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Question book to Pellew's Manual
of Med. and Phys. Chemistry

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QUESTION BOOK
TO
PELLEW'S MANUAL
OF
MEDICAL AND PHYSIOLOGICAL CHEMISTRY.

—BY—

JAMES S. WARD, A. B., M. D.,

*DEMONSTRATOR OF CHEMISTRY, LECTURER ON METALLURGY, MEDICAL
AND DENTAL DEPARTMENTS, UNIVERSITY OF TENNESSEE,
NASHVILLE, TENNESSEE.*

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P261

PREFACE.

PELLEW'S Manual of Medical and Physiological Chemistry having been adopted as the text-book for the use of students in the chemical laboratories of the Medical and Dental Departments of the University of Tennessee, the following questions have been formulated in order to aid students in the mastery of their prescribed laboratory work. As will be seen, the questions are prepared directly from Pellew's Manual, with but few exceptions.

In the closing pages of this little brochure will be found, in as condensed form as possible, a practical guide to the chemical and microscopical examination of urine; also, in connection, some clinical hints concerning the various deviations of pathological urine.

Trusting that the labor hereon spent is not amiss, and that the students of Pellew's most excellent work may be much benefited, these questions are most respectfully submitted.

J. S. W.

PART I.

The Carbohydrates.

INTRODUCTION.

- Give the difference between organic and inorganic chemistry.
- Give the difference between carbohydrates and hydrocarbonates.
- Where are the carbohydrates chiefly found?
- Are they ever found in animal tissue?
- What is meant by "Proximate Principles?"
- Is nitrogen ever found in the composition of carbohydrates?
- They are formed of what elements?
- In what proportion is hydrogen and oxygen found?
- Give three distinguishing facts concerning all carbohydrates.
- What is the reaction of carbohydrates?
- What fact is taken advantage of sometimes as a means of purifying them?
- Do they crystallize?
- Give the meaning of "colloid."
- Which are more complex in structure, the colloids or crystalloids?
- How are the carbohydrates classified and divided?
- Give the main divisions.
- Give the formula of each.
- Into what two classes are the poly-saccharids divided?
- Name some of the mono-saccharids.
- Name some of the di-saccharids.
- Name some of the poly-saccharids.
- Which class is the most complex in composition?
- Can we reduce poly-saccharids to mono-, or di-saccharids?
- Can we build up a poly-saccharid?
- Which are more complex, the di-, or mono-saccharids?
- If we break down a mono-saccharid, what results?

LESSON I.

CELLULOSE AND STARCH.

- To which class of carbohydrates does cellulose belong?
- Give the formula for cellulose.
- Where in nature is cellulose found?
- What may it be considered?

What does it form in the more delicate tissues?
 Where and how can this cell wall be seen?
 In what condition is cellulose found in the solid portion of plants?
 Does it ever contain inorganic substances?
 How do we prepare cellulose?
 What does the grating process do in preparing it?
 In what form do we get cellulose in commerce?
 Give the properties of cellulose.
 How is it affected, by air or moisture?
 How do strong acids and alkalies affect it?
 What is caramel?
 How is "Parchment Paper" made?
 How is cellulose affected by cupric hydrate?
 How do digestive ferments of human and herbivorous animals affect it?
 Give some of its uses.
 What is "Papier Mache?"

STARCH.

Where is starch found?
 Give the per cent. of water in potatoes.
 How is starch formed in plants?
 How do we get the starch out of the cellulose wall?
 Give structure of starch granules.
 How does cold water affect the granules?
 How does hot water affect the granules?
 How does hot water and alkalies dissolve out the starch?
 How do hot diluted acids and ferments affect granules?
 What is the "diastase ferment?"
 In what class do we find maltose?
 How do the young plant get its first nourishment?
 Give an important property of starch.
 What do we mean by "non-dialyzing?"
 Before starch can be assimilated, what change must take place?
 Where is this change made?
 What is the principal test for starch?
 Does iodine change the color of the cellulose walls?
 Is the blue color (iodide of starch) stable?
 How does heat affect it?
 How does KOH, AgNO_3 , Hg Cl_2 , affect it?
 What is the principal use of starch?
 Give some other use.

LESSON II.

DEXTRINS.

In the conversion of starch or of cellulose into simpler compounds, what are formed?
 In which class do we find dextrins?
 Can the different dextrins be separated and recognized?
 How?

What names have been given to them?
With what is dextrin associated in nature?
Give different ways of forming or preparing dextrins.
Are dextrins soluble in water?
Are they soluble in alcohol?
Are they crystalline?
How do they taste?
How does iodine affect the dextrins?
How does boiling water and diluted acids affect them?
How does stronger acids and amylolytic ferments affect them?
Name the amylolytic ferments.
When pure, do the dextrins ferment?
Give some examples of their uses.
Have they any advantage over starch?
Give some other uses.

GLYCOGEN.

To what group does glycogen belong?
Where in nature is it found?
How is it prepared?
Can different varieties of glycogen be obtained?
Our theories with regard to glycogen demand what?
Describe glycogen.
Is it soluble in water?
Are solutions of glycogen clear?
How can they be cleared?
How does iodine affect glycogen?
What will clear up the red or brown color from iodine?
How does alcohol affect its solutions?
How does glycogen help the liver?
Explain function of liver as regards sugar.
What is first consumed during fasting?
Any relation between glycogen and Diabetes Mellitus?
How are mono-saccharids produced?

DEXTRO-GLUCOSE, OR DEXTROSE.

In which group do we find dextrose?
Give formula for dextrose.
Where is dextrose found in nature?
Associated with what and forming what?
In what fruits do we find dextrose?
In what form are carbohydrates absorbed into the circulation?
Where can we find dextrose in the human system?
In what disease does dextrose occur in large quantity?
How is dextrose formed in nature?
How is it manufactured on large scale?
Is it as sweet as cane sugar?
Is it soluble in water and alcohol?

Does it diffuse easily?
 How about it fermenting?
 In what form is dextrose used as food?
 Give some other uses.

LAEVULOSE.

Give formula for laevulose.
 When and with what do we find laevulose associated?
 What sugar does laevulose and dextrose form?
 From what is laevulose prepared?
 Is it an easy process?
 Can it be crystallized?
 What does it do on evaporation?
 How is it similar, and how does it differ from dextrose?

GALACTOSE.

With what, from what, and how is galactose formed?
 Does it crystallize?
 How is it similar to dextrose?
 What is its chief interest to us?
 What is koumiss?

TESTS FOR GLUCOSE.

Give the five principal classes of tests for glucose.
 Give "Moore's Test." (See experiments.)
 How can you confirm Moore's Test?
 Why is it not a delicate test for the urine?
 Give the "Phenyl Hydrazine Test." (See experiments.)
 Does this give reliable results?
 Give the "Bismuth Subnitrate Test." (See experiments.)
 What does this and similar tests depend upon?
 Is this a delicate test?
 Give the "Picric Acid and Potash Test." (See experiments.)
 Is this an important test?
 Give "Trommers' Test." (See experiments.)
 Explain the reduction of copper in Trommers' Test.
 Give the ingredients of "Fehling's Solution."
 How is "Fehling's Solution" best prepared?
 What fact is taken advantage of in the use of "Fehling's Solution?"
 Of what strength is it made?
 What is the principal error in this test?
 Give "Fehling's Test." (See experiments.)
 How do you keep from adding too much glucose?

LESSON III.

CONVERSION OF STARCH INTO DEXTRIN, GLUCOSE, AND MALTOSE.

How is dextrin prepared from starch? (See experiments.)
 For commercial use, how is the heated starch treated?

What is the dextrin usually made in the laboratory?

Give the dextrins in their order in going from starch to glucose or maltose.

How can you recognize the presence of erythro-dextrin?

How is glucose prepared from starch? (See experiments.)

From what is the starch of commerce prepared?

In preparing, what acids are used, and why?

How do you remove the acids?

How do we get dextrose in solid form?

How is maltose prepared from starch? (See experiments.)

Where is the diastase ferment found, and how prepared?

Is it a strong ferment?

What does Section IV. of Experiments teach us?

To what ferment is ptyaline similar?

Is it as strong as the diastase ferment?

What must be the reaction of solution to get best results?

How do free acids and high temperatures affect them?

FERMENTATION.

From what was the name of "fermentation" derived?

To what was the name first given?

What did the name cover?

When did a proper understanding of fermentation begin?

Define a ferment.

Give the different groups of ferments.

BODIES ACTING LIKE FERMENTS.

Give three examples where bodies act like ferments.

UNORGANIZED FERMENTS.

What kind of bodies are the enzymes?

Are they soluble in water?

Are they soluble in alcohol?

Where are they found, and how formed?

What is a zymogen?

Which of these ferments act like a zymogen?

How are they prepared?

Can you get them in pure form?

In composition they are similar to what?

In what do they differ from albumen?

What does their action depend upon?

Will they act in any temperature?

Which do they stand best, dry or moist heat?

Why can't they stand moist heat?

Give the classification.

Name the ferments under each class.

On what do "Inverting Ferments" act?

Where have these ferments been found?

From what is the most important ferment of this class prepared?
 On what do the "Sacchrifying Ferments" act?
 Which is the more powerful, amylopsin or ptyaline?
 Where else have these ferments been found?
 On what do the "Glucoside-decomposing Ferments" act?
 What property have the glucosides?
 Which are the best known ferments of this group, and where found?
 On what do the "Peptonizing Ferments" act?
 Where does pepsin act best?
 Does it fully digest the proteids of food?
 By what is the work carried forward, and under what conditions?
 What is papain?
 How is it similar, and how dissimilar, to pepsin?
 On what do "Coagulating Ferments" act?
 Where is rennet found?
 Give the supposed purpose of coagulating the caseine of milk.
 On what do "Fat-decomposing Ferments" act?
 Into what is fat broken up in digestion?
 Has steapsin been isolated?

ORGANIZED FERMENTS.

So far, what kind of substances have the ferments been?
 How do they produce their effect?
 Have the organized ferments a distinct life?
 What do they feed upon?
 Where do they change or decompose substances?
 Under what general name are they grouped?
 Give the classes of microbes.
 What are "Mould Plants?"
 Name some of the larger members of same family.
 The work of these plants is done by what part of the plant?
 Describe the mycelium.
 How does the mycelium affect solid material?
 How does it affect liquids?
 What will impede their growth?
 What happens when growth is impeded?
 What phenomena is due to these microbes?
 Do yeast plants belong to a higher or lower order of life?
 Describe them, giving size.
 Is there more than one variety?
 How do they look under the microscope?
 How do they propagate?
 What will stain them?
 In what fermentation are they very active?
 Which class of microbes are the smallest?
 Describe some of their shapes.
 How do they propagate?

Do they have motion?
Where do we find them?

