly than in others, and that they consequently require a larger proportion of nitrogenous constituents in their food, to enable them to do the same amount of work ; and that when indigestion occurs in such persons, the nitrogenous products of imperfect digestion or tissue-waste, acting as nervous and muscular poisons, lead to the symptoms of which they complain.

NOTE.—In Diabetes there is an increased excretion of Urea, from the greater amount of food taken by the patients ; and it has been supposed by *Prout* that cases of Azoturia might pass into Diabetes.

Hippuric Acid—Tests for—

1. Evaporate the urine with **Nitric Acid,** and heat residue in a test tube=odour of Oil of Bitter Almonds.

Fallacy.—**Benzoic Acid** also gives this reaction.

2. Add a strong soln. of **Hydrochloric Acid,** and boil= white pp. (of Benzoic Acid).
3. Add a salt of **Silver** or of **Mercury**=white pp.

Hippuric Acid, inference from=Diabetes (when in *excess*). The amount of Hippuric Acid present is increased after eating certain fruits, *e.g.*, cranberries, blackberries, and plums.

NOTE.—Benzoic Acid taken in health is eliminated in the urine as Hippuric Acid, but when taken in disease is eliminated unchanged.

Extractives—*e.g.*, Kreatin and Kreatinin.

(NOTE.—*Kreatin is said not to exist in fresh urine, and to result merely from the Kreatinin taking up an additional equivalent of water. Kreatin is a neutral substance, Kreatinin is a powerful base.*)

Test.—Add Caustic Soda (excess) and Nitro-prusside of Sodium (defect)=red colour, becoming yellow.

Inference=Typhus fever and Pneumonia (when in *excess*) ; Anæmia, Chlorosis, also Tuberculosis (when in *defect*). NOTE.—Kreatinin, though a normal constituent of urine, cannot be said to have any practical significance.

Pigments—These appear to exist in the urine both as pigments and pigment-yielding (on standing ; or on

adding oxidising agents) substances or Chromogens. The *pigment* of normal urine is Uro-bilin—an amorphous yellow-brown pigment apparently identical with choletelin. The *Chromogens* are two—viz., Indican and the chromogen of Febro-Urobilin. We need only test for Indican (see Bile).

NOTE.—Uro-Erythrin (Purpurin) if present is known by adding Hydrochloric Acid and boiling so as to get a red or purple colour. It is present in Rheumatism.

Salts.—The salts in urine are both Inorganic and Organic.

NOTE.—The most important clinically are the phosphates, and oxalate of lime.

Inorganic.—Sulphates, Bi- or Acid Phosphates, and Chlorides.

Sulphates—Test.—Acidulate with **Hydrochloric Acid** (to prevent precipitation of the Phosphates), and add Barium Chloride = white pp. insol. in Nitric Acid.

Inference = Same as Urea (which see). The excretion of sulphur in the urine may be used as a means of diagnosing the condition of the secretion of bile; thus the more sulphur is excreted in the bile, the less appears in the urine, and *vice versa.*

In all cases the amount of Sulphates is proportionate to that of the Urea, except in Rheumatic Fever.

Phosphates—See before.

Chlorides—Test.*—Acidulate with **Nitric Acid** (to prevent precipitation of the Phosphates), and add **Silver Nitrate** = *curdy* white pp., insol. in *boiling* Nitric Acid, sol. in dil. (1 in 20) Ammonium Hydrate.

*Albumen, if present, must be separated before testing for Chlorides, as it also is thrown down by Silver Nitrate.

Inference = Ingestion of much Salt, or of much Water (when in *excess*); Acute Inflammatory Diseases, *e.g.*, Pneumonia* (when in *defect*).

*When the crisis occurs, the Chlorides reappear in normal or excessive amount.

Organic—**Oxalate of Lime** (see "Examination of Sediment").

(B.)—For its **Abnormal Constituents.**

Albumen—see before.

Sugar—Tests for (*i.e.*, Dextrose or Grape-Sugar.)

NOTE.—*Before testing for Sugar remove any Albumen by boiling and filtering.*

1. Add **Liquor Potassæ** (excess) and boil=Brown colour (MOORE-HELLER'S TEST).

2. Add **Liquor Potassæ** (excess) and a sat. watery soln. of **Picric Acid** (defect) and boil=Brown-red colour of Picramic Acid (JOHNSON and BRAUN'S TEST).

3. Add **Liquor Potassæ** (excess) and a solution of **Copper Sulphate** (defect—*i.e.*, until the cuprous oxide formed ceases to dissolve) and boil=Reddish-orange pp. of Suboxide of Copper (TROMMER'S TEST).

This test according to some can be depended on only when reduction occurs at a temperature *below* boiling; this, however, occurs only when the urine contains a relatively large proportion of sugar.

4. Add **Liquor Potassæ** (excess) *boil and filter* (*to remove Phosphates*), and then add **Fehling's Solution** of **Potassio-tartrate of Copper** (defect) and boil= Reddish-orange pp. (FEHLING'S TEST).

NOTE.—*As Fehling's Solution is easily decomposed by exposure, it should by boiled alone before use, and if discolouration occurs do not use it.*

4*a*. **Pavy's Pellets.**——Place a pellet (Potassio-tartrate of Copper)—after removing its cover—in a test-tube with a drachm of water; heat till solution becomes clear and deep blue; add an equal bulk of urine, and boil upper part of mixture=Red pp.

5. Add **Liquor Potassæ** (excess)—*if necessary, boil and filter* (*to remove Phosphates—the white phosphates would conceal the blackness of the reduced Bismuth*) and then add **Basic Nitrate of Bismuth,** or even the **Subnitrate,** and boil *for some time*=grey or black pp. (of metallic Bismuth) (BÖTTCHER'S TEST).

In all the above tests Caustic Soda may be used for Caustic Potash; and in all except Böttcher's, prolonged boiling is to be avoided, as reduction may occur in this way apart from sugar.

Adding too much urine is also to be avoided, as the test-fluid should always be in excess; and large quantities of non-saccharine urine may reduce the copper.

6. **Fermentation Test.**—(See later). May be used *qualitatively*, but is not delicate, for *Roberts* says that

urine containing 2½ grains of sugar to the ounce, and under, does not react to this test.

N.B.—Sugar is the only substance which ferments with yeast, and liberates CO_2, *and so it constitutes the ultimate test in all cases of doubt—e.g., some Life Insurance cases.*

6*a*. **Torula Test**—The detection of Torula occasionally assists in the diagnosis of Saccarine urine.

7. **Polariscope.**—By circular polarization not only the presence but the quantity of sugar can be accurately estimated. Glucose is dextro-rotatory, and hence called Dextrose.

8. **Oliver's papers.**—Full directions accompany these.

9. **Phenyl-hydrazin Test: Hydrochlorate of Phenyl-hydrazin** (twice as much as will lie on the point of the blade of a pen-knife) and **Acetate of Soda** (half as much more) are placed together in a test-tube containing about a drachm of urine. If the salts do not dissolve when the urine is warmed, a little water is added, and the test-tube with its contents placed for 20–30 mins. in boiling water. After this it is put into a vessel of cold water. If sugar be present, even in moderate quantity, there forms directly a yellow cystalline deposit, seen under the microscope to consist of yellow needles detached or arranged in clusters.

NOTE.—This test is reliable even in the presence of Albumen—but the latter is better removed.

Fallacies—

Moore's Test.—Is uncertain for small quantities (less than 1½ grains per oz) as urines free from sugar will sometimes darken with Caustic Potash. It is open to fallacy in high-coloured and albuminous urines, and where the liquor potassæ used becomes vitiated by the presence of lead from the glass bottles.

Johnson and Braun's Test.—Many high-coloured urines behave in much the same way.

Copper Tests.—With the copper tests a small amount of reduction may take place from presence of **Uric Acid, Hippuric Acid, Kreatinin,** when no sugar is present.

Fehling's and Bottcher's Tests.—**Glycuronic Acid** reacts to these tests, and is also dextro-rotatory (see **Polariscope test**), but it does *not* answer to the **Fermentation Test.**

Bottcher's Test.—The presence of **Albumen,** or of the principles of **Rhubarb,** may give black precipitates by their action on the Bismuth.

Phenyl-hydrazin Test.—The discovery of smaller and larger yellowscales, or powerfully refracting granules, must not, however, be mistaken for evidence of Sugar.

Sugar, inference from=Diabetes Mellitus (when in *excess*). It is found in *moderate* amount in many Acute Inflammations—and indicates commencing suppuration (a fact often useful in helping to diagnose obscure cases). A *trace* of sugar (unappreciable by the ordinary tests) exists in normal urine.

In some cases of Cerebral Tumor and Bulbar Paralysis, Sugar appears in the urine. Temporary Glycosuria often occurs after inhalation of Chloroform, Amyl Nitrite, &c , and is of no importance.

In some cases an intractable eczema is caused by it on the parts near the Meatus Urinarius (in both sexes); in other cases it is associated with numerous boils or carbuncles, and sometimes with gangrene.

