The urine, in health and disease, or, A simple explanation of the physical properties, composition, and uses of the urine, of the functions of the kidneys, and of the treatment of urinary disorders / by Arthur Hill Hassall.

THE URINE,

IN HEALTH AND DISEASE.

THE URINE,

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OR,

A Simple Explanation

OF

THE PHYSICAL PROPERTIES, COMPOSITION, AND USES OF THE URINE,

OF

THE FUNCTIONS OF THE KIDNEYS,

AND OF

THE TREATMENT OF URINARY DISORDERS.

WITH ENGRAVINGS.

BY

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MDCCCLIX.

PREFACE.

THE object of this little work is, to afford an explanation, as simple as possible, free from all unnecessary detail and complication, of the physical properties, composition, and uses of the urine; of the functions of the kidneys; and, more especially, of the principles of treatment of the chief urinary disorders.

By its means, it is hoped that the student and practitioner will be enabled, with little application or chemical knowledge, to become acquainted with the chief facts, scientific and practical, connected with the urine. This result is one of some importance; for it is certain that the great majority of medical men neglect to acquaint themselves with this class of diseases—being frequently deterred by the elaborate

manner in which the subject is treated, and, especially, by the extent of the chemical inquiries and reasonings intermixed with it.

Larger and more elaborate works are, undoubtedly, of great value, but are less suited for the student or general practitioner, who merely desires to acquaint himself with the chief facts connected with the subject.

74, Wimpole Street,
Cavendish Square.
November 22nd, 1858.

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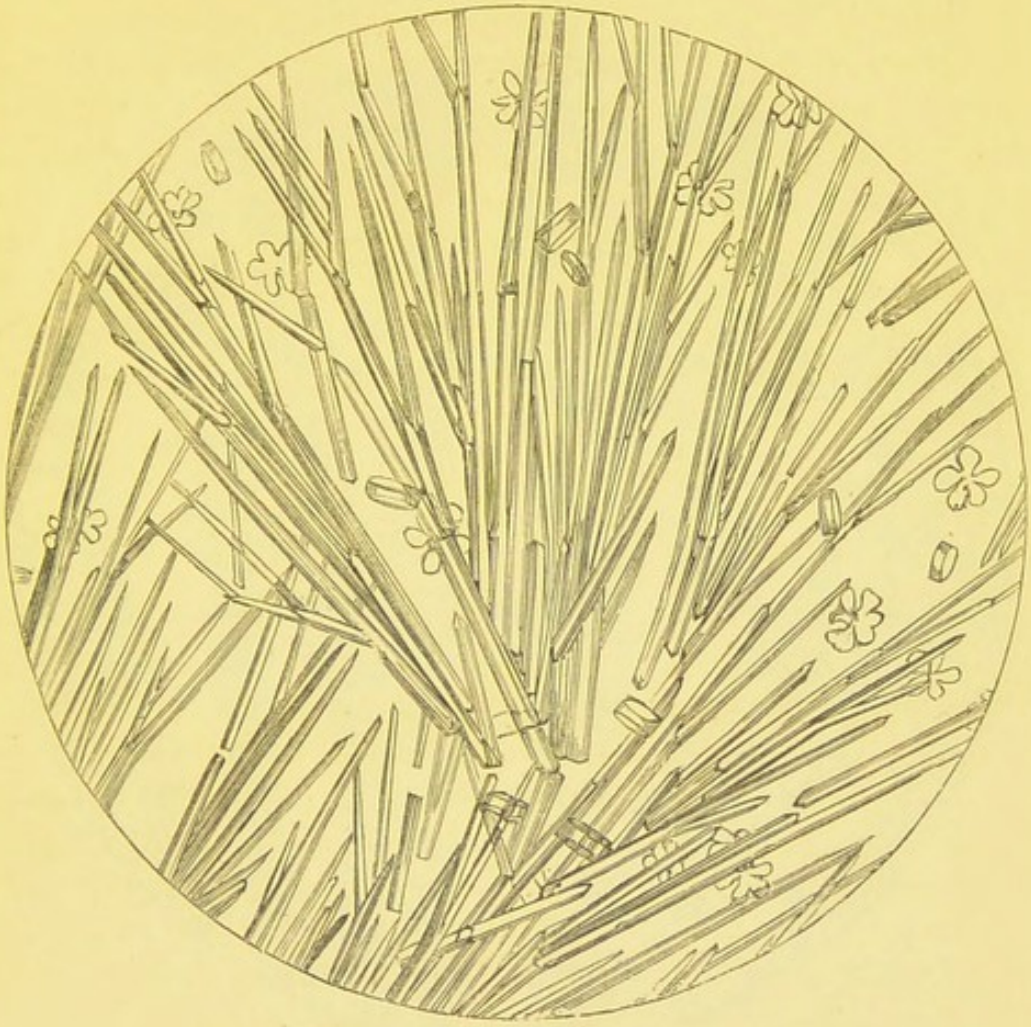

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UREA, from drop of *Human Urine* evaporated on a glass slide.
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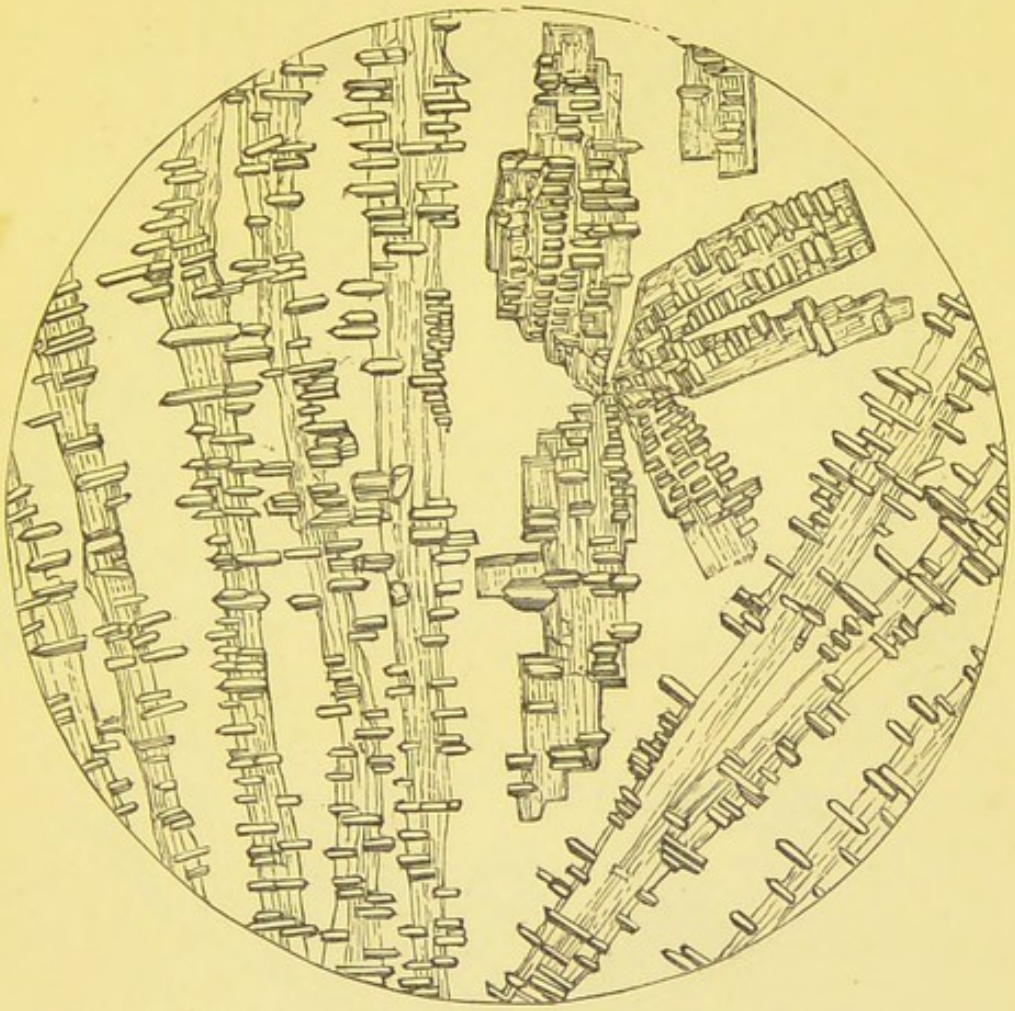