LESSON IV.

DI-SACCHARIDS, OR SACCHAROSES.

Where does this class of carbohydrates stand?
Give their formula.
Give the formulæ for mono- and poly-saccharids.
From what are they derived?
Do they take up water?
How much, and forming what?
How do they differ from poly-saccharids?
How do they differ from mono-saccharids?

CANE SUGAR, OR SACCHAROSE, OR SUCROSE.

Which is the most prominent of the di-saccharids?
Where is it found?
Where is it formed, and how?
From what is it obtained on large scale?
The cane sugar of commerce is produced from what?
In what does the sugar cane have the advantage over the beet?
Give the present per cent. of each.
Give the process for making saccharose.
Describe saccharose, or sucrose.
Is it soluble in water, alcohol, and ether?
Does it crystallize readily from its solutions?
Can it be converted into glucose? How?
What do we call this glucose? and why?
Give the changes in cane sugar under heat.
What is barley sugar?
What is the ultimate result of heating?
How can caramel be formed from sucrose?
What test serves to distinguish between dextrose and sucrose?
What will change dextrose into caramel?
What test shows this?
Give Moore's Test.
Will saccharose respond to the tests for grape sugar?
How else does it differ from corn sugar?
Give some of the uses of sucrose.
Give uses of caramel.

MILK SUGAR, OR LACTOSE.

Where is this sugar found?
Is it ever found in vegetable life?
Give the per cent. of lactose in milk.
How is it usually obtained?
How many forms of lactose have we?

How does the usual form occur?
 How does it taste and feel between the teeth?
 How will 130° C. heat affect lactose?
 What will further heat do?
 Will milk sugar respond to the tests for corn sugar?
 Does phenyl hydrazine affect both alike?
 How does it differ from glucose?
 Give its uses.

MALT SUGAR, OR MALTOSE.

To what is this sugar very similar?
 From what and by what is it produced?
 Prolonged action will change maltose to what?
 How else is it produced?
 Describe maltose.
 Is it soluble in water and alcohol?
 Will it respond to the grape sugar tests?
 How does it differ from lactose in the phenyl hydrazine test?
 Does it ferment easily? By what?
 What value does this give it?
 How can starch be made to undergo alcoholic fermentation?

FERMENTATION EXPERIMENT.

What temperature is used in this experiment?
 The starch is obtained from what?
 In what proportion is rye meal mixed?
 Why is rye meal used?
 What is meant by "mashed?"
 Why is the mixed meal "mashed?"
 What is then added, and how much?
 What does it do?
 What is now added?
 When is the fermentation completed?

LESSON V.

ALCOHOL, CARBON DIOXIDE, AND YEAST.

To what has the name alcohol been given?
 How long has ethyl hydrate been known?
 By what process was it first purified?
 What was pure alcohol first called, and how used?
 Can it be made from inorganic substances?
 From what is it usually prepared, and how?
 Through agency of what yeast plant?
 Describe this plant.
 What is meant by top and bottom yeast?
 What is the best temperature for yeast?
 What does it feed upon?

What else does it need ?

Does it produce anything else besides alcohol and carbon dioxide ?

Liquids after fermentation contain what per cent. of alcohol ?

How can per cent. be made greater ?

How high can it be made by distillation ?

Can it be carried above 94 per cent. ?

By what means ?

What is meant by hygroscopic ?

Describe alcohol as to sight, smell, and taste.

Give specific gravity.

Is specific gravity affected by addition of water

Of what value is a knowledge of the specific gravity ?

Give boiling temperature.

Give color of flame.

What does its vapors form ?

What is its freezing point ?

Does it absorb water readily ?

What value does this give it ?

Explain burning sensation when alcohol is swallowed.

Explain shrinkage on mixing alcohol and water.

Give uses of alcohol.

Give "Iodoform Test" for alcohol. (See experiments.)

Describe iodoform.

Is this a delicate test ?

Give the "Molybdic Acid Test." (See experiments.)

What is the blue color due to ?

Explain the reaction.

Is this a delicate test ?

Give the "Chromic Acid Test." (See experiments.)

Is it as delicate as the preceding ones ?

Give the "Acetic-Ether Test." (See experiments.)

Explain the reaction.

Why is sulphuric acid added ?

Describe odor of acetic ether.

Give test for carbon dioxide.

Give Section III. of Experiments concerning yeast.

PART II.

The Fats and Fixed Oils.

LESSON VI.

FATS AND SOAP.

- Are fats and oils classed as carbohydrates?
What name do we sometimes give this class of substances?
How do they differ from carbohydrates?
Do we know the exact chemical composition of carbohydrates?
Do we understand composition of the hydrocarbons?
To what class of compounds do they belong?
What is meant by compound ethers?
What have they in common?
Where do fats occur?
What is meant by the "highly oxidizable foods?"
Where in animals do we find them?
What is adipose tissue?
Where in vegetation do we find fats?
How are fats obtained from animal tissue?
What is the disadvantage in this method?
Give other ways of obtaining it.
Give Mouriez's method of obtaining fat.
Give the composition of fats.
Which is hardest, stearine or palmitin?
Does ordinary animal fat contain anything else?
Is the same true as to butter, castor weed, and linseed oil?
The physical properties of fats depend upon what?
These fats are salts of what?
In percentage composition which element of formula predominates?
Why is there more potential energy in fats than carbohydrates?
How does their weight compare with water?
When pure, what is their color, taste, and smell?
Do they evaporate easily?
Are they soluble in water and alcohol?
Name some volatile organic liquids that will dissolve them.
Are they inflammable?
How does dry heat or sulphuric acid affect them?

How does steam, alkalies, and diluted acids affect them ?

What is the change, and what is it called ?

Give the uses of fats in the body.

Give uses in medicine.

Give other uses.

SOAP.

Give formula for propenyl.

Give formula for fatty acid.

Define a soap technically.

Define a fat technically.

Define glycerine technically.

What are the soaps generally used ?

How is soap generally made ?

Which metal makes the hard soap ?

Explain reaction in soap-making.

Give equation for making hard soap from soft soap.

What appearance has water when soap is dissolved in it ?

Explain how soaps clean our hands.

What reagent is always present in soaps ?

What else do we find in soaps ?

How do acids affect soap ?

How do metallic salts affect them ?

Give preparation of lead soap.

What is formed when soap is put in hard or calcareous water ?

Is it possible to get a lather in this kind of water ?

What will aid in obtaining lather, and how ?

What is meant by emulsion ?

What is supposed to take place ?

Give an instance where this happens.

How are oils and fats best emulsified ?

LESSON VII.

BUTTER, OLEOMARGARINE, GLYCERINE, AND OILS.

BUTTER.

Where is this fat found, in what per cent., and in what condition ?

How is it extracted ?

How does churning cause the globules to coalesce ?

Give per cent. of fat in the butter of market.

What forms the rest ?

How do we use care to remove all the milk from butter ?

What fat is often used as a substitute for butter ?

Where is this fat found, and how prepared ?

When preparing, what becomes of the stearine and palmin ?

How is it now prepared for use ?

What advantage has it over butter ?

Is butter fat very complex ?

Give the fats, butter fats, and some of the other substances found in it.
Name some of the fatty acids which form butter fats.
What kind of salts of fatty acid are butter fats?
Which of these fats give the peculiar taste and odor to butter?
Give some properties of fatty acid.
Do they dissolve in water
Are they in these respects similar to ordinary fats?
Give the process by which we obtain fatty acid from butter.
How is ethyl butyrate formed?
Give its odor and uses.

GLYCERINE.

Give the formula and its synonyms.
This substance is formed when?
Is the glycerine we use obtained while manufacturing soap?
Why is not this glycerine used?
Where is the glycerine of commerce obtained, and how?
Where else is glycerine produced?
Describe glycerine.
Can it be solidized and crystallized?
Can it be evaporated?
Will it burn?
What will decompose it?
Will it undergo alcoholic fermentation?
This property gives it what particular use?
Can it be fermented?
How is nitroglycerine made?
Give some of the uses of glycerine.

THE OILS.

How do oils differ from ordinary fats?
Is castor oil a vegetable or animal oil?
Obtained from what plant, and what part of plant?
Where is the plant found?
How are the two grades of oil obtained?
Describe the pure oil.
How is it distinguished from the other oils?
Of what is castor oil made up?
Will this fat saponify? and if so, how?
Give some of its uses.
Where and how is olive oil obtained?
Does its quality vary—according to what?
Where does the finest grade come from?
Describe the pure oil.
Of what is it made up?
How does air affect it, and why?
Give uses of the best and inferior grades.
Do we get it pure?

With what is it adulterated ?

Where is cod liver oil found, and how extracted ?

Describe the pure oil.

Of what is it made up ?

Is it easily digested ?

Give some of its uses.

How is it adulterated ?

PART III.

The Proteids, or Albuminous Bodies.

INTRODUCTION.

- Are these classed as proximate principles?
- What substance do they all resemble?
- Are they found in the animal or vegetable kingdom?
- Where in vegetables are they found?
- Where in animal tissue?
- Does animal life form these bodies?
- Give the composition of proteids.
- The mineral matter present is regarded as what?
- Which element is the most characteristic?
- What name is often given to these bodies?
- Where do we get the nitrogen to form proteids?
- Is our knowledge perfect concerning structure of proteids?
- Are they crystalline or amorphous bodies?
- Are they all diffusible?
- Are they closely related to each other?
- Can they be transformed one into another in laboratory?
- Are they soluble in water?
- Are they soluble in neutral salts?
- How do diluted acids and alkalies affect them?
- Are they soluble in alcohol and ether?
- Name some reagents which will precipitate proteids.
- Name the most efficacious salt as a precipitating reagent.
- How does precipitating affect their identity?
- Do they decompose readily?
- How does continued heat affect them in air?
- How do they act when boiled with diluted acids?
- How do the unorganized ferments affect them?
- How do the organized ferments affect them?
- Are they easily classified? Why?
- What is the given classification based upon?
- What are the two main divisions?

ANIMAL PROTEIDS.

- Give the eight classes.
- How does water affect the "Albumens?"

How does heat affect them?

Give the two varieties.

How does water and salt solutions affect the "Globulines?"

How does heat affect them?

Give the five varieties.

How does water and salt solutions affect the "Derived Albumens?"

What will dissolve them?

Give the two varieties.

Why can't caseine be included in this group?

How does water, salt solutions, and diluted acids affect "Fibrine?"

How is fibrine coagulated?

How does water, salt solutions, diluted and strong acids affect the "Coagulated Proteids?"

How does water, salt solutions, diluted acids, and alkalies affect the "Amyloid Proteid," or "Lardacine?"

How does iodine affect lardacine?

Where do "Albumoses" stand?

In what are they soluble?

Are they diffusible?

What dissolves "Peptones?"