"*The youthful reader must not imagine, because he has detected sugar in a patient's urine, that therefore the sugar-producing individual is going to die, or even necessarily ill. If the person be obviously very ill and wasting, and sugar be found in the urine, then its appearance is ominous.*

. . . "*The loss of body-weight is often more important than the presence of sugar in the urine.*

. . . "At times sugar is found in urine that is *albuminous.* This may be the result of some nerve irritation standing in a casual relation to both. At other times they are found together towards the close of chronic renal disease, where the patient begins to waste; and in such cases a fatal result is usually not far distant. Whether the elimination of sugar in the course of time produces organic changes in the kidney, or disease in the kidney permits of the sugar in the blood draining away and so being lost, it is not possible to say. Certain it is that the two are commonly found together. Sometimes the indications so given are of the worst import; at other times they form no serious omen. It is of much importance to examine the urine of patients in the latter stages of chronic Bright's disease for sugar; and if it be found, the prognosis is very bad.

. . . "A certain amount of glycosuria—common in the urine after meals—is common with stout persons, and is probably merely a sort of 'waste pipe' getting rid of superfluous food.

. . . "If sugar be produced more rapidly than the liver can dehydrate it into glycogen, then it finds its way out by the kidneys." —FOTHERGILL.

Character of Diabetic Urine.—Urine containing Sugar is usually very pale, perfectly clear, and free from sediment. Specific Gravity high and amount increased. (N.B.—In **Diabetes decipiens**—amount of

urine is *not* increased). With the Sugar excreted there is also an increased excretion of Urea—due in part to an excess of nitrogenous food ingested, in part to increased tissue change.

Inosite or **Muscle-Sugar.**—This occasionally occurs in urine alternately with dextrose. It has no action on polarised light ; it does not ferment with yeast ; and it does not reduce cupric hydrate, although it causes it to dissolve. It is detected by precipitating the urine first with **Neutral Lead Acetate**, then with **Basic Acetate,** collecting the second pp. on a filter, suspending it in a little water, and decomposing by **Hydric Sulphide,** filtering and evaporating to a small bulk. A drop is then mixed with **Nitric Acid,** and evaporated almost to dryness on plantinum foil. A drop of **Ammonia** and one of **Calcium Chloride** are next added, and the whole gently evaporated to dryness. A rose-red tinge indicates the presence of Inosite.

Acetonuria may be briefly mentioned here.

Test for—*Legal's* (rough).—Add to the urine a few drops of a fresh and somewhat concentrated soln. of **Sodium Nitroprusside,** and some strong soln. of **Caustic Soda**=Red colour, rapidly disappearing and giving place to a purple or violet red colour on adding a little **Acetic Acid.**

Inference.—Normal urine contains a trace of Acetone, but this body occurs *in excess* in association with disease, *e.g.*, Fevers, Diabetes (some say the presence of Acetone in the blood causes "diabetic coma"), Cancer Psychoses, Starvation, &c. Recently it has been shown that excess of nitrogenous food tends to produce Acetonuria.

Bile.—The Tests for Bile include those for (1) Bile-pigments and (2) Bile-acids.

NOTE.—*Before testing for Bile remove any Albumen by boiling and filtering.*

Bile-pigments.—

1. **Nitric Acid.**—Pour *impure* Nitric Acid down side of test-tube to form layer at bottom=Rainbow-like play of colours (*green* must be present) at junction of the two liquids.—(GMELIN).

NOTE.—Dilution of the HNO_3 with three vols. of water favours the distinctness with which the green reaction is brought out.

1*a*. **Hydrochloric and Nitric Acids.**—Mix with *excess* of Hydrochloric Acid and then proceed as in Gmelin's test—(HELLER).

1*b*. **Nitric and Sulphuric Acids.**—Mix with *excess* of *impure* Nitric Acid and then proceed as in Gmelin's test—using Sulphuric instead of Nitric Acid—(FLEISCHL).

2. **Methyl-violet.**—Pour a soln. of this down side of test-tube to form layer at bottom = Bright carmine-red ring at junction of the two liquids.

3. **Tincture of Iodine.**—Add a *trace* of this = Green colour—(MARECHAL).

NOTE.—If the urine be very highiy coloured it may be diluted with water beforehand. The tincture of iodine may also be diluted with rectified spirit—as too much iodine impairs the distinctness of the green colour.

N.B.—These tests are best done on a porcelain plate and in good daylight.

Fallacies –

Indican.—Excess of this in urine gives most of above tests for Bile-pigments.

To distinguish—there are two tests for **Indican**, viz. :—

i. Add **Sulphuric Acid** = Urine becomes black and opaque, depositing a purple pp. on dilution with water.

ii. Add **Hydrochloric Acid** (an equal bulk) and **Chloride of Lime** (2 or 3 drops of a saturated soln.) = Indigo is formed and colours the urine blue.

NOTE.—The Chloride of Lime may be replaced by Chloroform.

Inference = Wasting diseases, *e.g.*, Gastric Ulcer, Cancer of Stomach, Phthisis with Diarrhœa. NOTE.—Excess of Indican is usually associated with obstruction of small intestine. Even in simple constipation there is often a notable Indicanuria. Indicanuria is a symptom of latent suppuration—see *Sugar*.

Santonin, Rhubarb (containing Chrysophanic Acid), and Senna—colour urine yellowish or greenish.

To distinguish –

i. Add **Liquor Potassæ**:—*Bile-pigments* become dirty brown ; *Santonin*, *Rhubarb*, and *Senna* become red. On further adding **Amyl Alcohol**, *Santonin*, &c., gradually become yellow ; *Bile* persists unchanged for a long time.

Bile-acids.—

1. Mix with ordinary (*cane*) **Sugar,** pour strong **Sulphuric Acid** down side of test-tube to form layer at bottom = Reddish-purple ring at junction of the two liquids—(PETTENKOFER).

Several authorities say this test is of no use when applied directly to the urine—the Bile-Salts must be separated first: *Halliburton's* directions are :—Evaporate 100 or 200 c.c. of urine to dryness on a water-bath and extract residue with absolute Alcohol, filter extract and precipitate the Bile-Salts from filtrate by adding twelve to twenty times its bulk of Ether. Collect pp., dissolve in water, decolourize with animal charcoal, and then apply the test.

1*a*. **Strasburger's** modification.—Mix with ordinary (*cane*) **Sugar,** dip in a piece of filter paper, and dry. Touch the paper with a glass rod dipped in strong **Sulphuric Acid**=Reddish-purple spot.

2. **Oliver's Papers.**—Full directions accompany these.

Bile, inference from = Jaundice, Phosphorus poisoning.

NOTE.—As Bile can be detected in the urine both before and after any recognisable changes in the colour of the skin, its presence may be of great service in detecting or tracing *obstructive* jaundice, *e.g.*, from gall-stones or pressure on bile-ducts.

Blood—Tests for—

1. Add freshly-prepared **Tincture of Guaiacum** and **Turpentine** (or better, **Ozonised Ether**—an ethereal soln. of Hydrogen peroxide, H_2O_2) = Deep-blue colour (VAN DEEN'S TEST). NOTE.—Really a test for Hæmoglobin.

Fallacies—This test though delicate is not conclusive, since (1) **Ferrous Sulphate** and **Ferric Chloride** give a similar reaction ; (2) when a patient is taking **Iodide of Potassium,** a certain blueness may also appear.

2. Precipitate the phosphates from the urine *per* **Liquor Potassæ** and gentle heat. The phosphates are coloured red or pink by the hæmoglobin which they carry down with them—(HELLER).

Dry these phosphates on an object-glass, add a crystal of **Common Salt,** and cover with a cover-glass. Put a drop of *glacial* **Acetic Acid** unto object-glass, and allow it to run in under cover-glass. Warm the preparation, then cool, and examine *per* microscope for *Hæmin*-crystals (*i.e.*, minute reddish-brown acicular

prisms, insol. in wator, sol. in liquor potassæ)—(*Hæmatin test*).

Fallacy—If **Bile-Pigments** happen to be present, confusing the result in *Heller's test*, the sediment is separated by filtration and dissolved in Acetic Acid, becoming red, but this colour vanishes on exposure.

3. **Microscope.**—The blood-corpuscles do not form rouleaux, and may be bi-concave or bi-convex, regular or irregular in outline yellowish or colourless, or absent. NOTE.—They remain visible longest in acid and dense urines; but may be quickly dissolved in ammoniacal urine, or urine of low specific gravity.

Fallacies—

i. "Red blood-corpuscles are smaller than **Pus** or **Mucus** corpuscles, and have a double outline.

ii. Globular **Vegetable Spores** may simulate red blood-corpuscles.