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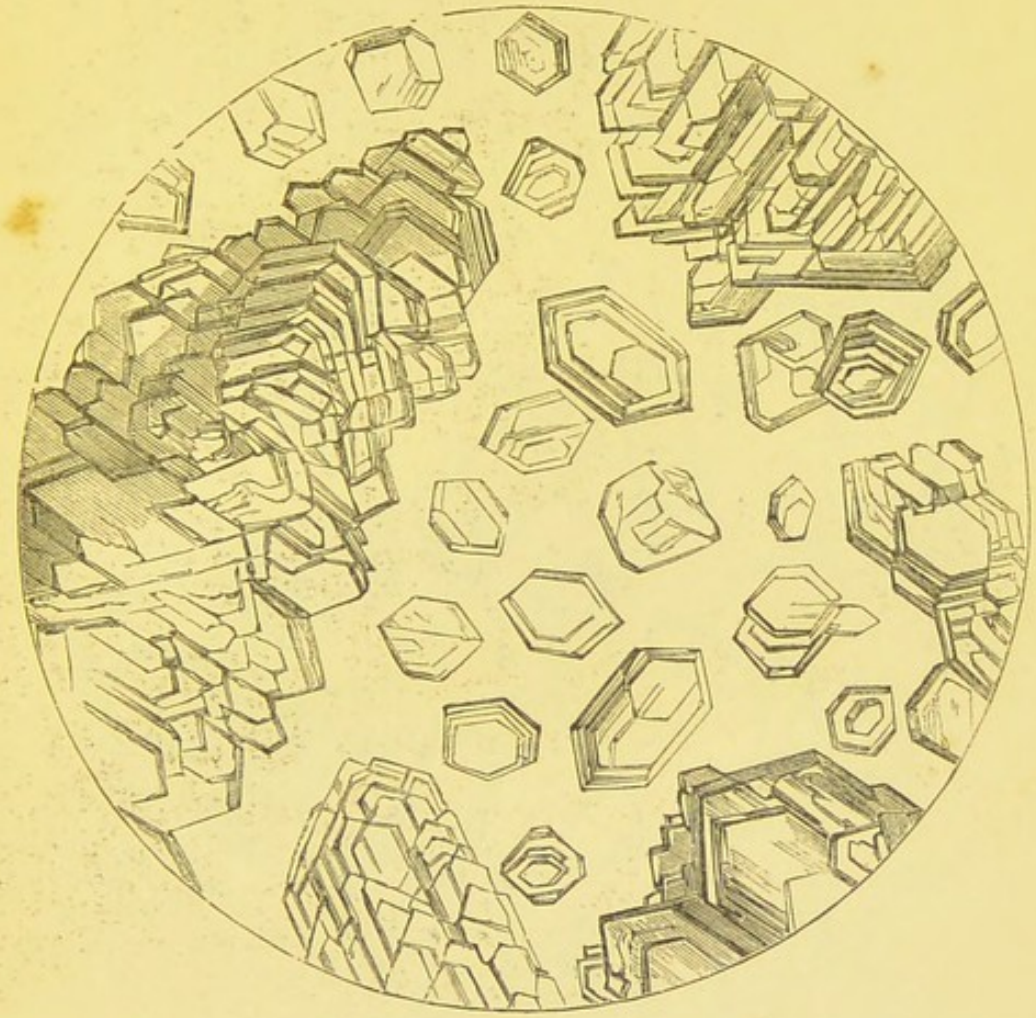

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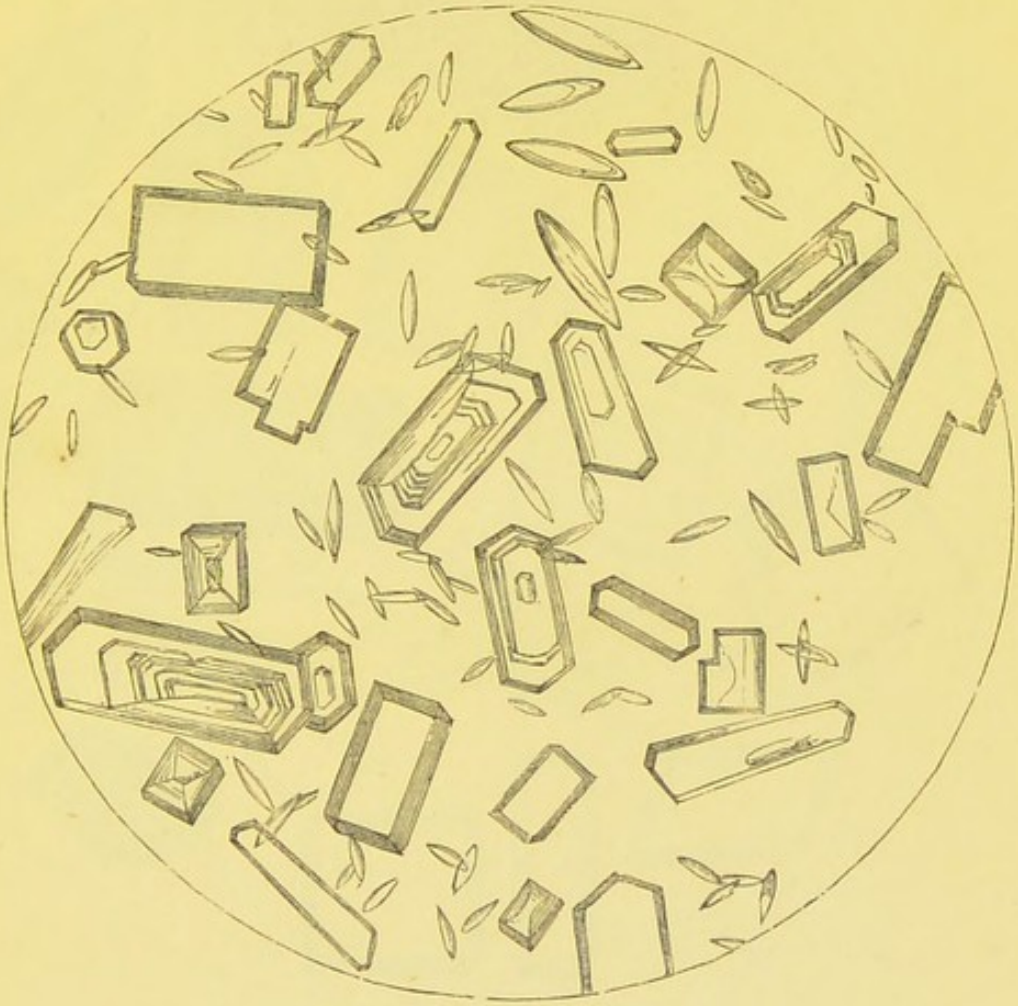