What will precipitate them?

Are they diffusible?

VEGETABLE PROTEIDS.

Give the four classes.

How does water and heat affect "Plant Albumens?"

How does water, heat, and Na Ce affect "Plant Globulines?"

How does water, salt solutions, and diluted alcohol affect "Plant Caseines?"

Give the three plant caseines.

How does water and alcohol affect "Gluten Proteids?"

ALBUMINOIDS.

Where are albuminoids found?

Are they similar to proteids proper?

How distinguished from them?

Have they been isolated?

Name the most important ones.

In which kingdoms are they found principally?

Where about in animal tissue?

Is this true of proteids proper?

Give some structures composed of these bodies.

Are they all soluble in water?

How does boiling affect them?

Are they digestible?

LESSON VIII.

GENERAL PROTEID REACTIONS.

What reactions are referred to in the heading?

Name these reactions.

Give the Xanthro-proteic Reaction. (See experiments.)

What is the resulting yellow substance in this reaction?

In what form is it? and how does water, alcohol, and ether affect it?

What will dissolve it? and what does it form with bases?

How are the salts formed?

Is this a delicate reaction?

Give the Millon's Reaction. (See experiments.)

How is Millon's reagent formed?

What sometimes causes this test to fail? and how?

Does this reaction affect albuminoids and proteids alike?

Give the Biuret Reaction. (See experiments.)

What will intensify the color?

Do you use diluted or concentrated CuSO_4 ? Why?

Is this a delicate test?

Give the Ferro-cyanide Reaction. (See experiments.)

Give the Sodid-sulphate Reaction. (See experiments.)

Why is acetic acid used instead of hydrochloric?

Why is this a valuable reaction?

Give the Picric-Acid test. (See experiments.)

Is this a very important test?

Give this test when testing for glucose.

ALBUMENS.

Where are albumens found?

Are they soluble in water, diluted acids, and salts?

What does coagulate them?

What does heating with acids, or alkalis, do to them?

What do they form with metals?

Are they digestible?

Give the two varieties of albumens.

What is meant by dialysis?

EGG ALBUMEN.

As found in egg, is it concentrated or diluted?

With what is it associated?

How is egg albumen purified?

Describe it when dried at low temperature.

Describe it in concentrated and diluted solutions.

How does heat affect it?

What else will cause coagulation?

Does serum albumen coagulate with same reagents?

Is our knowledge perfect concerning its chemical structure?

What element does it contain besides C O H and N?

What do we infer from its different coagulating temperatures?

For what poison is it used as an antidote?

Give uses for egg albumen besides food.

SERUM ALBUMEN.

Where is this albumen found, and in what per cent.?
Under pathological conditions, where is it found?
From what and how can it be prepared?
Describe this albumen when pure.
What varies the coagulating temperature?
Give the four points of difference between egg and serum albumen.
Give uses of serum albumen.

GLOBULINES.

Give the five varieties in this class.
How do they differ from the preceding class?
What will cause them to dissolve?
Why is it difficult to distinguish between albumens and globulines?
What will precipitate the globulines?
How does standing under water affect them?
How does heat affect their neutral solutions?
How do diluted acids and alkalies affect them?
How do concentrated acids and alkalies affect them?

VITELLINE.

Where is vitelline found, and in what per cent.?
With what is it associated?
What coloring matter is found with it?
To what is its color due?
How does sunlight and conc. H N O_3 affect it?
Do we extract vitelline absolutely pure?
Is it identical with the proteids found in the yolk of eggs of other birds?
How is it prepared and purified?
Describe it when pure.
What will coagulate it, and what dissolve it?

LESSON IX.

GLOBULINES (*continued*).

CRYSTALLINE.

Many claim this to be identical with what?
Where is it found, and associated with what?
How is it extracted?
Give coagulating temperature.

MYOSIN.

Where is myosin found, and under what conditions?
To what is formation of myosin similar?
What is muscle plasma?
What causes this spontaneous coagulation after death?
Give the name of the myosin ferment.
What happens when the fibers of myosin contract?
The change is accompanied by what?

Give the changes in muscular tissue when coagulation sets in.
 How soon after death does this coagulation commence?
 When does it stop?
 How is myosin obtained and purified?
 How does Na Cl and alkalies affect it?
 What does it form with acids?
 How is syntonine formed with it?
 Is it easily digested?

PARAGLOBULINE (*serum globuline*).

Where is paraglobuline found, and associated with what?
 How is it obtained and purified?
 How does Na Cl and the alkalies affect it?
 In what pathological condition is it sometimes found?
 Is it easily distinguished from serum albumen when occurring in urine?

FIBRINOGEN.

To what is this name given?
 Explain the coagulation of blood.
 How is fibrinogen obtained?
 How does Na Cl and Co affect it?
 How does dialyzing affect it?
 Give the use of fibrinogen.

DERIVED PROTEIDS.

Acid Albumen.

From what and how is this albumen derived?
 Are they constant quantities?
 How does water and the acids affect them?
 How do alkalies affect them?
 Will heat or ferments coagulate them?
 What do they represent?

Syntonine.

How is syntonine formed?
 How is it precipitated from solutions?
 Describe syntonine.
 How does water, neutral solutions affect it?
 How do acids and alkalies affect it?
 What will precipitate it?
 How does lime water and NH_4Cl affect it?
 Give its use.

Alkali Albumens.

How are these albumens produced?
 How do they differ from one another?
 Do they differ from Acid Albumens in more than reaction?
 Have they distinct chemical properties?
 How does water, solutions of Na Cl affect them?
 Do they combine with any of the metals?
 Forming what?

LESSON X.

FIBRINE—VEGETABLE PROTEIDS—TEST FOR SULPHUR IN PROTEIDS.

FIBRINE.

Where and how is fibrine produced?
Of what great use is it?
Describe the phenomena of coagulation.
How can fibrine be obtained?
Describe pure fibrine.
When heated in water, how is it affected?
How affected by dry heat?
Does drying destroy it?
Does it dissolve in water, alcohol, or alkalies?
How do acids affect it?
How does open air affect it?
Are all these properties the same in boiled fibrine?

COAGULATED PROTEIDS.

From what and how are these proteids produced?
Coagulated proteids, as derived proteids, seem to be associated with what?
Upon what does their formation seem to depend?
How does water, neutral salts, diluted acids, and alkalies affect them?
What change is produced by caustic alkalies and warm acids?
Are they readily digested?

AMYLOID SUBSTANCE—LARDACEIN.

Where is this found, and is indicative of what?
What appearance does it give to the tissues?
How is it obtained?
When obtained, how does it appear?
How does water and alcohol affect it?
How does conc. HCl and caustic alkalies affect it?
How does it differ from all the other proteids?
In what does it resemble carbohydrates?
What characterizes it as a proteid?

VEGETABLE PROTEIDS.

Does animal tissues form any proteids?
Are the vegetable proteids widely scattered?
Where in plants are they found?
How do they often differ from animal proteids?
In what are they similar to animal proteids?
How many are common to both kingdoms?
What is supposed to take place in the digestion of vegetable proteids?
Are vegetable proteids easily classified?
Name the plant proteids.
Which has no counterpart among animal proteids?

PLANT ALBUMEN.

Is there any doubt about there being such substances as plant albumens?
How are they prepared, and to what tests do they respond?

PLANT GLOBULIN.

From what is this large class of compounds derived, and how?
In what do they resemble, and in what differ from, animal globulin?

PLANT CASEINS.

How do acids and diluted alkalies affect this class?
Which is the most important number of this group?
Where is it found, and how extracted?
Of what value is it?
Give another number of this group.
In what does it differ from other gluten compounds?
What are formed on adding salts to its solutions?

GLUTEN PROTEIDS.

Where is gluten found, and of what importance is it?
How does water affect it?
Explain the rising of bread.
How does baking the bread help the rising?
Of what value is raised bread?
How can gluten be extracted from flour?
Gluten thus prepared contains what?
Describe it when dry.
How does water, neutral salts, and alcohol affect it?
How do diluted acids and alkalies affect it?
What do some claim as to its existence in dry flour?
What does gluten of wheat flour seem to consist of?
Name these proteids.

SULPHUR IN PROTEIDS.

Why are the tests under this heading of so much importance?
Name these tests.
Which is the simplest and most satisfactory?
Give this test. (See experiments.)
Upon what does this test depend?
In what else is this used as a qualitative test?
How is the test used in testing sewer gas?
Give the "Bismuth Test." (See experiments.)
Will this test interfere with the test for glucose in the same liquid?
Is the "Sodic Nitro-prusside Test" a delicate test?
Give this test. (See experiments.)
What is this test based upon?
In what form must the sulphur exist?
What per cent. of sulphur is found in a hair?

PART IV.

THE INORGANIC CONSTITUENTS OF THE BODY.

LESSON XI.

OXYGEN, HYDROGEN, CHLORINE, AND HYDROCHLORIC ACID.

OXYGEN.

Give the atomic weight of oxygen.

Is oxygen a very abundant element?

What per cent. of atmosphere is oxygen?

What per cent. of water is oxygen?

What per cent. of the earth's crust is oxygen?

Is it very abundant in organic tissue?

How can it be prepared?

Give its physical properties.

How do fish obtain their oxygen?

Will it combine with other elements?

Forming what?

What is meant by combustion?

What is the great source of energy and life?

Why do substances burn in oxygen and not in atmosphere?

How does oxygen act in the combustion of organic bodies?

What do non-metallic oxides form with $H\ O$?

Give the physiological properties of oxygen.

Give uses of oxygen in medicine and in the arts.

HYDROGEN.

Give the atomic weight of hydrogen.

Which was discovered first, oxygen or hydrogen?

Where does it exist free?

Where does it exist in combination?

How can it be prepared?

Give its physical properties.

Does it support combustion?

When it burns, what does it form?

When does it become explosive?

What is meant by it being a reducing agent?

How does hydrogen act in the presence of arsenic?

Give properties of $A\ H$.

How does it act when heated in a closed tube?

How does hydrogen act with antimony?
 How is the arsenic mirror distinguished from the one by antimony?
 What is this mirror test called?
 For what is hydrogen used?

CHLORINE.

Give atomic weight of chlorine.
 Does chlorine occur free in nature?
 Are its compounds numerous?
 In what form is it in the atmosphere?
 In what form is it always found in natural water?
 In what form do we find it in great deposits?
 What is the formula for common salt?
 In what form is it found in the juices of animals and plants?
 What are the alkaline metals?
 How is chlorine prepared?
 How is it treated for uses in the arts?
 Give its physical properties.
 Does it burn in oxygen and hydrogen?
 Give the three ways it acts upon organic matter.
 Which of these three gives it bleaching properties?
 Has chlorine much affinity for the metals?
 Are all the metallic chlorides soluble in H_2O —with what reaction?
 Give the physiological properties of chlorine.
 Give the uses of chlorine.