4. **Spectroscope.**—Dilute solns. of blood give rise to two dark lines (*absorption bands*, situated in the green and yellow of the spectrum, between D and E lines of Frauenhöfer. These are due to oxy hæmoglobin. If reducing agents be applied (*e.g.*, a little Ammonium Sulphide), the two bands are converted into one, nearly intermediate in position; if this reduced hæmoglobin be now shaken up with air, the hæmoglobin is again oxidised and the two bands reappear.

Fallacies—"Other red solutions such as **Carmine** and **Alkanet**, give spectra which, on careless inspection, might be mistaken for solutions of hæmoglobin; but their bands do not occupy exactly the same position in the spectrum, nor are they capable of reduction and re-oxidation in the manner described."—GUY AND FERRIER.

5. The urine gives the **Reactions of Albumen.**

Blood, inference from:—1. Morbid condition of *Urinary* System (Hæmoglobin and Corpuscles *both* present—*Hæmaturia*).

Hæmaturia may arise from:—

(1) Diet or drug; (2) Disease; (3) Injury.

I.—*Diet or drug.*

Rhubarb is the chief article of diet, and Cantharides and Turpentine the chief drugs causing Hæmaturia.

II.—*Disease.*

Under this heading are included only "surgical" causes. E. Hurry Fenwick classifies such causes under two groups, viz. :—

1. Symptomless Hæmaturia.

Symptomless Hæmaturia, in which pus is absent from the urine, and the prostate and the urethra have been found free from disease.

Onset sudden, Course intermittent, Painless for months.	*a.* Renal.	Blood usually profuse and bright; intimately mixed.	Renal cancer.
		Blood moderate but bright; intimately mixed.	Granular kidney; renal syphiloma; cardiac disease.
	b. Vesical.	Blood intimately mixed but probably noticed pure at end of clear micturition at some time or other in course of case.	1. Sessile or short-pedicled benign growth away from orifice of urethra. 2. Epitheliomatous tumour of posterior wall or sides.

From this table you will see that if there be no co-existing symptoms of pain, frequency of micturition or pus, you can classify hæmaturias into two groups—renal hæmorrhages and vesical growths.

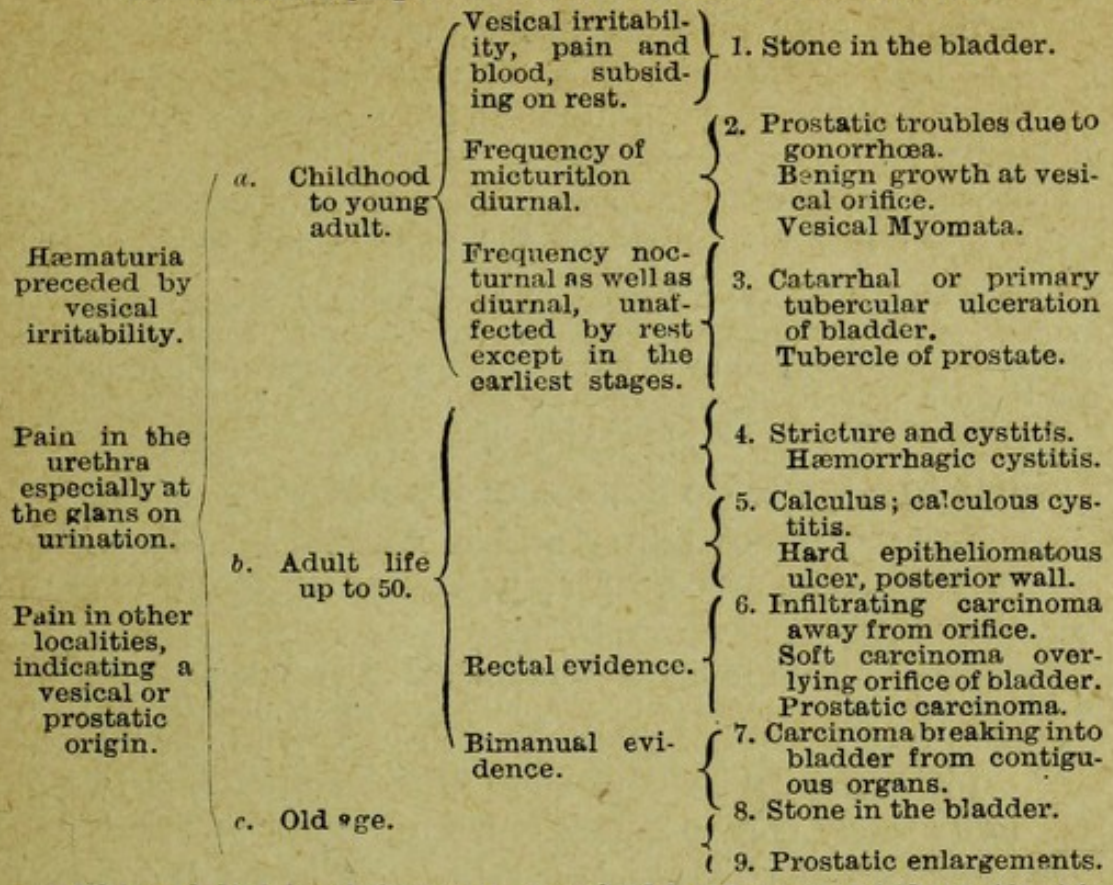
2. Hæmaturia with Symptoms.

Usually hæmaturia is accompanied by symptoms such as urethral pain, difficulty or frequency of micturition, or these develop in the course of the disease. They often permit us to locate the disease with certainty.

A.—Renal Symptoms co-existing with Hæmaturia.

i. Hæmaturia preceded by pain in the kidney.	*a.* Frequency marked at night; pus and debris passed usually in early stages. Blood unaffected by rest.	Primary tuberculosis of kidney.
	b. Frequency of micturition, if present, relieved by rest and at night; pus in later stages. Blood ceases on rest.	Stone in kidney.
	c. No frequency in earlier stages and without renal colic.	Growth of bladder partially occluding of dragging on lips of ureter.
ii. Hæmaturia accompanied by pain in the kidney.	*a.* Acute attack of nephritis grafted on a granular kidney.	
	b. Rare cases of Carcinoma renalis.	
	c. Rare reflex (?) conditions of the lower urinary organs *e.g.*, prostate.	

B.—Vesical Symptoms co-existing with Hæmaturia.



"This subdivision into groups marked by the ages of the patient is neither scientific nor accurate. It is convenient only, for it serves to remind you that the age of the patient is often a useful guide to the character of the complaint. Thus stone, occurring at every age, is most common before puberty and after 55" (Sir H. Thompson). Stricture generally arises before 35; inflammatory prostate between 20 and 30; benign growth between 20 and 40; malignant growth is most common before 10 and after 45; senile prostatic enlargement about 48 and onwards."

III.—*Injury.*

Significance of slight indirect violence in Symptomless Hæmaturia.—Should a slight strain or decided extra exertion be immediately followed in an *adult over 40* by a smart attack of hæmorrhage, you may with reason suspect a friable pre-existing growth. If in *youth or young adult* a slight traumatism produces a symptomless hæmaturia, there is perhaps some pre-existing renal disease (chronic Bright's).

Significance of slight indirect violence in Hæmaturia with symptoms.—"If hæmaturia depends on exercise, you ought to suspect a calculus." But movable kidney; hard cancer; large villous growth,

or tubercular ulceration of bladder; or large senile prostate may have same effect. On the contrary, if the hæmaturia persists in spite of absolute rest, you may exclude stone, and entertain the idea of ulcer or growth.

To discuss hæmaturia due to *direct* violence is unnecessary; the site of the injury usually locates the position and cause of the injury.

Should a patient have had symptoms of urinary disease previous to onset of hæmorrhage, the diagnosis will be easier, for the pain or frequency of micturition will afford a clue to the site of the disorder, and the use of the sound, combined with a careful rectal examination of prostate and base of bladder, may reveal the cause.

Rules to determine Source of Hæmaturia.

I. (*a*) "The brighter and more arterial the *cclour* of the urine, the nearer the source of bleeding is to the meatus."

Fallacy—In severe injury to kidney and in the malignant disease of kidney blood is poured out so rapidly and enters bladder in such quantity that it is expelled therefrom with a bright arterial colour.

(*b*) "The darker and more diffused the blood is, the more likely it is to emanate from a renal source."

Fallacy—This rule is to be rejected absolutely, as the dark colour simply depends upon the action of the acid urine on the hæmoglobin, *e.g.*, cases of profuse hæmorrhage into bladder accompanied by retention from clotting, or &c.

NOTE.—A microscopic trace of blood, enough to answer the tests for *Albumen*, coupled with excruciating pain in the loin and running far down into the thigh and scrotum, with retraction of testis, faintness and vomiting, coming on suddenly and ceasing abruptly, point to a calculus passing down ureter. *(Colic if accompanied by Albuminuria is renal; if by Jaundice, hepatic.)* Blood in urine, coupled with pain in the loins following active exertion, is a symptom of stone in the Kidney.