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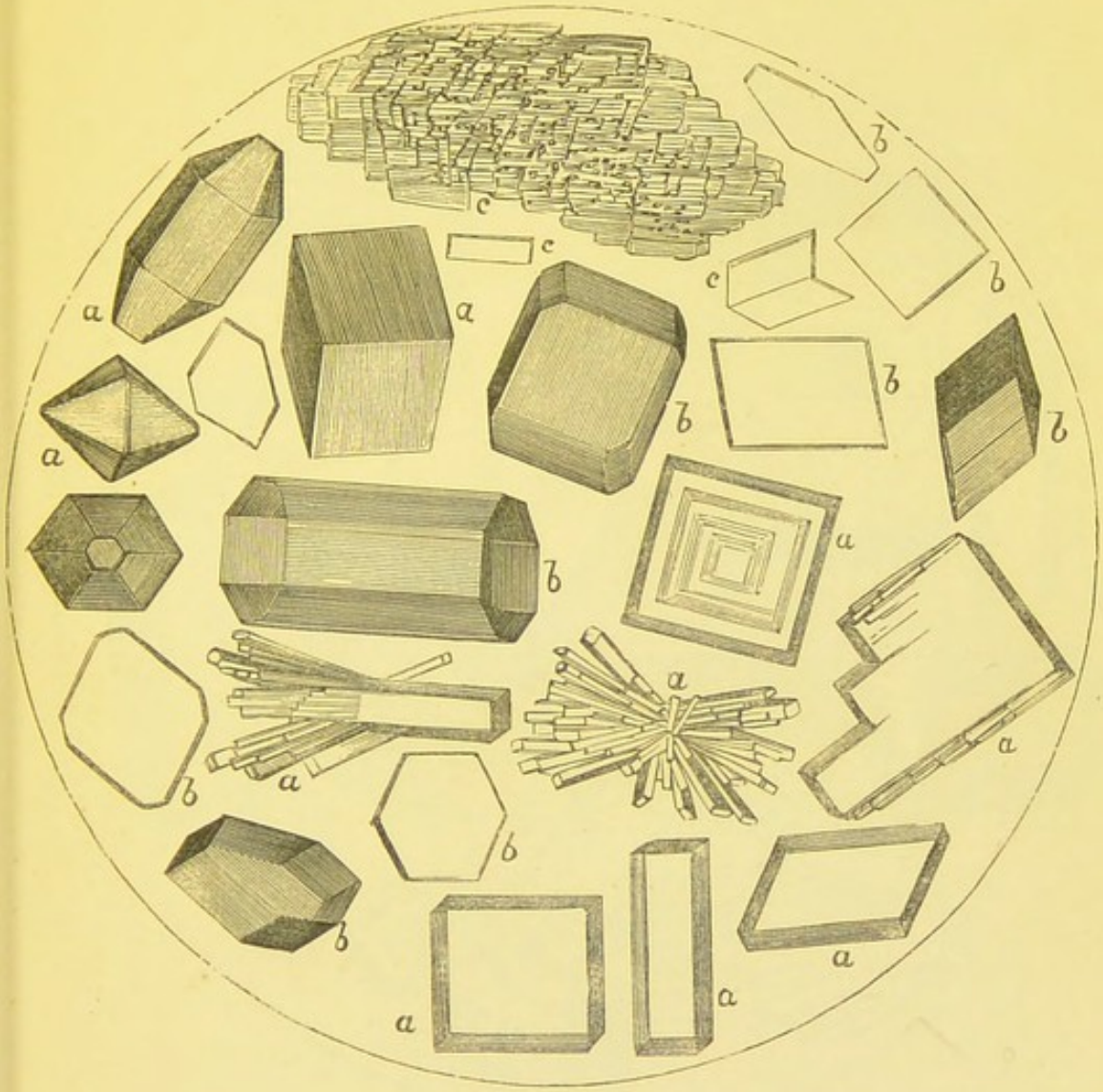

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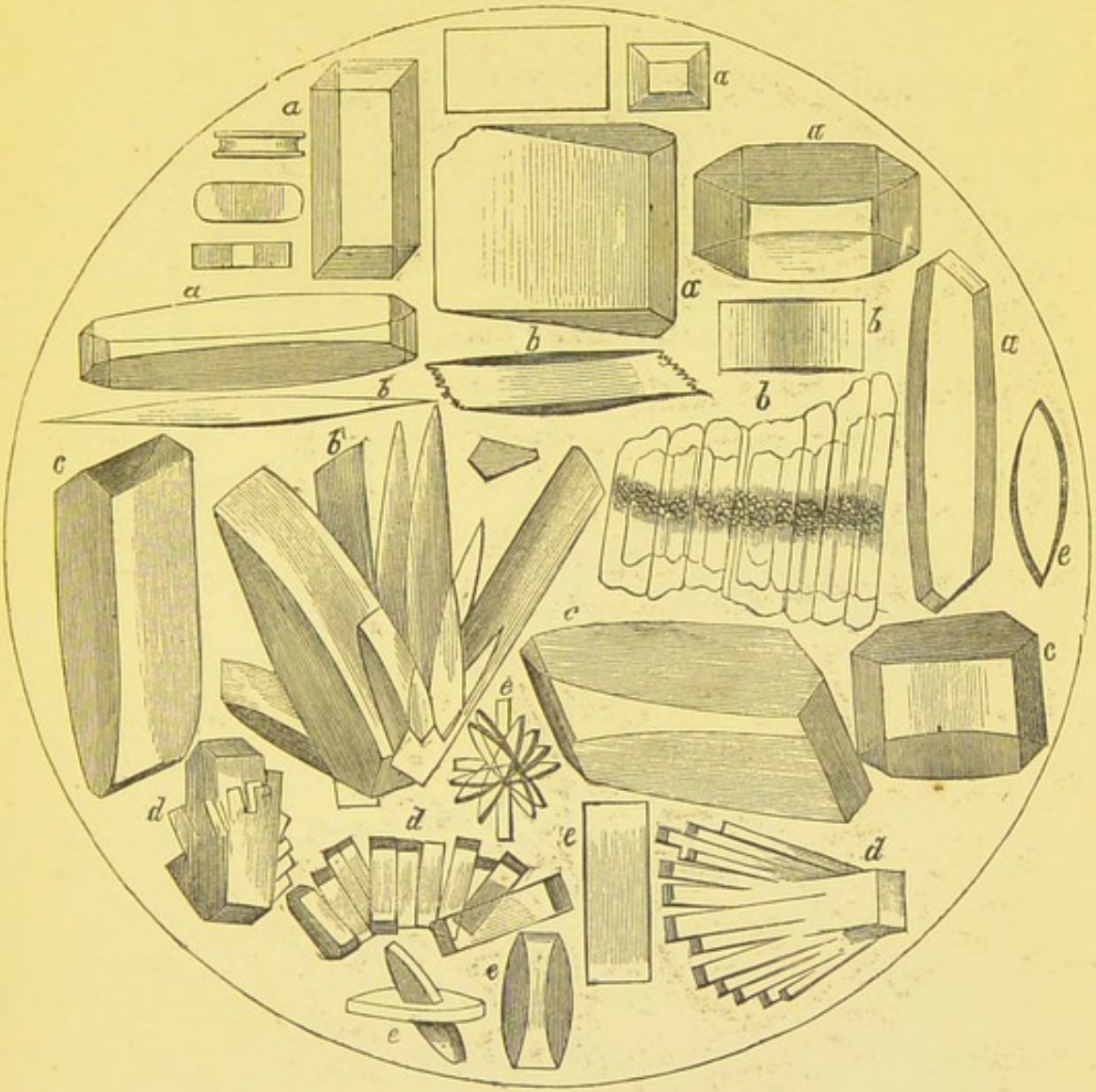