HYDROCHLORIC ACID.

How long has HCl been known?
 What is an alchemist?
 What is "aqua regia"?
 Where in nature is the gas found?
 How can it be prepared?
 HCl as a by product in the soda industry is contaminated with what?
 Give its physical properties.
 Give another name for hydrochloric acid.
 What test serves for both HCl and ammonia?
 What is the most delicate test for HCl ?
 Give properties of $AgCl$.
 Give another test for HCl ; also the properties of the resulting salt.
 Give physiological use of HCl .
 In what per cent. is it in the gastric juice?
 Give its use in medicine.
 Give its uses in the arts.

LESSON XII.

SULPHURIC, CARBONIC, AND NITRIC ACIDS.

SULPHURIC ACID.

Give the formula for sulphuric acid.
 How long has this acid been known?

What did the alchemists call it, and from what did they prepare it?
 Where is it occasionally found free in nature, and how formed?
 Are its salts numerous?
 Name some of them, and where found.
 How is the acid of commerce prepared?
 Give its physical properties.
 Give its chemical properties and uses.
 How does it act on metals?
 Are its salts soluble?
 What salts serve as good tests for H S and O ?
 How are Epsom or Glanber's salts good antidotes for lead poisoning?
 Are salts of H S and O as numerous as those of HCl ?
 Is the acid found in the animal economy?
 How does it affect animal tissue?
 Is it as corrosive as HNO_3 ?
 What is the proper treatment when acids get on the skin?
 Is H_2SO_4 used much in the arts and in medicine?
 Give its uses in the arts.

CARBONIC ACID.

Give the formula for the acid.
 Give the name and formula for the gas.
 What was the gas first called?
 Where is the gas found?
 Has the acid many salts?
 Name some of them.
 Give a simple way of producing this gas.
 How is it prepared on large scale?
 Give its physical properties.
 Has the gas acid properties?
 How is the acid formed?
 Are the acid and normal salts alike in solubility?
 Where is this gas found in the human body?
 Of what value is it to plants?
 What effect is produced by its inhalation?
 Does atmosphere filled with CO_2 contain much O ?
 How does it act when taken as effervescing beverages?
 Give its uses.

NITRIC ACID.

Give the formula for nitric acid.
 What name did the alchemists give to it?
 Where does it exist free, and how formed?
 Where are its salts found, and how formed?
 What is saltpeter, and where found?
 What is Chili saltpeter, and where found?
 Give physical properties of HNO_3 .
 Give its chemical properties.
 Is it very corrosive to the body?

How does HNO_3 act upon metals?
 What do the tests for this acid depend upon?
 How does it act with FeSO_4 in the presence of H_2SO_4 ?
 How does it act with organic bodies?
 How does it act with aniline?
 Give the test with brucine. (See experiments.)
 Give its physiological properties.
 Give its uses.

LESSON XIII.

PHOSPHORIC ACID, IRON, AND ALUMINIUM.

PHOSPHORIC ACID.

Give formula for phosphoric acid.
 Is it found free in nature?
 Are its salts numerous, and where found?
 How is it prepared?
 Give properties of phosphoric acid.
 Are its salts ever acid in reaction?
 Give the most delicate test for phosphoric acid.
 In what is the precipitate of this test soluble and insoluble?
 Give the ammonium magnesium phosphate test.
 Give the argentic phosphate test.

IRON.

Where is iron found free, and where in combination?
 Where is it found in life?
 How is it extracted from its ores?
 What impurities does cast iron contain?
 What is wrought iron, and how made?
 What is steel, and how made?
 Give physical properties of wrought iron?
 What peculiar properties has it?
 What two classes of compounds does iron form?
 How can they be changed from one to the other?
 In testing for iron in substances, what reagents are principally used?
 What must be the reaction of the solutions, and why?
 Give the tannate of iron test.
 For a long time the resulting product of this test was used for what?
 The resulting blood-red color is destroyed and restored by what?

ALUMINIUM.

Salts of this metal have been known how long, and what called?
 Does it occur free in nature?
 Where is it found, and associated with what?
 How is it now extracted from its salts, and how formerly?
 Give its physical properties.
 Give its chemical properties.
 In what do the alum salts resemble each other?

Give formula for soda alum and chrome alum.
How do the alums differ from these?
How is burnt alum made, and how does cobaltic affect it?
What is Thenard's blue, and for what used?
What is the test most usually employed?
How can iron and aluminium be separated?
What are lakes, and how formed?
For what and how are lakes used?
Give uses of aluminium.

LESSON XIV.

CALCIUM AND MAGNESIUM.

CALCIUM.

How long have compounds of calcium been known, and for what used?
Is the metal ever found free in nature?
Where are its compounds found, and similar to what?
In what form is it found in marble, chalk, limestone, etc.?
Give some other forms in which it occurs, and where found.
How is the metal prepared from its salts?
Where and how are its salts derived?
Give physical properties of the metal.
Which is the most important compound, and how does it act under heat?
For what is this reaction used on a large scale?
What is meant by slaked and unslaked lime?
Give the difference between air-slaked and water-slaked.
How can the water-slaked be changed to air-slaked, or CaCO_3 ?
Describe these two compounds.
Give the sulphate test for calcium with its objection.
Do magnesium salts act similarly?
Describe calcic oxalate.
How does a quick reaction in concentrated solutions differ from slow reaction in diluted solutions?

MAGNESIUM.

Is the metal found free in nature?
In what forms do we find its compound, and where?
Give the form as found in plants and animals.
How is the metal prepared?
Give its physical properties.
How does heating in air or with oxygen affect it?
How do diluted alkalies and acids affect it?
What is MgO called, and how prepared on large scale?
Describe MgO , giving its action with water.
For what is $\text{Mg}(\text{OH})$ sometimes used in medicine?
What is the best test for magnesium compounds?
Triple phosphate gives what form of crystals?
How can calcium and magnesium be separated?
Give the separation when iron is with them.

LESSON XV.

ALKALINE METALS, WOOD ASHES, ACIDIMETRY AND ALKALIMETRY.

ALKALINE METALS.

Name the alkaline metals.

How are the metals of this group characterized?

In what are the earthly metals La, Mg, Ba, and Sr similar and dissimilar?

What alkaline metals are most prominent?

Is ammonium a metal?

How are its compounds distinguished?

How can the gas be set free, and how recognized?

Are ammonium compounds soluble in water?

How does ammonium act with PtCl_2 ?

Describe the crystals formed.

SODIUM.

For what is this metal used on a large scale?

Is it found free in nature?

Give some of its compounds, its chief one, and where are they found?

How is the metal prepared?

Describe sodium and sodic hydrate.

How does water affect sodium?

Give the most delicate test for sodium, and its objection.

Give the potassium antimoniate test.

What is the form of NaCl crystals?

POTASSIUM.

How is this metal prepared?

Give its properties and color when burnt in flame.

Can the color be seen if sodium is present?

LITHIUM.

Of what value is this metal?

What compounds are used in medicine?

What is the carmine-red test?

How can lithium be separated from sodium and potassium?

WOOD ASHES.

What do ashes of plant represent?

Besides the mineral matter, what else forms the plant?

What is the per cent. of mineral matter?

How will the absence of either iron, phosphorous, or silica affect the plant?

The main bulk of the ordinary ashes is what?

How do sea weeds differ from land plants?

How do we test ashes?

ACIDIMETRY AND ALKALIMETRY.

Explain how to get strength of acids and alkalies.

PART V.

Water Analysis.

LESSON XVI.

WATER ANALYSIS.

What three uses of water often require examination?

WATER FOR MANUFACTURING PURPOSES.

For uses in steam boilers, what substances are examined for?

Why do we examine for these substances?

Which is the least, and which is the most, injurious of the three, and why?

How can the bicarbonates be removed?

When the sulphates are present, can the water be purified?

WATER FOR LAUNDRY PURPOSES.

What salts injure water for laundry purposes, and how?

Are the sulphates objectionable in laundry water?

QUANTITATIVE DETERMINATION OF HARDNESS.

How is the amount of hardness determined?

How is the standard solution of soap made?

How is the end of the reaction known?

How is the permanent hardness determined?

TESTS FOR DRINKING WATER.

BIOLOGICAL TESTS.

What do we test for under this head?

What is the object in Koch's gelatine plate-culture method?

Is this an easy and accurate method?

What are its disadvantages?

Would it be of any importance if the microbes could be counted, and why?

Are the biological tests satisfactory?

CHEMICAL TESTS.

What two constituents render drinking water dangerous?

Organic matter in sewerage is largely what?

By what is it attacked, and what results?

Where else is ammonia found?

What is Nessler's test?

- How is the test used quantitatively?
- What is increase and decrease of ammonia due to?
- When ammonia is present in large quantities, it shows what?
- What is always present in fresh sewerage?
- How do we get a good idea of this?
- What does albuminoid ammonia indicate?
- How are nitrites and nitrates formed in water?
- The presence of nitrous salts shows what?
- Is it easy to test for them?
- What is the test based upon, and is it an interesting test?
- Where do nitrites and nitrates occur in small quantities, and how formed?
- What takes place in this process of oxidation?
- In what two ways do we test for nitrates?
- What is the Reduction method?
- What is the Phenol-Sulphonic-Acid test?
- Are the nitrates and nitrites permanent products in water?
- When chlorides occur, are they permanent?
- What chloride is always present, and what influences the quantity?
- Have we any standard as to the limit of salt in unpolluted water?
- How do we determine quantity of salt in mineral water?
- What was potassic permanganate often used for in water analysis?
- How are the phosphates tested for?
- How is the total solid matter determined?
- What are tested for in mineral waters?
- To what is improvement due in stays at mineral springs?

PART VI.

The Animal Tissues and Secretions.

LESSON XVII.

BONE.

Is the chemical composition of bone constant?

Give the composition in adults.

Where is the fat found?

What else is in composition of bone besides water, fat, osseine, and mineral matter?

What gives elasticity to bone tissue?

How does ether added to dry bone affect it?

What gives strength and hardness to bone tissue?

Is the amount of hardness or elasticity always the same?

In a general way, how much is organic and how much inorganic?

OSSEINE (COLLAGEN):

Osseine is a mixture of what?

How is osseine obtained?

Give its physical properties.

How does water, acids, and alkalies affect it?

What will dissolve it, forming what?

GELATINE.

What is gelatine similar to?

How affected by warm and cold water?

Cooling of diluted solutions form what?

Describe gelatine, and has it any nutritive value?

What is glue?

How is gelatine used in photography?

Will gelatine and osseine respond to the general proteid reactions?

What is the difference between rawhide and leather?

What elements make up osseine and gelatine?

Give the stages in the decomposition of bone by heat.