II. (*a*) "Blood appearing towards or at the *finish* of clear urination denotes a vesical or prostatic origin."

This is a rule you may safely rely upon.

(*b*) "Blood appearing at the *commencement* of micturition is indicative of a prostatic origin."

E. HURRY FENWICK says, "I should prefer yon to modify this rule, however, by changing it thus—'*fluid* blood appearing at the commencement of the stream is usually prostatic,' for should a vesical clot settle to the opening of the urethra (the most dependent part of the bladder . . .) the clot will be shot out with the first rush of urine, and its early appearance in the stream will mislead you."

(*c*) "Blood issuing from urethra *between the times* of micturition denotes a bleeding of urethral origin."

This is self-evident and reliable. But be sure that the blood comes from the *meatus*.

NOTES.—i. In women, the menses, or blood from a Tumor at or near Cervix Uteri, escaping per vagina, may contaminate the urine, simulating hæmaturia.

ii. Malaria may cause *intermittent* hemæturia.

III. (*a*) "*Long thin clots** like earthworms or quill-barrels, *shorter and thinner clots* like red fishing worms, are almost certain to indicate bleeding from the renal pelvis, for they are casts or moulds of the ureter."

(*b*) The *thick long clots* of urethral formation usually follow upon traumatism of that canal. They can hardly be mistaken for ureteral clots. They are swept away before the stream of urine.

(*c*) "*Large, irregular-edged eroded clots* are usually derived from a bladder source."

In severe hæmorrhage from the renal carcinoma, or rupture of kidney, or even in granular kidney, the clots, which may become moulded in the bladder, are often enormous.

*NOTE.—*The clots should be floated in water.*

IV.—*Ultzmann's Fibrinuria.*—Ultzmann considered fibrinuria an important diagnostic feature in villous growths of the bladder. The urine on being passed is of a reddish-colour (not containing much blood), and rapidly coagulates into a jelly-like mass. Ultzmann's theory of the production of fibrinuria is that the spasmodic contraction of the bladder checks the blood returning from the villi, and the vascular loops therefore become extremely turgid. If the blood-pressure is very great the blood-vessels rupture and hæmorrhage ensues; if the tension is not sufficient to cause rupture of the vessels a transudation of plasma occurs, whose fibrin coagulates on the emission of the urine. This increased vascular tension also accounts for the presence of more albumen in the urine than would correspond to the quantity of blood and pus present.

E. HURRY FENWICK considers this symptom of the *very rarest* of those evoked by vesical growth, and of no importance whatever in enabling you to decide upon the character of the growth.

V.—"*Tapping*" *the Ureters.*- Sir H. Thompson advises this procedure—see "Collection of Urine for Examination purposes," pages 1 and 2.

VI.—Jaksch asserts that "when blood-cells are intimately mixed with the urine in such a way that though present in large quantity and deeply tinging the fluid, they do *not* form a sediment after many hours standing - it may be inferred that the hæmorrhage took place in the substance of the kidney, or in the renal pelvis or ureters. If, under these circumstances, they are seen with the microscope to be profoundly altered, having lost their colouring matter, and presenting the appearance of pale yellow rings, the further conclusion results that the blood was effused in the kidney itself, and the symptom points to acute nephritis, or to a fresh exacerbation in the course of chronic nephritis.

VII.—The passage of visible fragments of growth occurs usually only in vesical neoplasms.

VIII.—*Microscopy.*—The presence of blood-casts points to hæmorrhage from the kidney; that of the eggs of *Bilharzia Hæmatobia* usually to hæmorrhage from bladder.

NOTE.—*General treatment of profuse Hæmaturia, whether due to injury or disease.*—Absolute rest in bed. Topical application of cold (ice, Leiter's tubes, &c.)—more especially in hæmorrhage of upper part of urinary tract, *e.g.*, ruptured kidney. Avoid purgatives, prefer enemata. Diet to sonsist of slops. Drugs: Ergot with opium; Nux Vomica in atonic states.

II. Morbid condition of *Vascular* system (Hæmoglobin *only* present—Hæmoglobinuria (Hæmatinuria ?).

Hæmoglobinuria may arise from :—

Constitutional disturbances, *e.g.*, Scurvy, Purpura, Hæmophilia, Hæmorrhagic Smallpox, Malarial or other Fevers; Sunstroke.

NOTE.—Inhalation of Arseniuretted Hydrogen, introduction of Bile-acids or of much water into the veins, &c., may also give rise to it.

Peculiar forms of the affection have been met with, occurring in infants—**Infantile H.**; and in adults, **Paroxysmal H.** This latter is ushered in by shiverings and associated with fever. In such cases the urine appears to be bloody, but definite corpuscles are usually invisible—the hæmoglobin having been dissolved out and the corpuscles disintegrated. The attacks may pass off in a few hours, leaving the urine clear and free from blood. The disease has some relationship with "*Raynaud's Disease*," and the attacks seem to be determined at times very definitely by exposure to cold.

VI. Examine now the Sediment.

NOTE.—*The chief urinary deposits are Urates, Phosphates, Oxalates; Casts, Mucus, and Pus.*

(A). Inorganic Deposits.

1. Warm with supernatant **Urine.**—It is soluble = **Urates (Lithates).** *Confirm by microscope*—Brick-dust-like *amorphous* particles (really minute **spheres** with acicular spiculæ of Uric Acid projecting from them).

NOTE.—Urates may be pale white.

Inference—See before.

2. Insol. in above.

Warm with **Acetic Acid** (after washing by decantation with cold water)—It is soluble = **Phosphates.**

Confirm by miscroscope—Calcium phosphate is *amorphous* (*false* dumb-bells), or *crystalline* (hexagonal prisms, in bundles); Triple (*i.e.*, ammonio-magnesian) phosphate is *chrystalline* (triangular truncated prisms, rhombic prisms, hexagonal plates ; or feathers).

Inference—See before.

3. Insol. in above.

Warm with **Hydrochloric Acid** (after washing by decantation with cold water)—It is soluble = **Oxalates.**

Confirm by microscope—Colourless octahedral *crystals* folded like an envelope, or colourless *true* dumb-bells, *supposed to occur when the crystallising process is interfered with by excess of mucus or otherwise.*

Inference = Nervous exhaustion, overwork, mental distress ; Dyspepsia, excess of saccharine food or alcoholic liquors, seen after eating cabbage (when in

excess.). *It is probable that their presence is due simply to imperfect digestion, more especially as they often disappear readily on treatment by nitro-hydrochloric acid.*

4. Insol. in above.

Dissolve in 2 or 3 drops of **Nitric Acid,** evaporate gently to dryness, cool and add 1 drop of **Ammonia** = Blue colour, becoming purple on further adding **Caustic Potash** (*Murexide test*) = **Uric Acid.**

Confirm by miscroscope—Under the microscope the *crystalline* forms are numerous, but referable to combinations or modifications of a lozenge or diamond shape, or of a rhombic prism. *Charles* says—"Every crystalline urinary deposit of a distinct yellow, brown or red colour, may be said to consist of Uric Acid."

Schiff's Test for **Uric Acid.**—Dissolve the crytstals in **Sodium Carbonate** solution, drop this on filter paper moistened with **Silver Nitrate** solution = Black spot (of reduced silver).

NOTE.—The appearance of a sediment of Uric Acid is only to be looked upon as pathological when it occurs before the urine cools or immediately after.—GRAHAM BROWN.

Inference = Mainly indicate a gouty tendency.

NOTE.—*Urates, Oxalates, and Uric Acid occur in an acid urine; Phosphates in an alkaline urine.*

* Use miscroscope *before* applying the chemical tests, if the amount of sediment is small. N.B.—*When the deposit after standing is small, and yet where its microscope examination is important,* Sir Henry Thompson advocates the simple expedient of allowing the urine to stand in a corked bottle placed with the cork downwards—this deposit which adheres to the cork can be easily examined. *In other cases* the sediment can be transferred from bottle or, &c., to miscroscope by means of a pipette. Microscopes of 50-350 magnifying power are sufficient.

The near relationship of Uric Acid to Caffeine and Theine should be remembered when prescribing for gouty patients.

Rare forms of Inorganic Deposits are—

Cystine.—Yellowish-green laminated groups of hexagonal *crystals.* Occasionally form the substances of a calculus.

Xanthine.—A substance very like Uric Acid in its crystals and composition. Also in rare cases forming a calculus.

Leucin (circular oily discs) and *Tyrosin* (loose or compact star-like aggregations of acicular *prisms*). Bodies whose presence is associated with Acute Yellow Atrophy of Liver and less often with Phosphorus poisoning.

B.—Organic Deposits.

1. **Mucus and Epithelial Cells** (taken together because (1) the former without the latter would, as a rule, not be visible; (2) the seat of origin of the former is indicated by the character of the latter—see below).

Mucus *is distinguished from* **Pus,** thus :—

Mucus does *not* (1) mix freely with the urine; (2) become stringy when shaken up with **Liquor Potassæ;** (3) exhibit definite corpuscles under the **Microscope;** (4) accompany **Albuminous Urine.**

Inference = Catarrhal and inflammatory conditions of the Genito-Urinary passages (when in *excess*).