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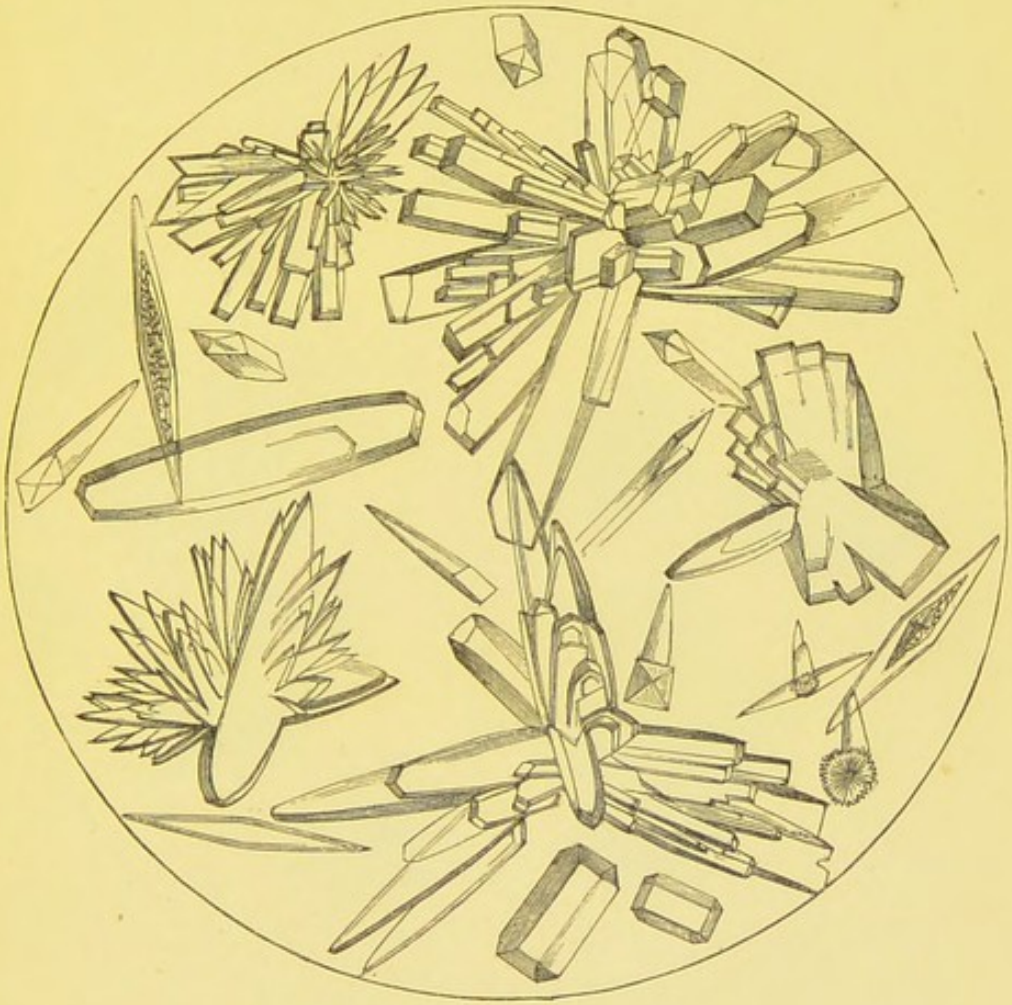

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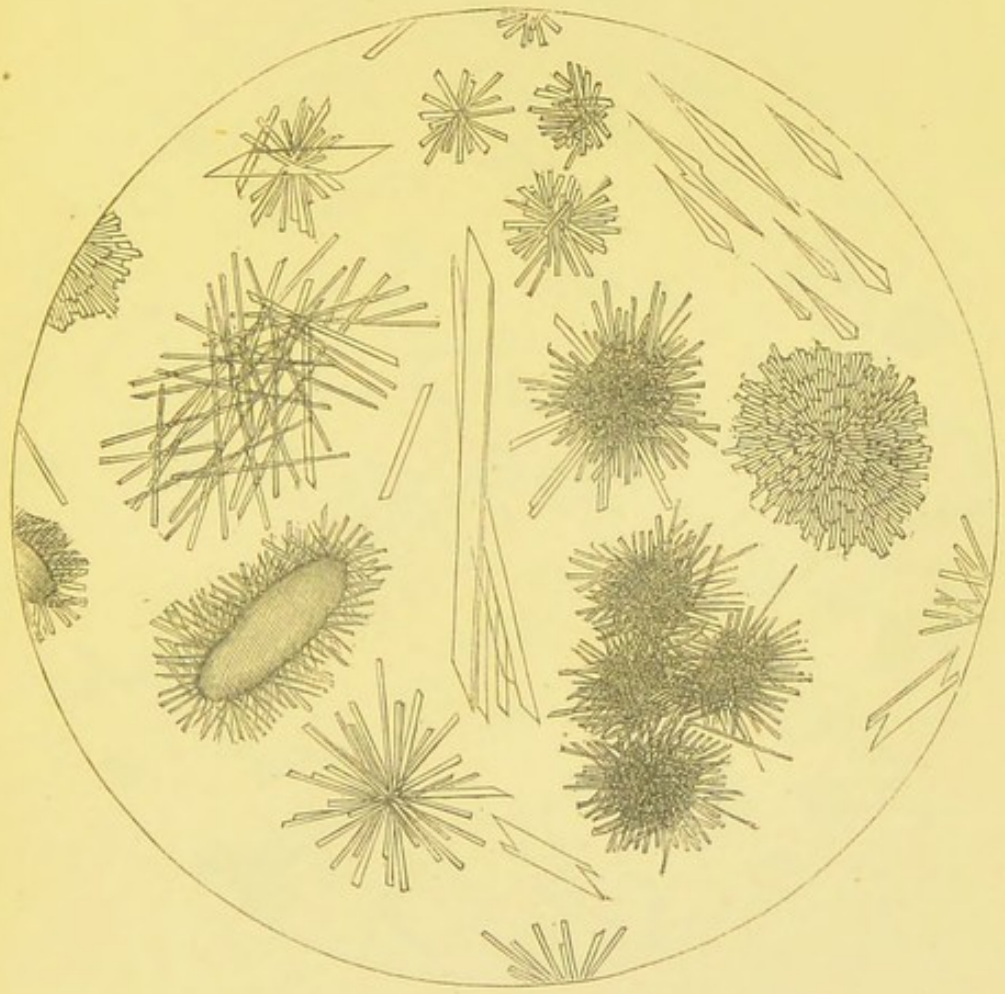

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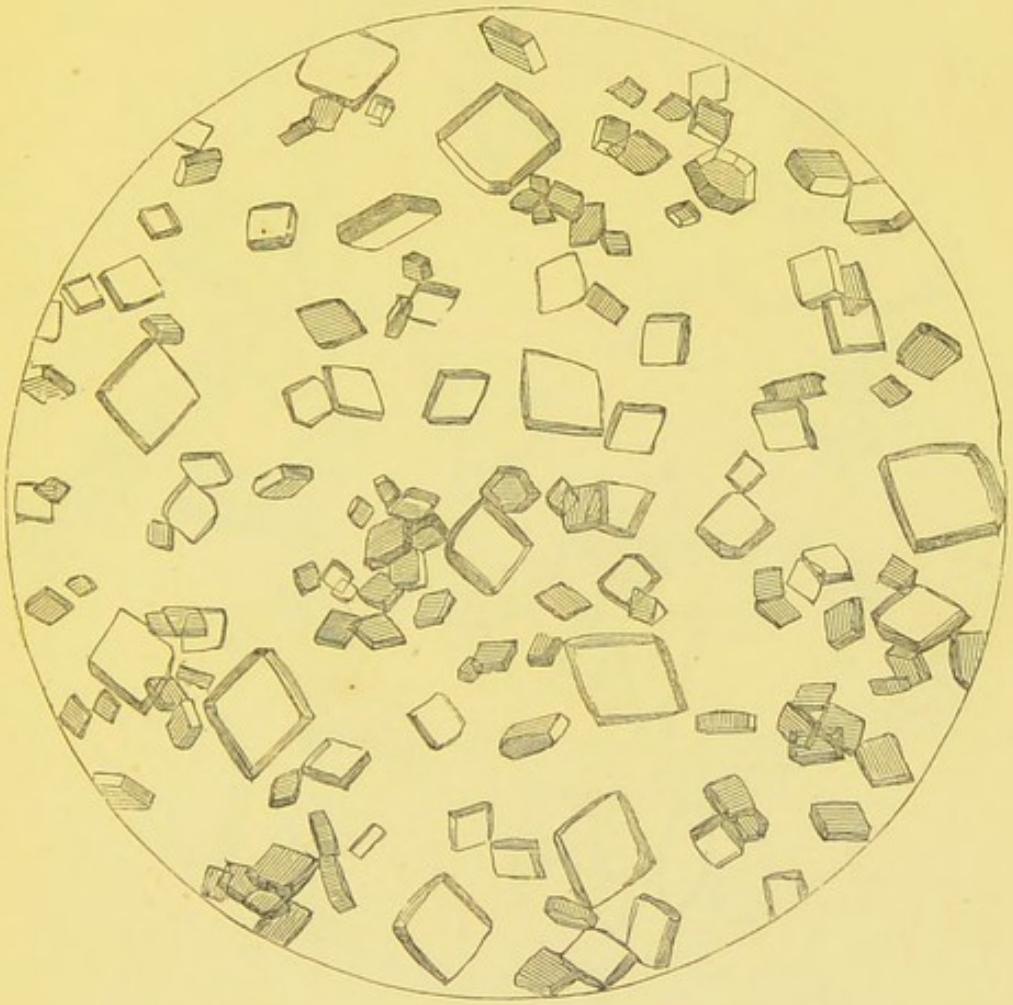