BONE BLACK OR BONE CHARCOAL.

How does bone charcoal differ from ordinary animal or vegetable charcoal?

Does its absorbing filtering powers last indefinitely?

How can its filtering powers be restored?

How is bone black used in the arts?

BONE ASHES.

How are bone ashes obtained?

How do we test for the carbonates, phosphates, and chlorides?

How for calcium and magnesium phosphates?

How is Ca and Mg separated in the presence of phosphates?

Can iron be detected?

LESSON XVIII.

MILK.

What is milk, and for what intended?

What is colostrum, and how does it differ from milk?

Describe milk, giving specific gravity.

What is meant by milk being amphoteric?

Give the composition of milk.

Variations in composition depend upon what?

Give the average per cent. of constituents in cows' milk.

Give the average per cent. of constituents in human milk.

In what particulars do they differ?

How do they differ as regards nourishment for children?

Is milk a good culture medium for microbes?

How then should cows' milk be treated before feeding to infants?

PROTEIDS IN MILK.

Which is the most important of the proteids found in milk?

What other proteids are found in milk?

Is caseine in solution in the milk?

How can it be prepared pure?

Give its properties when pure.

What is the semen noticed in boiled milk?

How can caseine be precipitated from its solutions?

By what is it coagulated, and upon what does the coagulation depend?

Where is rennet found, and for what used?

How does lactose differ from the other sugars?

To what is lactic fermentation due?

What temperature aids the fermentation best, and what stops it?

How do microbes affect milk?

INORGANIC CONSTITUENTS.

Are the mineral salts abundant?

Name some of them, and the most important one.

BUTTER FAT.

How does butter fat occur in milk?

What do these globules contain?

By what are these globules enclosed?

Why do we believe it to be proteid matter?

What is the present belief in regard to butter?

ADULTERATIONS OF MILK.

- What chemicals are added sometimes as preservatives?
- What are the two common ways of falsifying milk?
- Which is the most dangerous, and why?
- When does addition of water become dangerous?

TESTING OF MILK.

- Upon what will examination depend?
- What instrument do inspectors use in examining milk?
- Describe the lactometer.
- What is taken as the minimum gravity of genuine milk?
- What else does the inspector notice?
- Which is heavier, skimmed or whole milk, and why?
- How is watered milk determined?
- Where will cream stand on the lactometer?
- Can moderate skimming or watering of milk be detected, and why?
- One degree below 100° mark shows what?
- What great advantage lies in the lactometer?
- Since cream is lighter than milk, would not milk rich in cream be condemned by the lactometer?
- What are some of the difficulties in quantitative analysis?
- What has been suggested as a means of determining the quality of a sample of milk?
- Upon what does the appearance of milk depend?
- Mothers' milk disagreeing with child shows variation in what?
- To what may this condition be due?
- In examination of mothers' milk, what knowledge is necessary to determine any serious change?
- Between what does specific gravity vary in normal milk?
- Between what does percentage of cream vary?
- What milk should be examined?

KOUMISS.

- To what is this name now given?
- What is the history of koumiss?
- From what was it originally prepared?
- From what is it prepared nowadays?
- How is the alcoholic fermentation produced?
- Describe the ferment.
- Give the composition and steps in the formation of koumiss.
- Give the uses of koumiss.

LESSON XIX.

BLOOD.

- Describe blood, and give its functions.
- It is the source of what fluids in the body?

GENERAL PROPERTIES.

- Give some of the general properties of blood.
 What takes place in coagulation?
 Give variations in specific gravity.
 What is the quantity of blood, and how influenced?
 Describe its taste and odor.
 How does H_2SO_4 affect its odor?
 What is reaction of blood, and why?
 What influences reaction?
 What is the color of blood, and to what due?
 Where is haemoglobin found in blood?
 How can it be dissolved out?
 How does $NaCl$, Na_2SO_4 , etc., affect blood?
 Difference in color of arterial and venous blood is due to what?

COMPOSITION.

- Give the composition of human blood.
 Is haemoglobin an important constituent of blood?
 Where is it found, and how vary?
 How is haemoglobin prepared?
 Give properties of extracted oxy-haemoglobin.
 What element is found in oxy-haemoglobin?
 Which is the most characteristic, and why?
 Has the counting of corpuscles any value?
 Describe the combination of oxygen and haemoglobin.
 How can they be separated?
 How does pure haemoglobin act?
 What is Methaemoglobin? Describe it, and where found?
 Describe Haematin, and how formed?
 Describe Hamin, and how formed?
 Describe serum, and what does it contain?
 What two proteids does serum contain?
 Describe the acetic acid test for albumen.
 Is it a reliable test, and why?
 Is acetic acid with potassic-ferro-cyanide a satisfactory test?
 Is the nitric acid or Heller's test a satisfactory one?
 How is it made?
 What special value has the picric acid test?
 Is the separation of paraglobin by means of CO_2 satisfactory?
 How does fat exist in blood?
 What varies amount?

LESSON XX.

BLOOD (CONTINUED) AND BILE.

- The inorganic constituents of blood consist of what?
 Give total quantity of mineral matter in blood.
 Name some of the mineral matter.

In examining blood stains, what two questions arise?
 What test will answer the first question?
 Give the haemin test. (See experiments.)
 What precautions must be observed in this test?
 What advantage has the haemin test over others?
 What disadvantage has it?
 Does the haemin test tell us the source of the blood?
 Is the identifying of individual corpuscles difficult?
 Why and how can it be done?
 How does water affect corpuscles?
 Do we look at the mass when using the microscope?
 How is the examination sometimes perfected for jury use?
 Describe some of the variations in corpuscles.
 Are the corpuscles of the same animal all equal in size?
 Are corpuscles of much medico-legal value?
 Is the guaiacum test a ready test?
 What reagents are used?
 Give the test. (See experiments.)
 Is the guaiacum test a delicate one?
 What are its objections?
 In what way is it of value?
 What instrument is often used to detect blood?
 How is the suspected material prepared for the spectroscope?
 What are the drawbacks to this way of testing?

THE BILE.

Where does the bile originate, and where does it go?
 How is it obtained?
 Give the physical properties of bile.
 Give its chemical properties.
 Give its physiological properties.
 How does it assist digestion?
 How does it act in the intestines?
 To what does calomel owe its effects?
 Is bile ever given as a medicine?
 Has it any antiseptic properties?
 Where is *cholesterine* found?
 Is it ever found in gall stones?
 Where else is *cholesterine* found?
 Where in pathological conditions?
 How is *cholesterine* best prepared?
 Give its physical properties.
 Give its chemical properties.
 Give its physiological properties.
 Give the test for *cholesterine*. (See experiments.)
 Where in the vegetable and animal kingdoms is *lecethin* found?
 Give its physical properties.

Give its chemical properties.

Give its physiological properties.

Name the bile pigments, and of what do they consist?

Where are they found in health and in disease?

How can bilirubin be obtained?

In what form will it occur?

How distinguished from biliverdin?

From whence comes the coloring matter of bile?

How is biliverdin obtained?

Where is it found chiefly?

Describe it.

Give Gmelin's test. (See experiments.)

Give Ultzmann's test. (See experiments.)

Give the iodine test. (See experiments.)

Which of these tests is the most delicate?

What is *mucin*?

Where is it found?

Give its properties.

Has it a uniform composition?

What is its great importance?

What are bile salts?

What are they, and from what acids?

Are they equally distributed in all animals?

How can the acids themselves be obtained?

What is the color of their crystals?

How does alcohol, chloroform, and water affect them?

How affected when boiled with acids or alkalies?

Give the Pettenkofer test. (See experiments,)

PART VII.

The Digestion.

LESSON XXI.

DIGESTION.

Before food can be distributed throughout the body, what must take place?

To what is the diffusion of food through the intestinal membrane due?

What is the law of the diffusion of gases?

Name some substances which diffuse readily.

Name some which do not.

What names are given to the two classes?

Give some exceptions to both classes.

Do crystalloids diffuse through colloids?

What is the process called?

Will living animal membranes act as well as dead ones?

What condition influences the process of dialysis?

To which class do the ordinary foodstuffs belong?

What must take place before they can enter the system?

How is their molecular composition altered?

In their change is there any potential energy lost, or is the class of proximate principles changed?

SALIVA.

Where is this fluid derived, and what are its properties?

What do we find in saliva with microscope, in health and in disease?

What mineral matter is found in it?

What organic matter?

How can the ferment ptyaline be obtained?

What is the main property of ptyaline?

How does it compare with the diastase or amylase ferments?

In what reaction will it act best?

How do strong acids and alkalies affect it?

What are the uses of saliva?

GASTRIC JUICE.

Food undergoes what change in the mouth?

Can gastric juice be obtained from living animals?

Describe it, giving specific gravity.

What is its reaction—to what due, and in what per cent.?
 What is the composition of the gastric juice?
 How is pepsin prepared from pigs' stomachs?
 Describe it when thus prepared.
 Is it a diffusible substance?
 On which class of foods does pepsin act?
 How do peptones differ from the organic proteids?
 What else forms peptones besides pepsin?
 Into what two classes are peptones and albuminoids divided, and why?
 How many varieties of albuminoids have been distinguished?
 In what are they soluble, and by what precipitated?
 Are they diffusible?
 What do peptones represent?
 In what are they soluble, and by what precipitated?
 Are all the peptones formed in the stomach?
 Where else are they formed?
 Are they found in the blood of the portal vein?
 What do we infer from their absence there?
 Upon what does the action of pepsin depend?
 What acids form syntonin?
 Does pepsin need any acid for itself?
 Will nitric acid answer in digestion?
 How about acetic, lactic, and butyric acids?
 Ought HCl to be used in acid dyspepsia?
 How does NaCl affect digestion?
 How does alcohol?
 What now is the main object in digestion?

CLINICAL TESTS ON THE GASTRIC JUICE.

How do we treat the stomach to obtain gastric juice for examination?
 What six tests do we now apply to the juice?
 What ought the reaction be, and due to what acids?
 How is total acidity determined?
 How are acid salts determined from free acids?
 Why is the test for free HCl an important one?
 What two tests are used for determining presence of HCl?
 Give the phloroglucin test.
 Give the resorcin and sugar tests.
 Are these tests affected by organic acids?
 When is lactic acid present, and how tested?
 How are syntonin, albumoses, and pepsin tested for?
 In what two diseases are these tests of so much value?
 How does acidity vary in cancer and ulcer of stomach?

PANCREATIC JUICE.

Is the pancreatic juice easily obtained? How?
 Describe the juice.

What does it contain ?

What unorganized ferments are found ?

On what does each ferment act ?

How is amylopsin obtained ?

How is its action, as compared with ptyaline ?

On what does trypsin act, forming what ?

How does it differ from pepsin ?