The part affected is indicated by the character of the accompanying ephithelium.

Kidney—Spheroidal, single or multiple nucleated Epithelium; *Pelvis of Kidney, Ureter, and Prostate;* Irregularly columnar nucleated Epithelium; *Bladder, Urethra,* and *Vagina*; Irregularly circular, squamous nucleated Epithelium.

2. **Pus**—See **Mucus.**

Inference = Catarrhal and inflammatory conditions of Genito-Urinary passages. The urine of **gouty persons** frequently contains pus.

The part affected is indicated thus :—

"That from *Urethra* will be swept out with the first few ozs. of urine—which should therefore be collected separately. If the remainder of the urine comes away clear, the diagnosis is pretty certain; but if not, an effort may be made to distinguish between pus from *Kidney* and that from *Bladder*—by first washing out

bladder and then tying in a catheter, a sufficient sample may be obtained—if it be uniformly turbid, the source of pus will be above the bladder; if clear, probably in the viscus.—THOMPSON.

NOTES.—(1) Where pus is suspected the urine from each micturition should be collected in several vessels. (2) Pus in alkaline urine usually comes from bladder; pus in acid urine usually is from some other part of urinary tract.

3. **Casts.**—A cast is a solid mould of any part of an Uriniferous **tubule.**

The **Varieties,** as *shown by microscope*, are—(1) **Blood-casts,** composed of *Fibrin* formed by coagulation of blood plasma exuded from the surrounding capillaries into the uriniferous tubules (?), sometimes composed of coagulated *Blood.* (2) **Pus-casts,** composed of *Pus*, and (3) **Hyaline-casts** (also termed **transparent, waxy, &c.**), composed of *Mucus* (according to some)—due to hyper-*secretion* of epithelium of tubules; *colloid matter* (according to others)—due to colloid *degeneration* of Epithelium of tubules.

There are again several *kinds of Hyaline Casts:*—

i. *Epithelial.*—When epithelium of tubules is loosened from any cause, the cells adhere to the casts.

ii. *Granular.*—If the loosened epithelial cells have undergone disintegration.

iii. *Fatty.*—If the disintegrated cells have undergone fatty degeneration.

iv. *Crystal-containing*—Those that have been described consisted of urates and hæmatoidin, and as yet they have been found only in infants and in cases of gout and renal congestion. (NOTE.—If healthy urine be concentrated in vacuum at a low temperature, 37°—39° C, casts may be observed which consist of Acid Urate of Soda)—LEUBE.

Perhaps we ought to include under this heading some of those bodies which are at present classed together under the general name of "detritus casts"—JAKSCH.

v. The "cylindroids of Thomas" should be perhaps included in this group.

Inference = Valuable, almost indispensable, but as several varieties may occur together in the same urine, conclusions must be cautiously drawn from the prevailing type(s). With these precautions and with the patient's history in view, *Roberts* says that "the following conclusions are *generally* warranted:—(*a*) **Epithelial** and **Blood Casts** indicate a disease of recent origin; (*b*) **Transparent** large **Waxy Casts,** mixed with dark **Granular Casts,** indicate a chronic disease; (*c*) **Epithelium** and **Casts** containing much **Fat,** indicate fatty degeneration."

Casts, especially hyaline, are not unfrequently present in healthy urine.

These casts are *generally* present in Albuminous Urine, and require 12 hours to settle to the bottom of the urine-glass. They should always be searched for in cases of Albuminuria; occasionally the addition of a little acid to precipitate the uric acid crystals, or some other plan of carrying the scanty tube-casts mechanically to the bottom, may facilitate the search. After being transferred from urine-glass, to the slide of a microscope by means of a pipette, a cover-glass is applied in the usual way and the search begun. The Hyaline Casts are often so transparent as to escape any but the most careful observation, and then a little Majenta or Carmine staining fluid introduced beneath the cover-glass much facilitates their detection; cutting off some of the light used has a similar effect.

Fallacy.—As a rule there is no mistaking a tube cast; shreds of **Mucus,** especially when mixed with granular matter, are the commonest objects which simulate casts—their disappearance on the application of a little heat to the slide determines their character.

Finlayson says—"The clinical significance of tube-casts is sometimes considerable, not only in the differentiation of the various forms of Renal disease, but as indicating the existence of a renal affection in cases involved in doubt. Thus, in bloody or purulent urine, where the origin of the blood or pus is obscure, the existence of tube-casts clearly points to a renal element in the case and afford much guidance.

"The absence of tube-casts usually counts for little—they may easily be missed, or the reaction or state of the urine may be unfavourable for their **preservation.** When the reaction is alkaline they may not be formed; or if formed, readily destroyed."

T. Lauder Brunton says:—"Without doubt certain renal diseases may exist, and may continue throughout their course either to recovery or death, without the occurrence of casts in the urine. But for all practical purposes it may be accepted that when casts do occur, they indicate the existence of a disease of the Kidneys which is possibly incurable—certainly serious. Besides the value of casts in determining the existence of Kidney disease, they are further most important aids in helping to distinguish what variety or stage

of disease it may be; and also in making out the actual condition of the Kidney, thus furnishing valuable data on which to form a prognosis and to suggest a plan of treatment.

"Little, however, is to be seen from one examination. This should be performed frequently, as in that way alone can the morbid progress in the Kidney be recognised. . . . .

"The fact that casts are very abundant in any sample of urine is not in itself of necessity a serious sign. Thus in "Granular Kidney" —one of the most serious of all renal affections—the casts may be, and usually are, very few, and require careful looking for; whilst in the convalescence from Acute Nephritis they may be extremely numerous. In Chronic Nephritis, however, the number becomes an important element in the consideration."

4. **Blood Corpuscles and Fibrin**—See before.

5. **Fatty matters—Test.**—Osmic acid blackens fat.

Inference:—Fatty degeneration of some part of the Genito-Urinary passages; continued exhibition of Cod-liver Oil; Phosphorus-poisoning and after Fractures; presence of Milk or of Oil added for purpose of deception; Chyluria; Rupture of a fatty liver, &c.

6. **Spermatozoa—Test.**—Exhibit a characteristic tad-pole appearance under the microscope—the tail loses in urine the vibratile movement it possesses in semen.

Inference=True Spermatorrhœa. (See Phosphates).

7. **Parasites.**—The one of greatest interest is the ovum of *Bilharzia Hæmatobia*, associated with Hæmaturia (see "Endemic Hæmaturia").

8. **Micro-organisms.**—Occur frequently, and have been divided into the following groups:—

i. *Those which gain access to urine after it has left the body, e.g.*, torula sarcinæ and various bacteria.

ii. *Those which gain access to urine after it has left the kidney, but while still within the body, e.g.*, bacterium associated with ammoniacal decomposition.

iii. *Those which are excreted as foreign matter by kidney from blood, e.g.*, numerous forms, frequently micrococci, associated with septic conditions and various zymotic diseases.

9. **Extraneous matters.**—*e.g.*, Hairs, threads, fœtal bones, fæces, &c. They are of no clinical significance.

C. EXAMINATION (QUANTITATIVE.)

(*a*) For its **Normal Constituents.**

Urea—Estimation of.

NOTE.—*Before estimating the amount of Urea, remove any Albumen by boiling and filtering.*

1. *Roughly.*—The readiness with which crystals of Urea Nitrate form on adding HNO_3 to a soln. containing Urea, affords a means of estimating roughly the quantity of it present; *the more readily the more Urea.*