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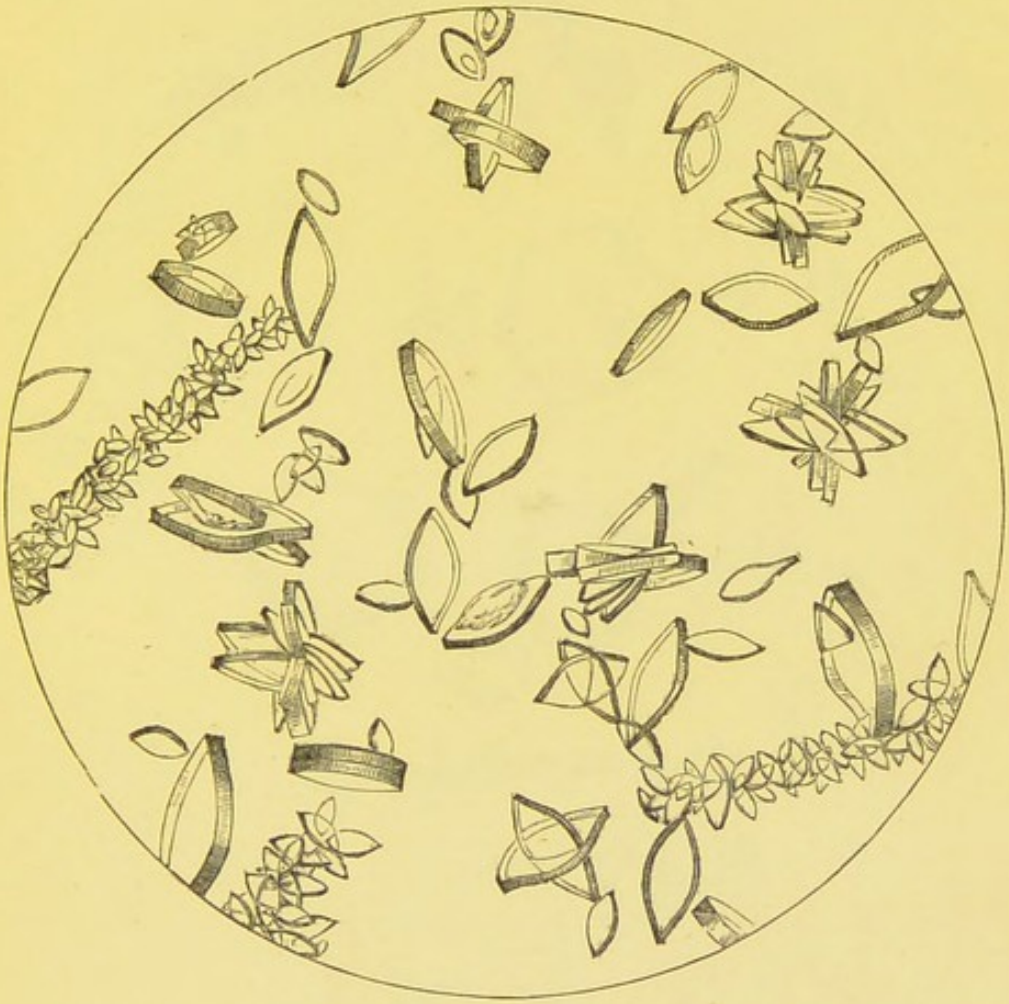

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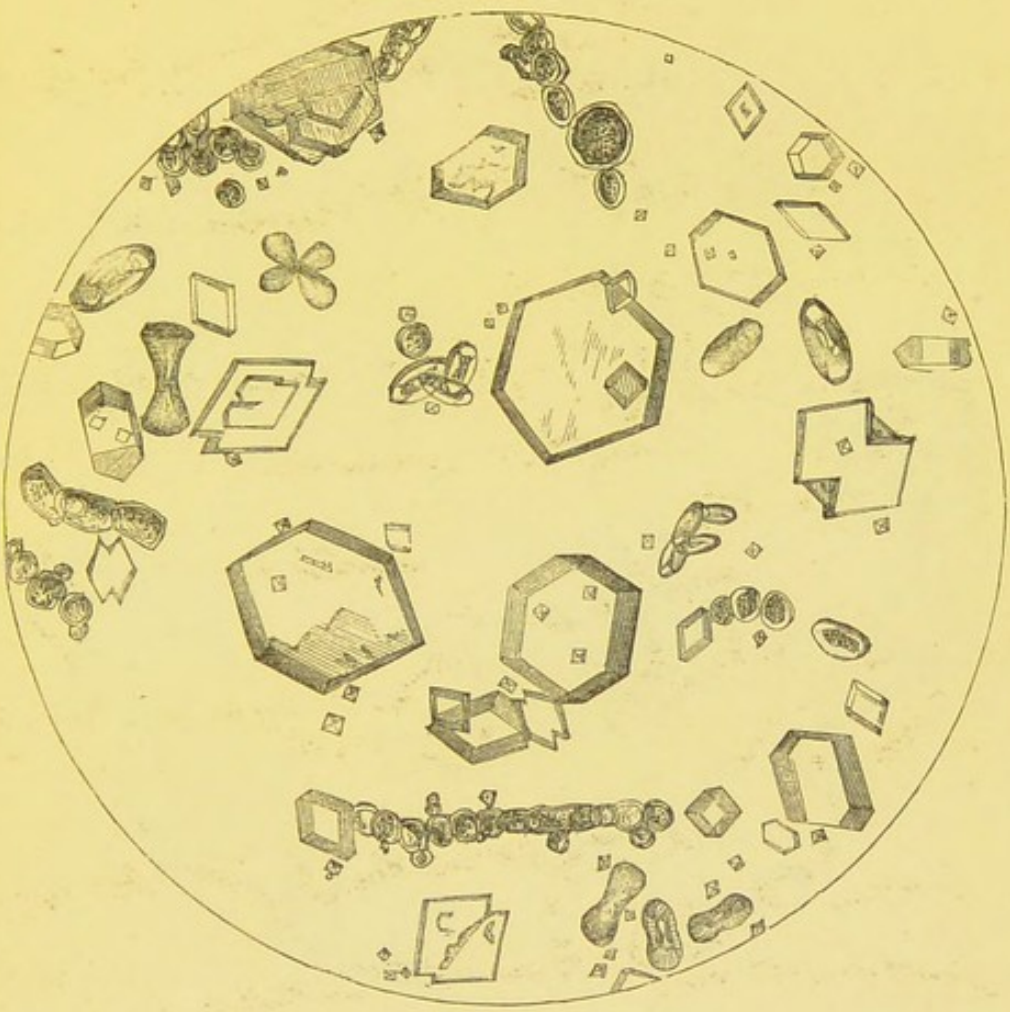