Trace the action of trypsin.

What will it digest which pepsin will not ?

What will pepsin digest which trypsin will not ?

Has steapsin been thoroughly isolated ?

Is its action on fats fully understood ?

How does it affect fats ?

What action has *rennet* ?

What is leucine and tyrosin, and how formed ?

Where are they found ?

Describe the crystals of pure and impure leucine.

What is the composition of leucine ?

Describe the crystals of tyrosin.

In what is it soluble ?

PART VIII.

The Urine.

INTRODUCTION.

In what form do the various foodstuffs enter the system?

They are utilized for the production of what?

They are utilized by what process?

What becomes of most of the carbon and hydrogen atoms?

What becomes of the nitrogen, the sulphates, and phosphates?

What waste products are thrown off by the kidneys?

What other duties do the kidneys perform?

From what is the urine derived, and where?

Describe the uriniferous tubules.

Where do they originate?

Describe the Malpighian bodies.

Is the formation of urine fully understood?

Do any of the cells seem to be secreting in nature?

What is one of their special functions?

How does the epithelial covering of the glomeruli act?

How do the cells of the epithelial covering differ in action from a sheet of parchment paper?

Only what class of bodies pass from the blood into the urine in health?

When cells are impaired what is observed?

COMPOSITION OF URINE.

(Average Composition of Normal Urine.)

	Per Cent.	Grains.	Grammes.
Water.	96.00	50 ounces.	
Solids, as tabulated below.	4.00	1000.0	60.00—70.00
Urea.	2.00	500.0	30.00—40.00
Uric Acid.	0.04	10.0	0.04— 0.03
Chlorides, Sodium and Potassium... ..	1.00	170.0	10.00—13.00
Sulphates, Calcium and Potassium... ..	0.11	40.0	1.50— 2.50
Phosphates, Sodium and Potassium... ..	0.12	45.0	2.50— 3.50
Phosphates, Magnesium and Calcium, ..	0.08	30.0	0.01— 1.30
Etc., etc.			

Name the different solids found in the urine.

What per cent. of urine is water?

What is the per cent. of solids?

Which of the solids exists in the largest quantity?

How does the quantity of urea compare with all the rest?

Name the *alkaline* and the *earthy* phosphates.

NOMENCLATURE.

Polyuria=much urine $\left\{ \begin{array}{l} \text{Physiological} = \text{Urina Potus.} \\ \text{Pathological} \left\{ \begin{array}{l} \text{Hydruria.} \\ \text{Diabetes} \left\{ \begin{array}{l} \text{Diabetes Insipidus.} \\ \text{Diabetes Mellitus.} \end{array} \right. \end{array} \right. \end{array} \right.$

Urina Potus=Increase of water.

Hydruria=Increase of water, with diminished solids.

Diabetes Insipidus=Increase of water, with increase of solids.

Diabetes Mellitus=Increase of water, with *sugar*.

Oliguria=Diminished quantity.

Anuria=Entire suppression.

Dysuria=Painful micturition.

Stranguria=Pain, with Oliguria.

Azoturia=Increase of *urea*.

Anazoturia=Diminished *urea*.

Phosphaturia=Increase of *earthy phosphates*.

Baruria=Great density.

Lithuria=Deposits of *lithic acid (tithates)*.

Albumenuria=Presence of *albumen*.

Mellituria=Presence of *sugar*.

Glycosuria=Mellituria.

Peptonuria=Presence of *peptones*.

Chlyuria=Presence of *fat globules, albumen, cholesterine, etc.*

Uræmia=Solids of urine retained in blood.

LESSON XXII.

GENERAL PROPERTIES OF THE URINE.

On what does the quantity of urine voided in twenty-four hours depend?

Why does the amount differ in winter and in summer?

How does labor affect the amount?

Solids being normal, with increase of water, is called what, and due to what?

How does Hydruria differ from Urina Potus?

How does Diabetes Insipidus differ from Hydruria?

How does Diabetes Mellitus differ from Diabetes Insipidus?

How does Diabetes Insipidus differ from Oliguria?

Give the average twenty-four hour amount in cubic centimeters.

Give it in ounces and in pints.

Name some diseases which influence the amount.

Name some drugs which influence the amount.

Why is it often necessary to determine the exact amount.

What is the average specific gravity of healthy urine?

How does the specific gravity vary?

Give the limits of variation in health.

How can we tell in these variations whether the urine is healthy or not?

How is the specific gravity of Diabetes Mellitus changed, and to what is change due?

How does the presence or absence of urea affect specific gravity?

Of what value is a knowledge of the specific gravity?

What is the instrument called for taking specific gravity?

How can you test a new urinometer?

Is the specific gravity of Urina Potus high or low?

How is it in Diabetes Insipidus, Azoturia, and Oliguria?

How in Anazoturia, Diabetes Mellitus, and Uræmia?

How does it differ in Urina Potus and in Hydruria?

Upon what does the color of urine depend, and how varies?

From what are the pigments of the urine believed to be derived?

Name some diseases which affect color, independent of quantity.

Name some drugs which also affect color.

Thick, viscid, or ropy urine shows what?

How is consistency affected in severe inflammation of bladder?

To what would the disordered consistency then be due?

Foam on standing urine indicates what?

What is the normal reaction of urine, and to what due?

When alkaline, to what due?

After urine has stood for some time at ordinary temperature, what takes place?

Give the name for the best known bacteria.

The decomposition results in the formation of what salt?

What is the odor we notice around ill-kept water closets?

How is the transparency interfered with?

How can the reaction be interfered with by diet and drugs?

How does vegetable food and fruit make the reaction alkaline?

Does fever change the reaction any?

What does ammoniacal urine indicate?

How can we test for ammonia in urine?

TRANSPARENCY.

Is urine ever perfectly transparent?

Name the seven conditions which render the urine turbid.

What is always found in urine to prevent perfect transparency?

How does heat, acids, and alkalies affect mucus?

What two conditions will cause a deposit of *phosphates*?

Will the deposited phosphates be earthy or alkaline?

(Sodium and potassium phosphates are never thrown down.)

Which of the two conditions precipitate the *triple phosphates*?

What is the composition of the triple phosphates?

How do we recognize the phosphates?

What do we call an excess of phosphates?

What conditions bring about a precipitation of *urates* ?
They will be urates of what elements ?
What color do they usually have ?
In what three ways are they recognized ?
Is normal urine on leaving the bladder sterile ?
What change takes place upon standing ?
What will the microscope show it to contain ?
How can these germs be recognized without the aid of the microscope ?
Bacteria with triple phosphates in fresh urine indicates what ?
When does *pus* occur, and how recognized ?
In what condition are pus cells frequently found ?
How are they affected by potassic hydrate or ammonia ?
How are *epithelial cells* identified ?
Under what conditions and with what do *fat globules* occur ?
How are the fat globules recognized ?
This condition of chyluria is due to what ?
In health what will vary the intensity of the *odor* of the urine ?
What are the odors of decomposing urine ?
To what will the putrid smell be due ?
When observed in recent urine, what does it indicate ?
What is the odor of the urine in Diabetes Mellitus ?
Name some drugs which will influence the odor.

GENERAL CHEMICAL PROPERTIES.

The urine is the great channel for what ?
The complexity of the excretion varies with what ?
What per cent. of urine is solid matter ?
How much of the solid matter is organic ?
What is the organic matter composed of ?
Are the urates always present ?
How can an excess of urates be determined ?
Excess of urates indicates what ?
The inorganic constituents consist of what ?
Which of these salts exists in greatest quantity ?
Which are of but slight importance ?
How does sodium chloride react with silver nitrate ?
How are the chlorides affected in severe illness ?
In severe illness a return of the chlorides is regarded as what ?
What is the meaning of "meniscus" ? (See experiments.)
How do you test for urates in excess ? (See experiments.)
Which of the chloride salts is most abundant ?
How do you test for chlorides ? (See experiments.)
How are chlorides below the average known ? (See experiments.)
How are the sulphates tested for ? (See experiments.)
What is the test for the phosphates ? (See experiments.)

LESSON XXIII.

UREA AND URIC ACID.

How does urea and uric acid stand in importance?

They are the end products of what?

Is their excretion important?

In what animals is urea most prominent?

In what animals is uric acid most prominent?

Are they both found in the human urine?

What is the formula for urea?

Is it very abundant in the urine of man and carnivorous animals?

Where is it found in the body?

How much is excreted in twenty-four hours in health?

What will vary the normal amount?

How is the amount affected in fever?

How in kidney disease?

Interference with excretion of urea may bring on what trouble?

Is urea formed in the kidney?

Can urea be prepared synthetically?

How can urea be extracted from urine?

Give physical properties of urea.

How does it taste?

How does water and alcohol affect it?

How does ether and chloroform affect it?

What does urea form with acids?

How are the crystals of the nitrate of urea formed? (See experiments.)

How are the crystals of the oxatate of urea formed? (See experiments.)

How are the crystals of mercuric nitrate formed? (See experiments.)

Is the compound formed by urea and $\text{Hg}(\text{NO}_3)_2$ of any importance?

In most kidney diseases what is the main danger to be guarded against?

Give two reasons why the examination of urea is so infrequently made.

Is it the actual or relative amount that is of interest?

Is a fever patient doing well who only passes thirty grammes of urea a day?

How does specific gravity show variations in urea?

Is specific gravity of any value when glucose or albumen is present?

Is Liebig's method an accurate one?

Upon what does hypobromite method depend?

Whose apparatus is used in testing by hypobromite method?

Which of the two is preferable, and why?

What is urea?

What names are given to increased and diminished urea?

How will specific gravity be affected in anazoturia?

URIC ACID.

Is uric acid always present in human urine?

What animals have it in large quantity?

How can it be prepared?

Describe it when pure.

In what is it soluble, and in what insoluble?
 Salts of uric acid are called what?
 How are the urates precipitated, and how dissolved?
 How does the hypobromite test affect the urates?
 What is the prettiest test for uric acid? (See experiments.)
 For what is this test often used?
 Give the relationship between uric acid and urea.
 The amount of uric acid and urates depend upon what?
 What diseases are indicated by uric acid and urates?

LESSON XXIV.

ALBUMEN IN THE URINE.

Which of the various proteids and albuminoids do we always find in the urine?

Under abnormal conditions what proteids occur?
 Which of these is the most important, and with what mixed?
 Is the temporary occurrence of serum albumen an indication of disease?
 Are the words "albuminuria" and "peptonuria" names for diseases?
 Are the kidneys always the source of the albuminuria?
 How can we tell whether it comes from the kidneys or not?
 Is urea increased or diminished in Bright's disease, and why?
 Will the specific gravity be high or low?
 Name some of the standard tests for albumen?
 Which one of these tests is the most satisfactory?
 Describe *Heller's*, or the *nitric acid test*. (See experiments.)
 If the urine is concentrated what may happen?
 How will the ring of the acid urates, or of uric acid, differ from the albumen ring?