2. *Accurately.*—By **Gerrard's Ureometer.**

PRINCIPLE.—The "*Hypobromite Test.*"

$$CON_2H_4 + 3\,NaBrO = 3\,NaBr + CO_2 + 2\,H_2O + N_2$$

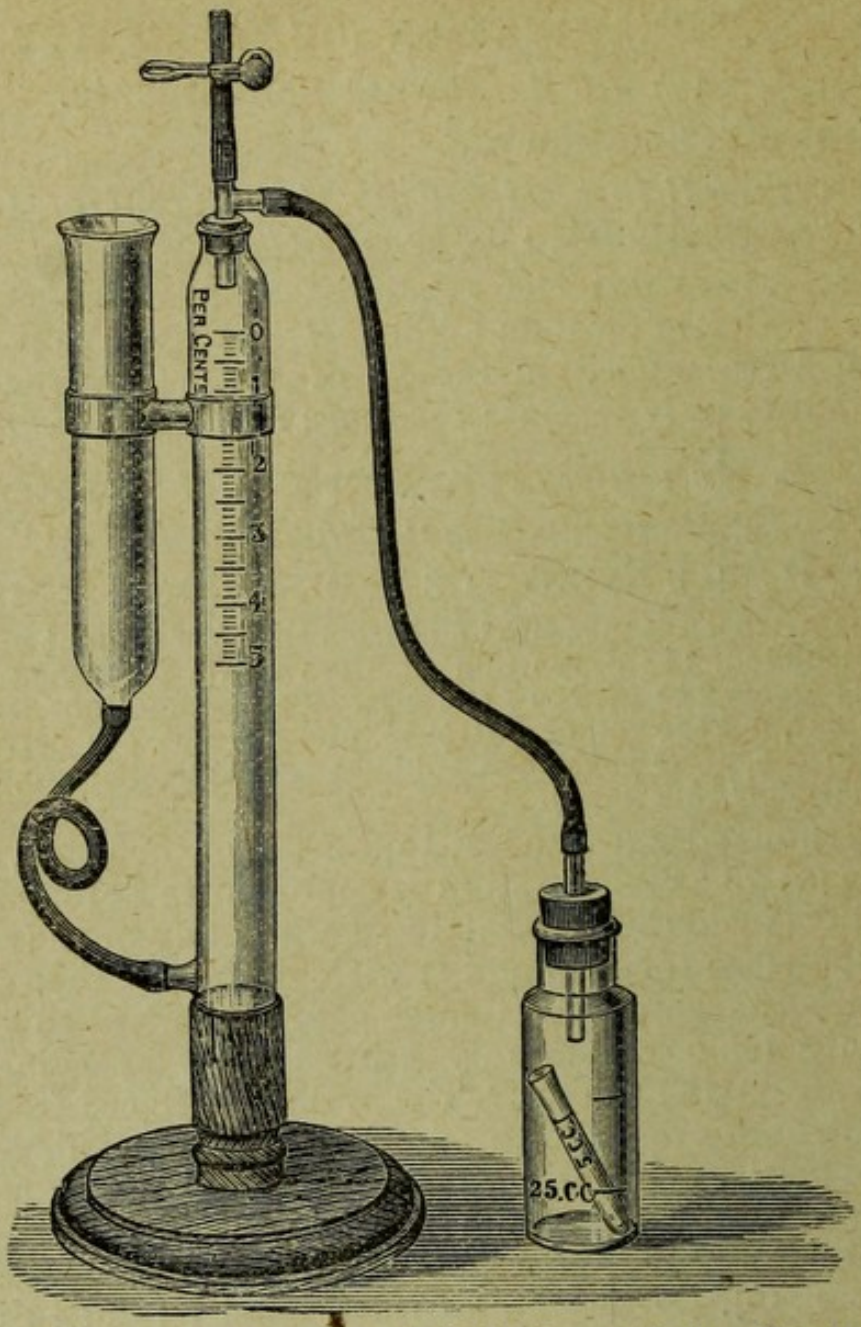
The Nitrogen is measured and from that the amount of Urea can be calculated, the proportion of Urea to its contained Nitrogen being *roughly* 2 to 1 (15 to 7 exactly). The graduations are made to represent, not the vol. of Nitrogen present, but the percentage of Urea in the urine that such volumes are equivalent to, a tedious calculation is thus saved.

METHOD.—Pour into test-tube 5 c.c. of the urine, and into bottle (*a*) 25 c.c. of **Sodium Hypobromite Solution**. Place test-tube inside bottle, avoiding spilling any of the contents. Fill the glass tubes (*b* and *c*) with **Water** so that the level reaches the zero line, taking care that when this is done the tube (*c*) contains only a little water by being placed high—it having to receive the water displaced from (*b*) by the nitrogen evolved. Now connect the india-rubber tubing to the bottle, and noting, lastly, that the water is exactly at zero, upset the contents of the test-tube into the Hypobromite Solution. Nitrogen is evolved, and depresses the water in (*b*). When this ceases, lower (*c*) until the levels of the water in both tubes are equal.

To be exact.—Dip (*a*) into cold water to cool the gas before taking a reading, and note the result, which shows the *percentage* of Urea.

NOTE.—In relation to disease we must know, not only the percentage (*i.e.*, *relative* amount), but the absolute amount passed daily; for the percentage may be high in consequence of diminished passage of water (as after

sweating), or restricted supply of water, while the daily excretion of Urea is normal.



The soln. of Hypobromite of Soda is made by dissolving 100 grammes of Caustic Soda in 250 c.c. of water, then adding 22 c.c. of Bromine.

To avoid the danger of the Bromine vapour, the Bromine is sol l in hermetically sealed glass tubes, containing 2·2 c.c ; one of these placed in the large bottle with 25 c.c. of the Soda Solution, gives, when broken with a sharp shake, the exact quantity of Hypobromite for one estimation of *Urea, and all bad odour is avoided.*

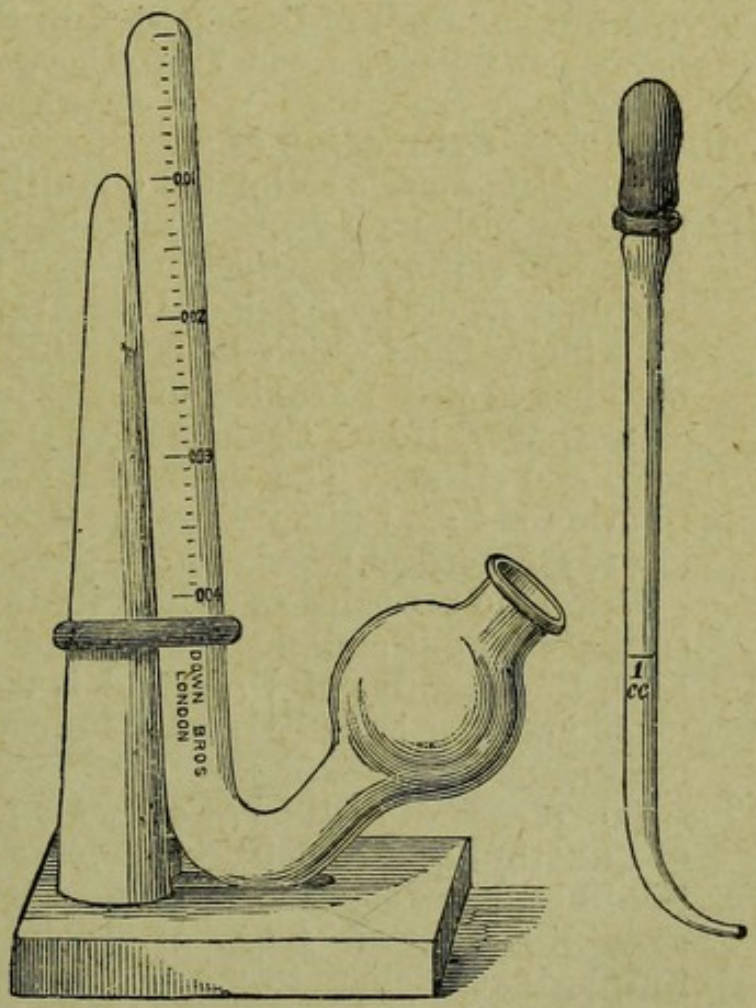
Agents:—GIBBS, CUXSON & Co., Wednesbury.

2*a*. Squibb's process is essentially the same thing—the Liquor Sodæ Chloratæ of the U.S. Pharmacopœia, containing the **Hypochlorite of Soda** instead of the Hypobromite, is used. This is free from the only disadvantage of the Hypobromite process—viz., the necessity of handling the Bromine vapour from time to time in the preparation of the Hypobromite Solution, which rather readily undergoes decomposition after keeping.

2. Also *accurately* by **Down Bros. "G.P. Ureometer.**

PRINCIPLE.—Also the "*Hypobromite Test.*"

METHOD.—Fill the vertical tube with a solution of **Hypobromite of Sodium** by pouring the solution into the bulb until it is almost half full; the apparatus should then be inclined horizontally until the entire tube is filled and just a little left in the bulb (say $\frac{1}{3}$); then restore the apparatus to the vertical position.



Having drawn into the pipette 1 c.c. of the urine to be tested (which should be taken from the collected excretion of twenty-four hours, and the exact quantity of which should be noted), the pipette is passed into the apparatus, the point being placed immediately under the long arm; the india-rubber cap is now slowly compressed, so that the gas which is liberated all passes up the long tube; as the urine passes through the solution, the Urea becomes decomposed and Nitrogen set free. This

gas now collects at the upper part of the tube, and its volume being measured, indicates the amount of the Urea from which it is evolved.

In cases where there is much Urea, it is advisable to mix the urine with an equal amount of water before testing; the result will then be equal to one-half of that indicated on the scale.

METRICAL SCALE.—Each division indicates 1 gramme of Urea in 1 c.c. of Urine. The percentage of Urea is got by multiplying the result of the test by 100. To ascertain the total amount of Urea voided in 24 hours, multiply the result by the number of c.c. of urine passed in that time.

ENGLISH SCALE.—(*Suggested by* **Dr. F. R. Cruise,** *Dublin*).—Each division indicates 1 grain of Urea per fluid oz. of urine. The result of the test when multiplied by the number of ozs. passed in twenty-four hours will give the total amount of Urea passed in that time.