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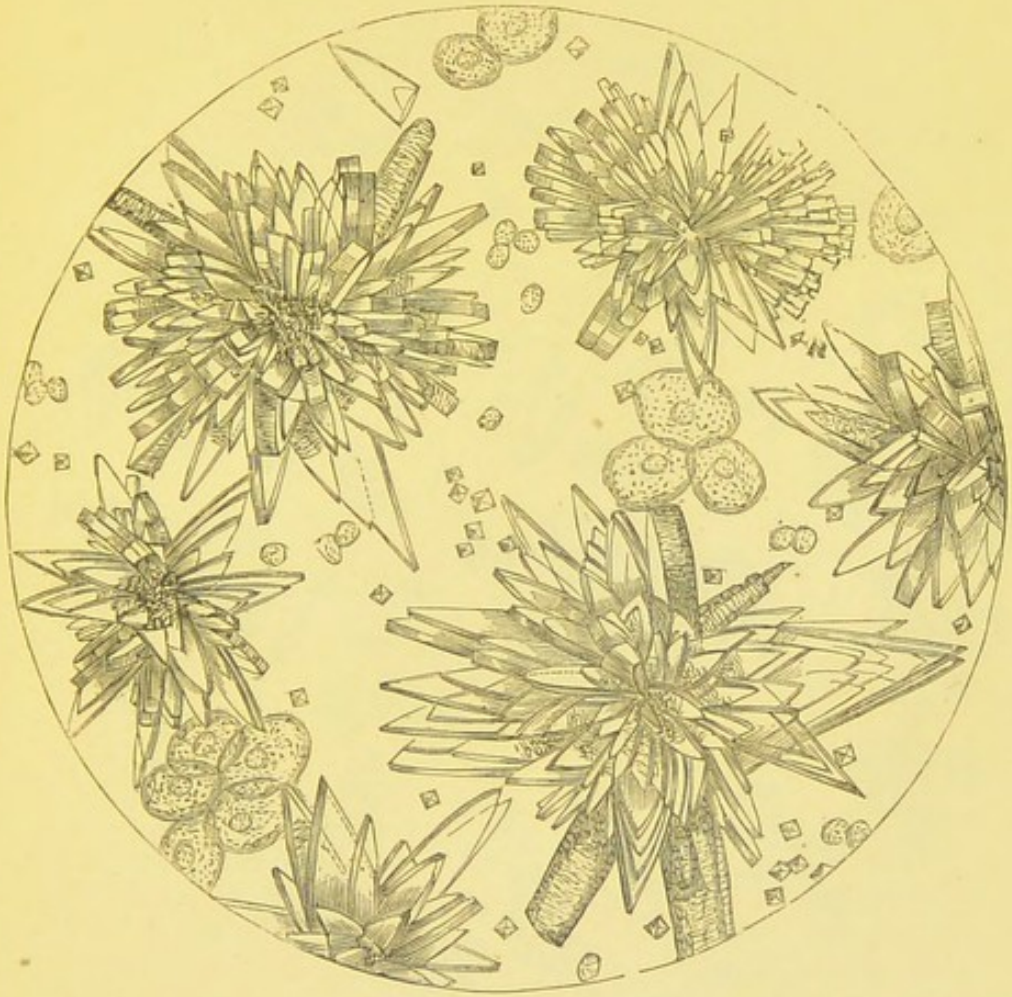

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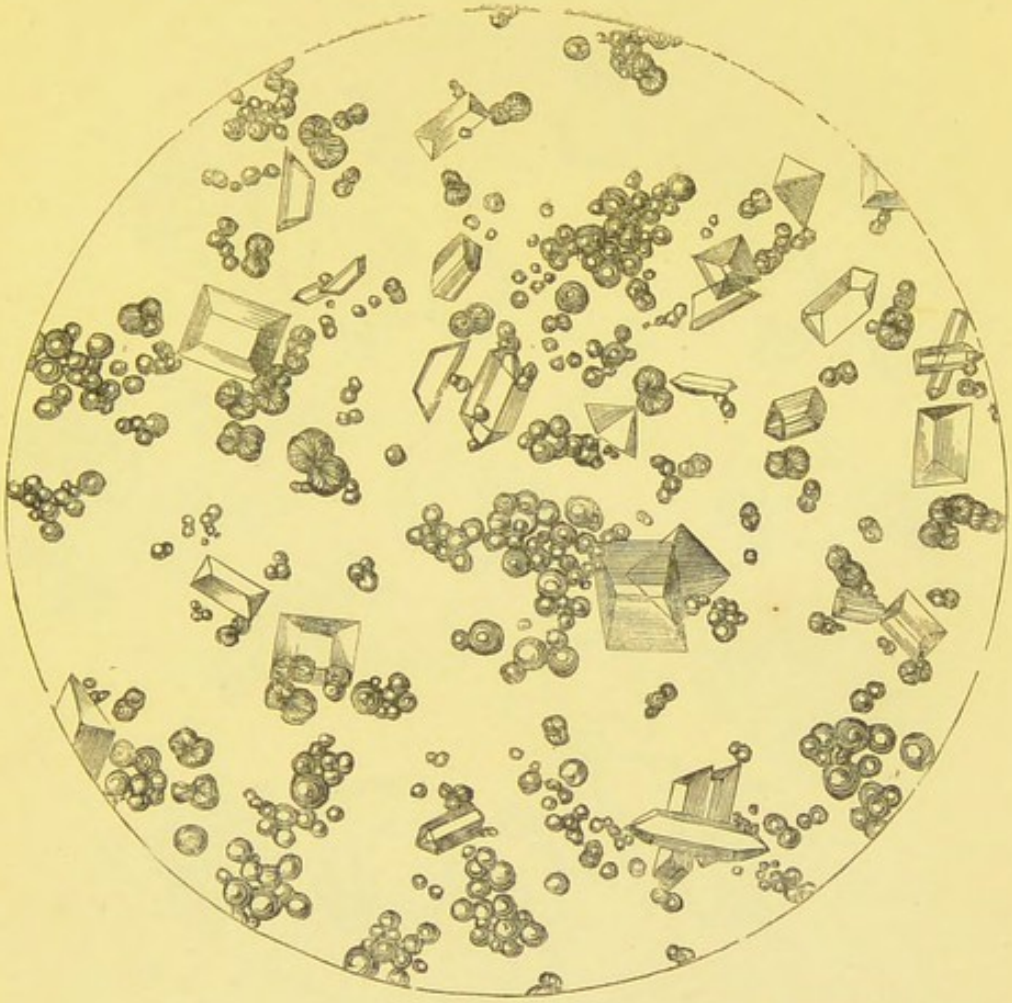