What else besides albumen and the urates may form a ring?
 How is this ring tested?
 Is this test ever used for approximate quantitative estimation?
 Give the *picric acid test*. (See experiments.)
 Is the picric acid test a good one?
 What quantitative test is based upon the picric acid test?
 Describe the test with the "albumenometer."
 Are the results with the albumenometer definite or approximate?
 What other proteid has been observed in the urine of late years?
 Occurring in what diseases, and under what conditions?
 How can the presence of peptones be determined?
 Give the *acetic acid* and *heat test*. (See experiments.)
 Give the *ferrocyanide test*. (See experiments.)
 What precaution must be observed in these tests? (See experiments.)

LESSON XXV.

GLUCOSE IN URINE.

What representatives of the carbohydrates does the urine sometimes have?

- What carbohydrate is of specific interest to us ?
Is dextrose found in normal urine ?
Does it ever occur in increased quantity in health ?
Under what condition and what name is given to it ?
When persistently present what is it called ?
How is the amount of urine affected in Diabetes Mellitus ?
How is the color and specific gravity affected ?
How is the amount of urea affected ?
Give *Moore's* test for glucose. (See experiments.)
Is Moore's test a satisfactory one, and why ?
Give *Nylander's* test for glucose. (See experiments.)
Is this a satisfactory test, and why ?
Give the *picric acid* and *potash* test. (See experiments.)
What special value has this test ?
Give *Trommer's* test. (See experiments.)
Give *Fehling's* test. (See experiments.)
Are Trommer's and Fehling's tests very satisfactory ?
What products sometimes come up to interfere ?
What test is of importance where other tests give dubious results ?
Give the *phenyl-hydrogen* test. (See experiments.)
What special value has this test ?
What interesting substance has Dr. Marshall isolated ?
Is it of any importance ?
How distinguished from glucose ?
What quantitative test is the most satisfactory ?
Give Fehling's quantitative test. (See experiments.)
Must concentrated urine be used, and why ?
Is it ever impossible to make the test satisfactory ?
What other test is used largely by practitioners ?
Give the *fermentation* test. (See experiments.)
Is this a very delicate or accurate test ?
Give some of the objections to it.

PART IX.

Microscopical Examination
of the Urine.

INTRODUCTION.

How do the chemical tests of the urine compare with the microscopical tests?

How is the sediment for examination to be obtained?

What power should be used in microscopic examination?

LESSON XXVI.

SEDIMENTS IN ACID URINE.

What is the reaction of normal urine?

When does the reaction change?

Give the deposits occurring in acid urine.

How does uric acid sediment appear to the unaided eye?

How under the microscope?

What colors do the crystals have with and without mineral acids?

How do alkalies affect them?

Give the murexide test for uric acid. (See page 254.)

When are uric acid crystals in urine, dangerous, and why?

Are the urates always deposited in the urine?

Where is an excess of these salts found?

Has the brickdust sediment in chilled urine any clinical significance?

How can the urates be recognized chemically?

Are urate sediments amorphous or crystalline?

How does their color range?

The sediments are principally composed of what urate?

Is the urate of sodium ever crystalline?

Where does the urate of ammonium form, and how appear?

Does oxalate of calcium occur in normal or pathological urine?

What diet will cause them to be formed?

When and how does this sediment become dangerous?

In what two forms do the crystals occur?

Are they smaller or larger than uric acid crystals?

How does change in reaction of urine affect them?

Are hippuric acid crystals often found in human urine?

What diet will produce them?

Have they any clinical significance?
 Describe the crystals, and how distinguished from uric acid crystals?
 Describe crystals of calcium sulphate.
 Are they of any importance?

LESSON XXVII.

SEDIMENTS IN ALKALINE URINE.

What changes take place in urine after standing?
 How is ammonium carbonate formed? (See page 240.)
 What characterizes the newly formed deposits?
 Of what is the sediment mostly composed?
 Give the crystalline deposits in alkaline urine.
 What crystals occur under pathological conditions?
 What is meant by triple phosphates?
 Give the formula for triple phosphates.
 Where does it regularly occur?
 When may it be considered as an abnormal product?
 What two classes of crystals are formed?
 Do we often find the feathery shaped crystals?
 How do the "coffin-lid" crystals vary?
 With such variations, how can we distinguish them?
 What do we often find mixed with the triple phosphates?
 Describe the ammonium urates, and how distinguished?
 Is the calcium phosphate deposit amorphous or crystalline?
 Describe the crystals.
 Under what reaction are they found?
 Are they of any clinical importance?
 Is calcium carbonate often found?
 Describe the deposit.
 How does it act when treated with acetic acid?
 Are they of any clinical importance?
 What else do we find in the alkaline fermentation of urine?
 When does leucine and tyrosin occur in urine?
 With what are they usually accompanied?
 What is Gmelin's test for bile pigment? (See pages 205, 209.)
 How can the crystals of leucine and tyrosin be deposited?
 Describe the crystals.
 Is cystine often found in urine?
 It is the result of what?
 Describe the crystals.
 How does it differ from the other compounds of the body?
 In what is it soluble, and in what insoluble?

LESSON XXVIII.

CASTS.

Of what value is the study of casts in the urine?
 Is there any albuminous matter in normal urine?

How are casts formed and thrown off?
Describe their general appearance.
Is a dark or light field of microscope preferable when examining?
What will the casts look like?
What is meant by "hyaline" casts?
What has been claimed of some varieties of hyaline casts?
In disorders of kidney what happens?
What do we then find adhering to casts?
What do we call such casts?
What casts do we find resulting from inflammation?
What do we find adhering to granular casts?
What name is given to such casts?
More rarely we find what casts?
Are these different casts all distinct?
How then do we designate them?
Name now the different varieties of casts.
Which of these varieties are the least alarming?
Name the others, in the order of their importance.
How do the blood and pus casts help in differential diagnosis?
Do casts settle fast in the urine?
What usual preparation is made for examining for casts?
Ought more than one slide to be examined?

LESSON XXIX.

BLOOD, PUS, AND EPITHELIAL CELLS.

How do blood cells appear under the microscope?
After blood stands in urine what takes place?
When granular, what may they be mistaken for?
How may we distinguish between them?
Which test is the most delicate?
Which is preferable, and why?
Give the hæmatin test. (See page 208.)
How can we tell whether blood is from kidney or not?
How may pus cells be described?
How are they distinguished from blood cells?
How does acetic acid affect them?
How does KOH affect them?
Pus cells occur from what cause?
When coming from kidney, what do they indicate?
With what will they be associated?
When coming from bladder, what will be the condition of the urine?
Pus in urine of females may be from what source?
How does pus in male urine help in diagnosis of urethritis?
How else is it of importance in chronic inflammation of the urethra?
How does the first urine that passes in chronic inflammation appear?
What germ may be found?

Where are epithelial cells found ?

How may they be described ?

Is it possible from their appearance to tell from what part of tract they come ?

For practical purposes how is it best to divide them ?

To what are the round cells similar ?

How are they distinguished from pus cells ?

From whence may these cells come ?

With what associated when from uriniferous tubules ?

From whence may the columnar cells come ?

Describe squamous cells.

From whence may they come ?

How do those of vagina differ from those of bladder ?

What is the condition of these cells as seen in urine ?

From whence and when may interesting specimens containing these cells be obtained ?

What is the discharge known as lochia ?

LESSON XXX.

SPERMATOOZA, MICROBES, FOREIGN BODIES.

When are spermatozoa found in the urine ?

Describe them.

Does it take a high or low power to see them ?

What class of microbes do we find in decomposing urine ?

Which of the three is the least common ?

When are they found ?

What part of the plant develops in the urine ?

How is it recognized ?

When are yeast fungi found ?

In what urine do they develop most rapidly ?

Describe them.

When are bacteria found ?

Does it require a high power to see them ?

What bacteria is of the most importance ?

Are these germs pathogenic or non-pathogenic ?

Are they ever found in cystitis ?

Have disease germs ever been found in fresh urine ?

In what disease have they been found ?

What foreign bodies will mislead those beginning with the microscope ?

For what will small air bubbles be mistaken ?

How are they distinguished ?

For what are threads and fibers often mistaken ?

How is a thread or fiber distinguished ?

What fibers are most often met with ?

How are they distinguished ?

Epitome of Urinalysis, with Clinical Hints.

(Use early-morning urine, if not the twenty-four-hour urine.)

AMOUNT: 1,200 to 1,500 c.c., or 40 to 50 fluid oz., or 2 1-2 to 3 pints.

Clinical Significance	{	Increase	{ Urina Potus. Hydruria. Diabetes. Cardiac Hypertrophy. [pressure. All conditions causing increased blood
		Decrease	{ Albuminuria Acute Fever Inflammatory process } up to crasis.

SPECIFIC GRAVITY: 1.015 to 1.025. *Varies inversely with quantity.*

Clinical Significance	{	Increase	{ Diabetes Mellitus. Azoturia. [solids. Acute Fever, first stage, from increase of Bright's Disease, from blood pressure.
		Decrease	{ Bright's Disease. Urina Potus. Hydruria. Anazoturia.

COLOR: *Bright amber, or lemon yellow, or pale yellow.*

1. *Almost Colorless*, in diabetes, hydruria, urina potus.

2. *Normal*.

3. *Highly Colored*, from concentration or presence of uroerythrine.

Test for Uroerythrine: To about three drams of urine add two drops of the acetate of lead, and if present a rosy, pink precipitate will fall.

4. *Blood Red*, or *Garnet*, to uroerythrine, or blood.

5. *Dark Brown*, to blood, or billiary coloring matter.

Genelins' Test for Bile Pigment: Put some yellow HNO_3 in test tube, and add urine gently, and at junction will rise bands of green, blue, red, and yellow.

6. *Green Urine*, in jaundice, from billiverdine.

7. *Dirty Blue*, in cholera and typhus fever.

CONSISTENCY: *A thin, easily dropping fluid, flowing like water.*

Sometimes viscid, ropy, and turbid, due to pus in an alkaline urine.

Foam on standing urine indicates sugar or albumen.

REACTION: *Slightly acid, due to acid sodium phosphate, NaH_2PO_4 .*

Alkalinity may be due to the phosphates or carbonates of sodium and potassium (fixed alkalies), or to ammonium carbonate (volatile alkali).

Clinical Significance { *Volatile Alkali* indicates inflammation of some part of genito-urinary tract.
Fixed Alkali, in indigestion, constipation, deranged liver, poor respiration, with retained CO_2 and other enfeebled conditions of body.