Agents:—DOWN BROS., 5 and 7 St. Thomas's Street, Borough, ondon, E.C.

Uric Acid—Estimation of.

(1). Uric Acid is estimated quantitatively by mixing the urine with one-twentieth of its bulk of **Hydrochloric Acid** and setting it aside in a cool place for twenty-four hours. The deposit of Uric Arid is then collected on a filter, from which it is carefully washed off and then boiled with **Peroxide of Lead** in a little water, so as to convert it into Carbonic and Oxalic Acids, Allantoin and Urea. The amount of Nitrogen in this solution is then estimated by the Hypobromite method already described.

Uric Acid contains one-third its weight of Nitrogen, so that by multiplying the weight of Nitrogen evolved by 3, the quantity of Uric Acid is obtained. Besides ·0045 gramme is to be added for each 100 c.c. of the urine employed.

(2). A second method *(Cook's)* is to add 3 or 4 drops of **Caustic Soda** to 300 or 400 c.c. of Urine, and after the Phosphates have subsided to add to 100 c.c. of the clear liquid about 4 c.c. of a soln. (1 in 3) of **Zinc Sulphate,** sufficient to make the urine faintly acid. This precipitates the Uric Acid as insoluble zinc urate. The pp. is washed on a filter with a saturated soln. of **Zinc Urate** and then placed with the filter in

the Urea apparatus, and the Nitrogen estimated by the Hypobromite method as already described.

NOTE.—When boiled with Liquor Potassæ, and **Cupric Sulphate** Uric Acid reduces the latter to Cuprous Oxide. "The writer has seen a case in which the reduction was so great as to lead the patient, who was a medical man, to think that he was suffering from Diabetes, and to put himself on an animal diet, by which his condition was, of course, made worse."—T. LAUDER BRUNTON.

Salts.—These are chiefly

1. **Sulphates**—Acidulate the Urine with **Hydrochloric Acid,** add **Barium Chloride**=a white pp.—if well marked, indicating *excess;* if simply a milky turbidity, the amount of Sulphates is *normal.*

3. **Phosphates**—Roughly by rendering the Urine alkaline with **Ammonia,** and adding an **Ammonio-Magnesian** Solution to it=a pp. (of Ammonio-Magnesian Phosphate) at once if the amount be *normal,* but delayed when the amount is *sub-normal.*

3. **Chlorides**—(1) Comparison with healthy Urine. (2) *Hopman* and *Ulzmann's* method—If in using a soln. of **Silver Nitrate** of definite strength (1 to 8) we get a *curdy* pp., which on shaking does not become disintegrated, we judge that the chlorides are present in *normal* amount, a milky turbidity is got if amount is *sub-normal.*

(*b*) For its **Abnormal Constituents.**

Albumen.

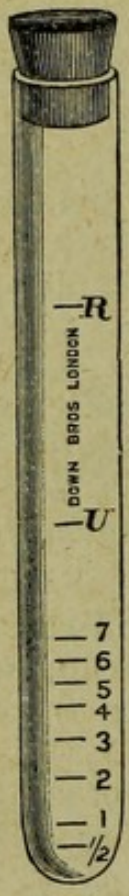
1. *Roughly.*—The *relative* quantity of Albumen in any specimen of urine may be fairly estimated by thoroughly boiling a small quantity of it, acidified with **Acetic Acid,** and allowing to stand for some time until the precipitated Albumen subsides.

2. *Accurately.*—By *Roberts'* **Nitric Acid** test:—

Dilute the urine—by successive equal quantities of water—until it gives a haze on adding HNO_3, *which does not become visible until* $\frac{1}{2}$ *or* $\frac{3}{4}$ *min. after.* This diluted urine contains (as shown by careful chemical analyis) 0·0034 per cent. of Albumen (0·0148 grains

per fluid oz.); and from the degree of dilution required the amount contained in the urine may be calculated, *e.g.*, if diluted to 50 times in volume (by adding 49 equal vols. of water), then $0{\cdot}0034 \times 50 =$ per cent. and so on.

3. Also *Accurately.*—By **Esbach's Albuminometer.**



PRINCIPLE.—The "*Picric Acid Test.*

METHOD.—Pour urine into tube up to mark **U,** add *reagent* (**Picric Acid 1, Citric Acid 2,** in **Water 100**) up to mark **R,** now close the tube by the thumb, and mix by reversing it to and fro several times, but avoid shaking. Allow the tube to stand upright for twenty-four hours, then read off on the scale the height of the coagulum.

The figures indicate the parts per 1000 of Albumen in the urine, and give by dividing by 10 the *percentage, e.g.*, if 4 is the point of coagulum, then it contains 4 parts per 1000, or 0·4 *per cent.*

From this, of course, if the daily amount of urine is known, the *absolute amount* passed can be found.

NOTES.—(1) if the urine is alkaline, render *faintly* acid with Acetic Acid. (2). When the urine is very abundant it may be diluted with an equal quantity of water, and the result multiplied by 2. (3) Urine with less than 0·5 per 1000 cannot be accurately estimated by this method.

Fallacy.—The amount of pp. may be increased by the Citric Acid precipitating Uric Acid. Johnson omits the Citric Acid, and uses a Soln. of Picric *Acid the strength of which is 5 grains to 1 oz.*

Agents.—DOWN BROS., St. Thomas's St., Borough, London, E.C.

4. Also *accurately*—A tube of known length is filled with urine and placed in a **Polarising Apparatus**—from the amount of rotation which the polarised ray undergoes in passing through the urine, the Amount of Albumen it contains may be calculated.

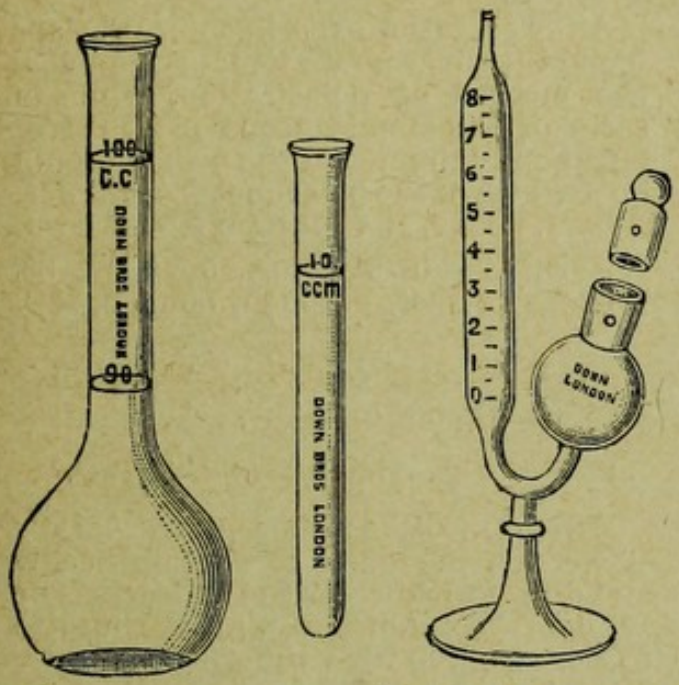
Sugar.

1. *Roughly.*—By **Fermentation,** small lump of **Yeast** (size of a walnut) is added to 4 ozs. of Urine in a 12-oz. bottle, corked, but with an opening cut in cork to allow the CO_2 generated to escape; it is then placed in a warm

situation for 24 hours or until fermentation has ceased. The S.G. *before* fermentation should be compared with that *after* fermentation—the difference in the number of degrees represents approximately the number of *grains* of sugar *per ounce* of Urine.

Fallacy.—It is well to conduct a blank experiment with simple water and yeast at the same time, as a security against the gas being evolved from the yeast or in any other way.

2. *Accurately.*—By **"The Quantitative Saccharometer."**



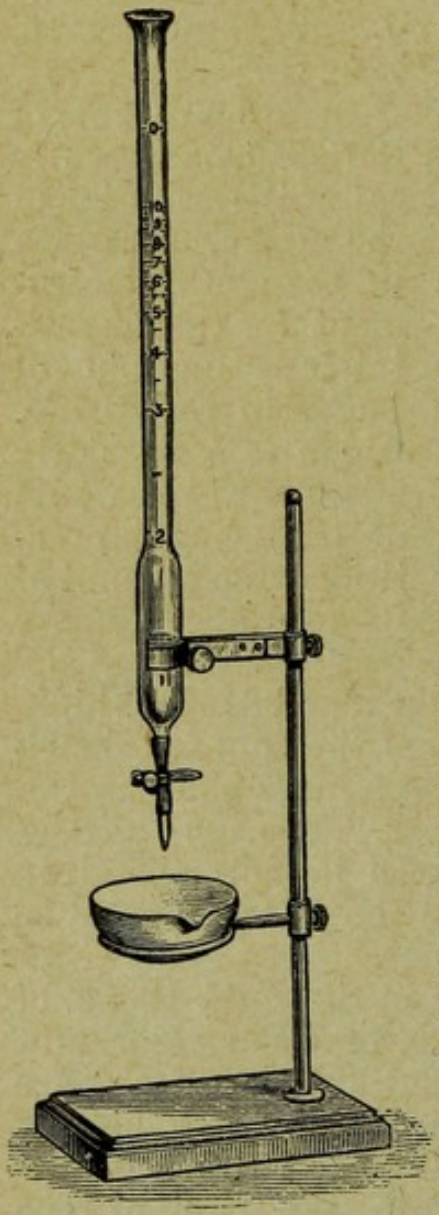
Extract from *The Lancet*, January 16, 1892:—

Dr. Edgar Gans, of Carlsbad, has recently called the attention of the profession at Berlin to a simple instrument for the quantitative estimation of Sugar in the Urine, which is particularly adapted to the wants of the general practitioner, on account of its accuracy and easy manipulation.