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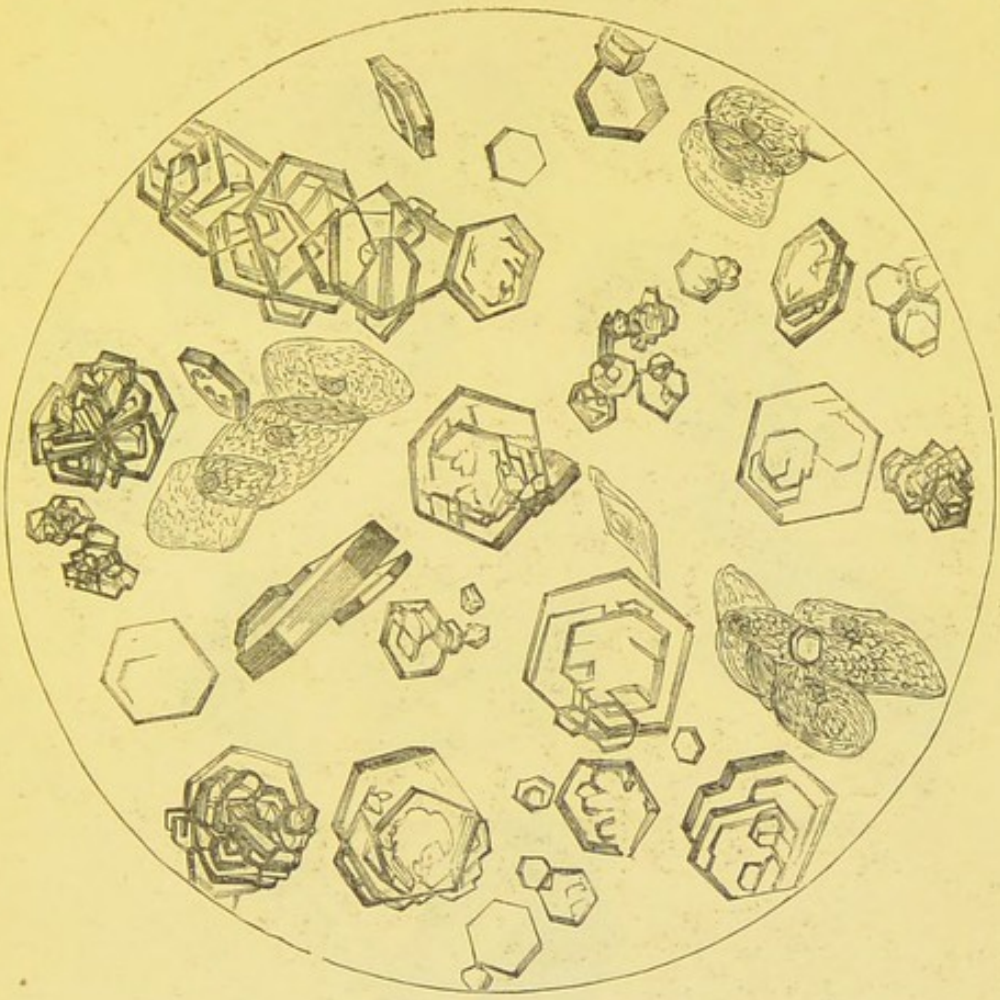

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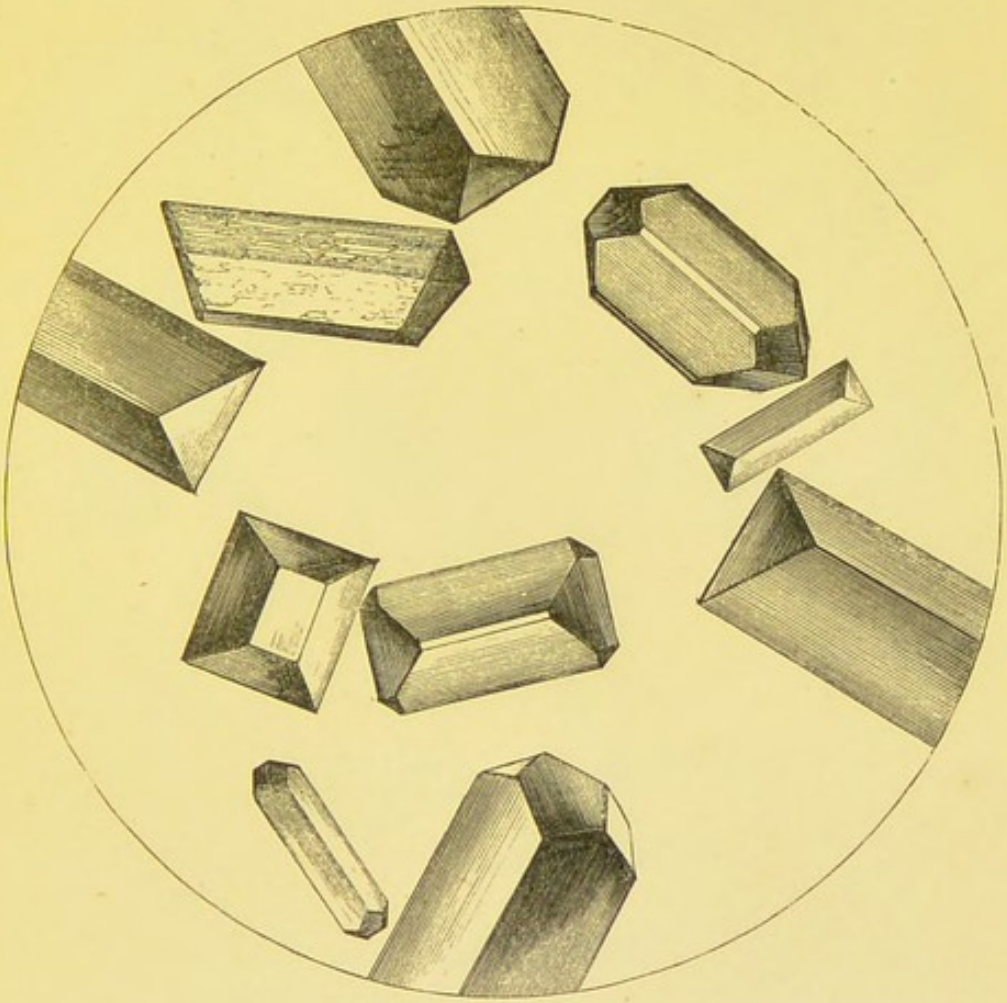

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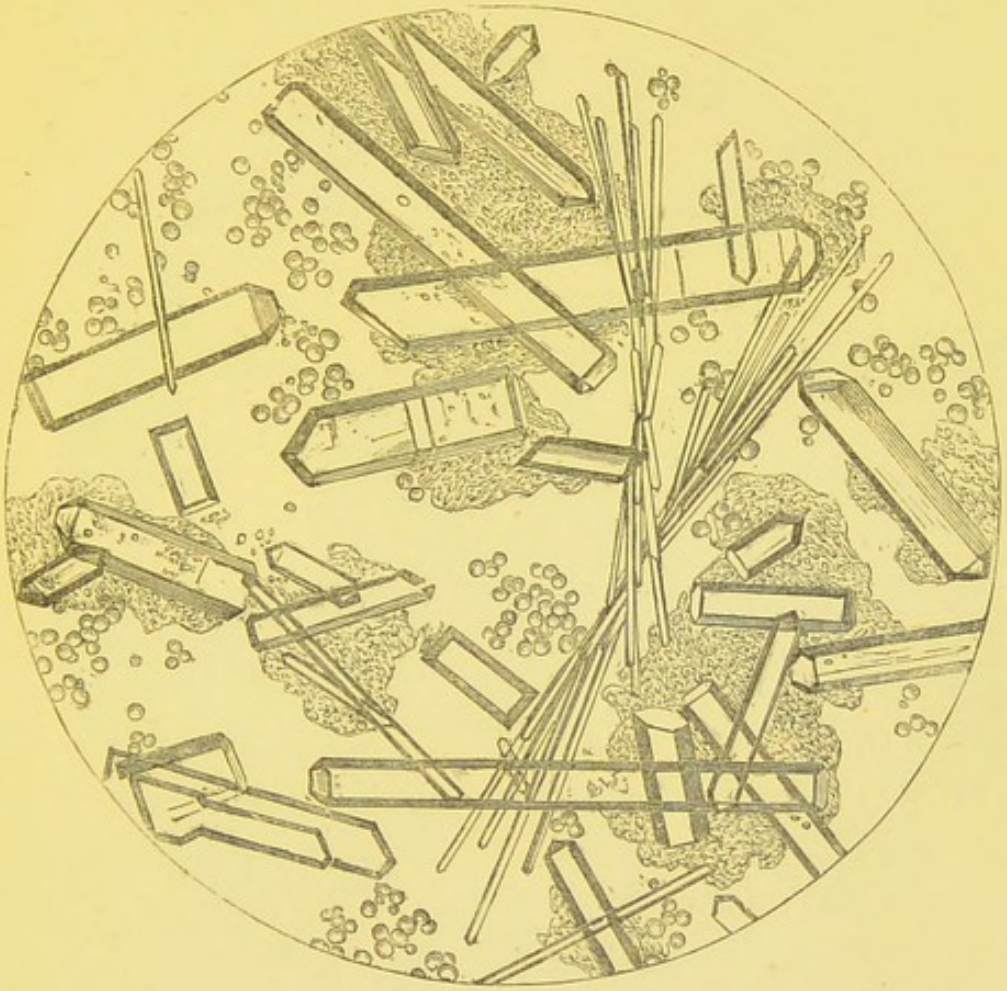