TRANSPARENCY: *Clear and transparent, excepting mucus.*

1. *Mucus* { (1) Unchanged by heat, acids, or alkalies.
 (2) Appearance.
 (3) Microscope.
2. *Earthy and Triple Phosphates* { (1) In alkaline urine.
 (2) Acids dissolve.
3. *Urates* { (1) In acid urine.
 (2) Heat dissolves.
 (3) Alkalies dissolve.

Excess of urates is shown by cooling rapidly in ice or under stream of cold water.

4. *Microbes* { (1) Decomposing urine.
 (2) Can't be filtered clear.
 (3) Unaffected by heat, acids, or alkalies.
 (4) Microscope.
5. *Pus* { (1) Creamy, white deposit or cloud when abundant, or as white strings or threads.
 (2) Alkalies give ropy deposit.
 (3) Microscope.
 (4) Few drops of Tr. Guaiac added to cause turbidity. Then warm, and if blue color is formed indicates pus.
6. *Epithelial Cells and Debris*, shown only by microscope.
7. *Fat Globules* { Appearance.
 Microscope.
8. *Turbidity to Drugs*, cleared up by alcohol.

Clinical Significance { *Phosphates* { Food with excess of phosphates.
 Disease of bone.
 Disease of nerve centers.
 After great mental strain.
 Indigestion.
Urates { Gout.
 Rheumatism.
Microbes, Disease of genito-urinary tract.
Pus.
Fat Globules, disease in glomerulii.

ODOR: "*Aromatic*," "*characteristic*."

Clinical Significance { *Sweetest* in diabetes mellitus.
Ammoniacal, due to inflammation of tract.
Putrid, due to decomposition.
Violet, due to turpentine.
"Repulsive", due to asparagus, or cauliflower diet.

CHLORIDES: *Mostly sodium chloride.*

Test.—Acidify half a test tube of urine with HNO_3 . Filter off any precipitate that may occur, and then add to the filtrate half an inch of AgNO_3 . In normal urine the resulting precipitate of AgCl is quite heavy—

either curdy or lumpy. If the mixture only becomes milky the chlorides are below the average.

Clinical Significance { Diminished in severe illness. Cessation in pneumonia very serious. First sign of convalescence is a return of the chloride.

UREA : $(\text{NH}_2)_2\text{CO}$. 20 to 35 grains in twenty-four hours.

Test with Doremus Apparatus.—Fill the urinometer up to the mark = with sodium hydrate solution, and then add 1c.c. of bromine. Thoroughly mix, and then add water until long arm and bend of urinometer is full. Now draw up, by means of the pipette, 1c.c. of the urine to be tested, and pass the pipette into the urinometer as far as the bend, and slowly compress the bulb on the end of pipette, thereby causing the urine to ascend in the hypobromite solution. Carbonic acid and nitrogen gas are disengaged according to the following equation :

The CO_2 , however, is absorbed by the hydrate of sodium.

Each division mark on the urinometer indicates 0.001 grammes of urea in 1c.c. of urine, or if graduated in grains each division mark indicates one grain in one fluid ounce of urine, from which the urea of twenty-four-hour urine can be calculated.

Clinical Significance { Increase { Nitrogenous diet.
Diabetes.
Acute febrile process up to crisis arising from increased disintegration of nitrogenous elements.
Decrease { Vegetable diet.
Fasting.
Bright's Disease.
Liver trouble.

URIC ACID : *Test.*—(1) Microscope.

(2) Formation of urates.

(3) Murexide, when analyzing for calculi.

Amount is abnormal when found in fresh urine by microscope, showing tendency to stone or gravel ; and if crystals are formed in kidneys chronic nephritis may result.

Amount abnormal, when sufficient to form urates in fresh urine, showing gouty or rheumatic diathesis.

ALBUMEN : (Filter if not clear.)

Heller's or Nitric Acid Test.—Put in test tube half an inch of HNO_3 , dil., and to this, down the side of the tube, run the urine very gently. A precipitate at the juncture of the two liquids is due to either—

Clinical Significance { Albumen { A white zone.
Undissolved by heat.
Urates { Red zone.
Occurs just above juncture.
Heat dissolves.
Drugs { White zone.
Alcohol dissolves.

Diluting the urine will prevent the precipitation of urates. A brown ring of coloring matter sometimes forms in normal or concentrated urine.

Picric Acid Test.—Put half an inch of picric acid solution in small test tube, and to this, down the side of tube, add the urine very gently. A white or yellowish ring at juncture of liquids, which precipitates on mixing, shows *albumen*.

Esbach's Test.—Fill the albumenometer up to the mark U with urine. Then fill to R with the test solution. Mix *gently*, close with rubber cork, and leave for twelve or eighteen hours. The lines graduated on each albumenometer represent the number of grammes in 1000 c.c. of the urine under examination.

Precautions: (1) See that the urine to be examined is distinctly acid. (2) If much albumen is present, dilute with one or two volumes of water, and make corrections in final calculation.

Acetic Acid and Heat Test.—Fill a test tube nearly full of urine. If urine is alkaline add two or three drops of acetic acid until just acid to test paper. (If already acid do not add anything.) Boil the top part of the urine, and examine it carefully against a dark background. If the liquid, after heating, looks at all turbid, let it cool a minute or two, and then add a drop or two of HNO_3 dil. If turbidity remains or is increased, shows albumen.

Ferro-cyanide Test.—Fill a test tube half full of urine, and to this add half an inch of $\text{HC}_2\text{H}_3\text{O}_2$ conc. and a few drops of K_4FeCy_6 . If albumen is present a white flocculent precipitate will be observed.

Or, put in a tube half an inch of $\text{HC H}_3\text{O}_2$, with a fourth as much K_4FeCy_6 . To this, down the side, add very gently with a pipette the urine. If albumen is present a white zone will form at the junction of the liquids.

Clinical Significance	{	(1) From inordinate use of egg albumen.
		(2) When blood pressure in kidney is greater than normal comes in disturbed circulation, as heart disease, impaired venous circulation.
		(3) Bright's Disease, or where membranes of kidney are diseased.
		(4) False albumen, where pus, blood, or any albuminous fluid gets in the urine.
		(5) Hydræmia, or changed condition of blood.
		(6) Functional disorders.

GLUCOSE: Urine is pale, abundant, and has sweetish odor.

Reaction is always acid, but undergoes putrid (alkaline) decomposition in short time.

In testing, always remove albumen by boiling.

Moore's Test.—Put some urine in a test tube, and add one-third as much KOH. Boil the upper layer of the solution, and if sugar is present the urine will change to *brown color*. Also notice the smell of caramel. The color disappears on the addition of HNO_3 conc.

Nylander's Test.—To the boiling urine in a test tube add half an inch of Nylander's solution. Boil for two or three minutes more, and let it stand. A black precipitate will quickly form if much sugar is present, more slowly if it is dilute.

Picric Acid Test.—Add to the urine in a test tube a few drops of picric acid and half an inch of KOH, and boil. If sugar is present the color will change to a very dark brown or black.

Trommer's Test.—To the urine in a test tube add about one-fourth its volume of KOH. Then add CuSO_4 , drop by drop, shaking constantly until the urine has a turbid, greenish hue. Boil, and if sugar is present a red or yellow precipitate at once forms.

Fehling's Test.—Add a few drops of Fehling's solution to a little water in a test tube, and boil. To the boiling liquid add a drop or two of the urine, and keep it boiling. If sugar is present a red, and then a yellow, precipitate will form.

Phenyl Hydrazin Test.—Measure out on the tip of a penknife blade two parts of phenyl hydrazin and three parts of acetate of soda, and put them in a small test tube. Fill the tube two-thirds full of the urine to be examined. Dissolve the salts by warming very gently and by agitation, and then stand the test tube in boiling water in a water bath for twenty or thirty minutes. After this take it out, and put it into a beaker of cold water. Notice, as it cools, the formation of a yellow crystalline precipitate of phenyl glucosazan if sugar is present. The crystals are yellow, needle-shaped, and in radiating groups.

Roberts' Density or Fermentation Test.—Take specific gravity of about four ounces of urine. Then put in it half a cake of *Fleischman's yeast*, and leave in warm place for twenty-four hours. Take the specific gravity again, and every "degree" in specific gravity lost in fermentation corresponds to one grain of sugar per fluid ounce of urine.

Einhorn's Saccharometer Test.—Take one gramme of *Fleischman's yeast* (1-16 of cake), shake it thoroughly in the graduated test tube, with 100 c.c. of the urine. Then pour the mixture into the long arm of the saccharometer, and let it stand for twenty-four hours in warm room. If sugar is present alcoholic fermentation begins in few minutes. The evolved carbonic acid gas gathers at the top of the cylinder, forcing the fluid back into the bulb. The graduation on the saccharometer shows per cent. of sugar, or number of grains in fluid ounce of urine.

Fehling's Quantitative Test.—Take with a pipette 100 c.c. Fehling's solution, and put in beaker half full of water and boil. While heating, dilute the urine to be examined ten times with water, and fill the burette up to the 0 mark. While the Fehling solution is boiling add to it, drop by drop, the diluted urine in burette. Continue to add the urine until the blue color has disappeared from the mixture. The end of the reaction will be shown not only by the absence of this blue color, but also by the color of the precipitate changing from purple or dark red to a bright vermilion. The percentage of sugar will be equivalent to 50 divided by the number of c.c. of diluted urine used.

Or, Fehling's solution is so made that 50 c.c. of the CuSO_4 is exactly decomposed by 0.05 gramme of sugar, from which the number of grammes of sugar can be calculated.

CLASSIFICATION OF MICROSCOPIC SEDIMENT.

UNORGANIZED ACID SEDIMENT.

1. *Uric Acid* (crystalline).
2. *Urates*. { Sodium (amorphous and crystalline).
Potassium (amorphous).
Calcium (amorphous).
Ammonium (crystalline).
3. *Calcium Oxalate* (crystalline).
4. *Hippuric Acid* (crystalline).
5. *Calcium Sulphate* (crystalline).

UNORGANIZED ALKALINE SEDIMENT.

1. *Triple Phosphates* (crystalline).
2. *Ammonium Urates* (crystalline).
3. *Calcium Phosphate* (crystalline and amorphous).
4. *Calcium Carbonate* (crystalline).

ORGANIZED SEDIMENT.

1. *Mucus* (forming "nubecula").
2. *Casts*. { Hyaline,
Waxy,
Granular,
Hyaline and { granular,
epithelial,
blood,
pus.
Granular and { epithelial,
blood,
pus.
3. *Blood*.
4. *Pus*.
5. *Epithelial Cells*. { Round,
Columnar,
Squamous.
6. *Spermatozoa*.
7. *Microbes*. { Mould,
Yeast plant,
Bacteria.
8. *Foreign Bodies*. { Air bubbles,
Threads,
Fibers,
Scratches on slide.

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