It consists of a U-shaped glass tube about 6 inches high, the longer leg of which is graduated, as the annexed sketch shows, the shorter leg terminating in a glass bulb, on the extremity of which fits a glass stopper. The sides of the bulb and of the stopper are pierced in corresponding diameters by two fine holes, so than the exit of air can be prevented by a slight turn of the latter.

To use the Instrument, first mix in the *flask* 10 c.c. of the urine to be examined with 90 c.c. of clean water, and shake up with a piece of **Yeast** about the size of a coffee bean till there are no longer fragments of yeast floating about in the vessel. Then pour 10 c.c. of this mixture (using the graduated *test-tube)* into the bulb of the *U-shaped glass tube*, and adjust the stopper so that the holes in the bulb and stopper coincide. Now tilt the tube

to the left, so that the level of the fluid in the tube corresponds with the zero on the scale, and by a slight turn of the stopper shut off communication with the atmosphere. Leave the instrument in an ordinary-room temperature (about 65° F) for 18 to 20 hours, and, fermentation going on, the liquid in tube will rise from the point O in proportion to the amount of CO_2 given off—*i.e.*, in proportion to the amount of Sugar in the urine. The instrument is so graduated that the points on the scale correspond to the per cent. of sugar, so that if the fluid in the tube rises to 2·5, the per cent. of sugar is 2·5.



After repeated experiments, Dr. Gans found that in accuracy it almost equalled the method of polarization, while in cases of the simultaneous presence of Sugar and Albumen in the urine it could be used when the polarimeter could not. —L. M. SCOTT, M.A., M.B., D.P.H., Aberd.

Agents:—DOWN BROS., 5 and 7 St. Thomas's Street, Borough, London, E.C.

3. Also *Accurately*.—By **Gerrard's Glycosometer.**

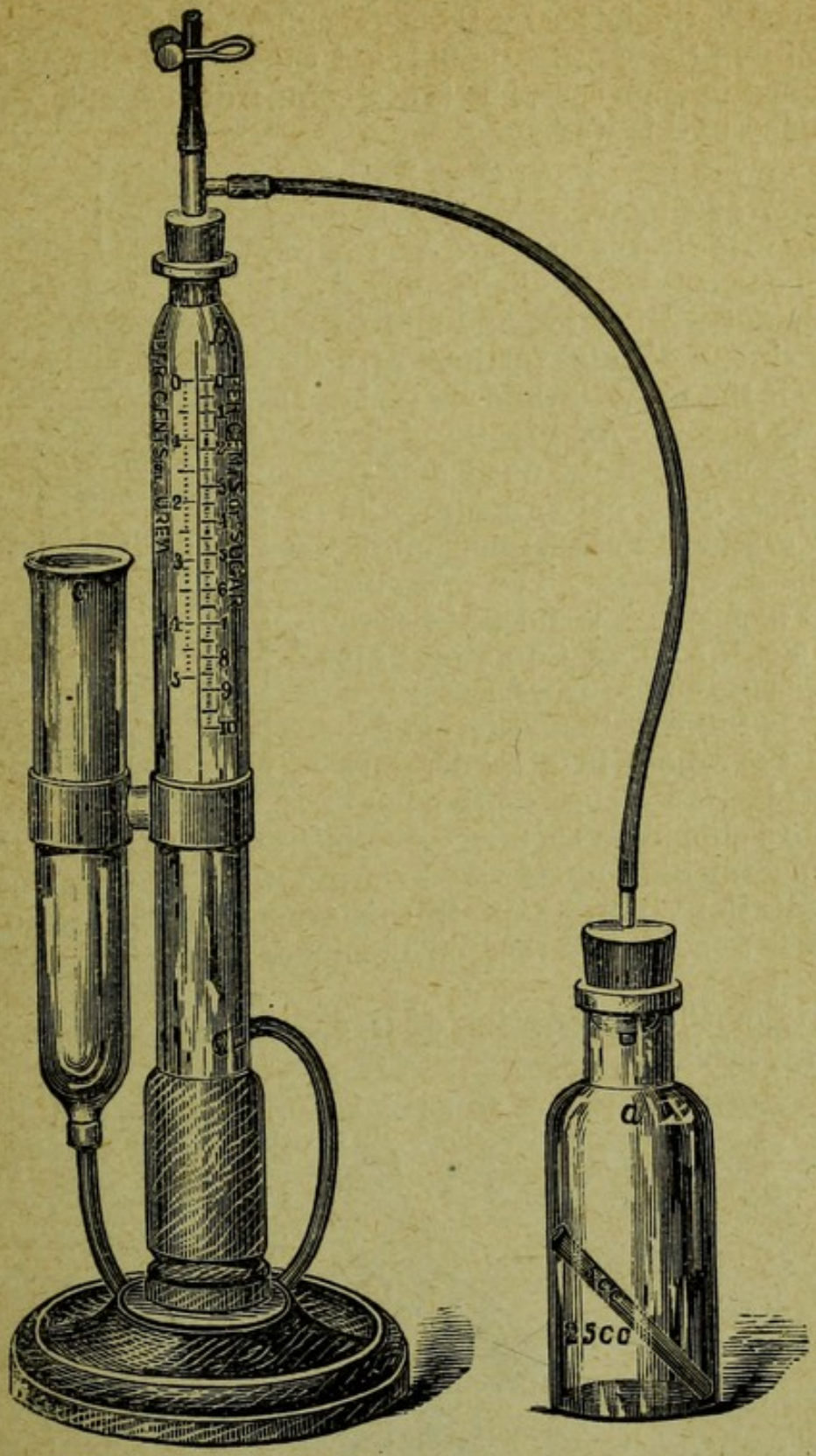
PRINCIPLE.—The "*Reduction Test.*"

METHOD.—Take either 10 *drachms* or 10 c.c. of urine found to contain Sugar, and dilute with water to 100 *drachms* or 100 c.c. Mix well. Now fill the burette to the zero line with the diluted urine. Next put 10 c.c. (2½ drachms) **Fehling Solution,** and 40 c.c. (10 drachms) Water into the porcelain dish and boil. Whilst Boiling, run the urine from the burette into the dish in a slow stream until the blue colour has gone from the Fehling.

The level of the urine in burette shows the *percentage* of Sugar present, and the equivalent in grains per ounce is found by reference to the table sold with the instrument.

NOTE.—The Instrument is graduated to read *percentages* of Sugar between 10 and 1, but should urine contain *more than 10 per cent.* then dilute 10 volumes to 200 with Water, proceed as before and *multiply* the observed percentage by 2. If there is *less than 1 per cent.* use undiluted urine, test as before, then *divide* the reading by 10.

Agents:—GIBBS, CUXSON & CO., Wednesbury.



"Acme Sacchar-Ureater" (Registered).

This is a simple apparatus for the direct estimation of Sugar and Urea in urine; the former by the "Fermenta-

tion test," the latter by the "Hypobromite." . . . In combining these tests, there is not the same accuracy to be obtained in each case, but fairly comparable results can be obtained in this way.

METHOD—(*a*) **For the Estimation of Sugar.**—Measure one vol. of urine in the tube so marked, and pour it into the *Bottle* "*A*." Wash out with water, and add to the urine. Dilute further with water if the urine is known to be full of sugar. Acidify the urine with **Tartaric Acid** until acid to test paper ($\frac{3}{4}$-1% of free acid). Add a few grains of **Yeast,** and connect up the apparatus. The *Measuring Tube* "*B*" is filled to zero with a sat. soln. of **Common Salt** (CO_2 being sol. in *water*). When "*B*" is full "*C*" must be empty. Place the whole in a moderately warm place—the surrounding temperature should be such as to enable it to rise to 92°-94° F. When fermentation ceases—or from time to time during fermentation—lower C until the levels of brine are equal. Allow it to cool, and read off the answer.

(*b*). **For the Estimation of Urea**—Refer to **"Gerrards Ureometer."**

Agents:—GIBBS, CUXSON & Co., Wednesbury.

Homer