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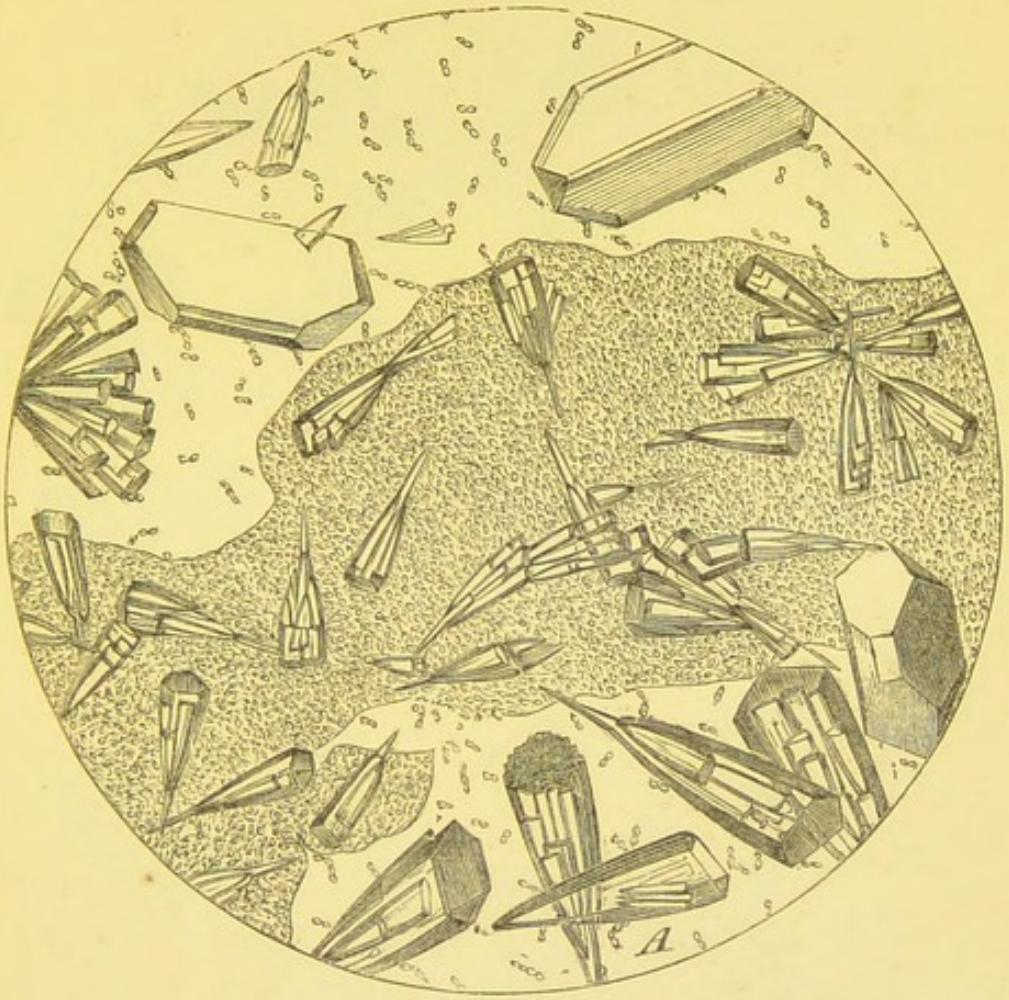

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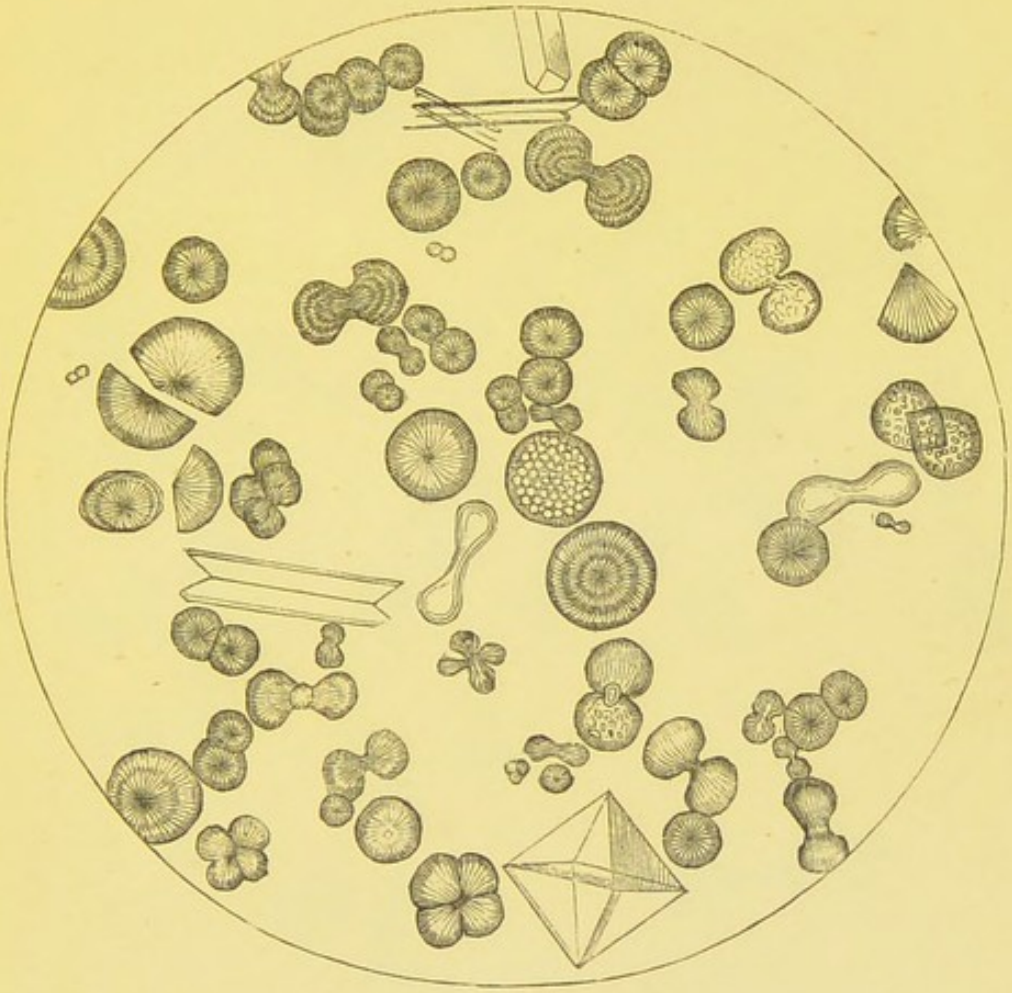

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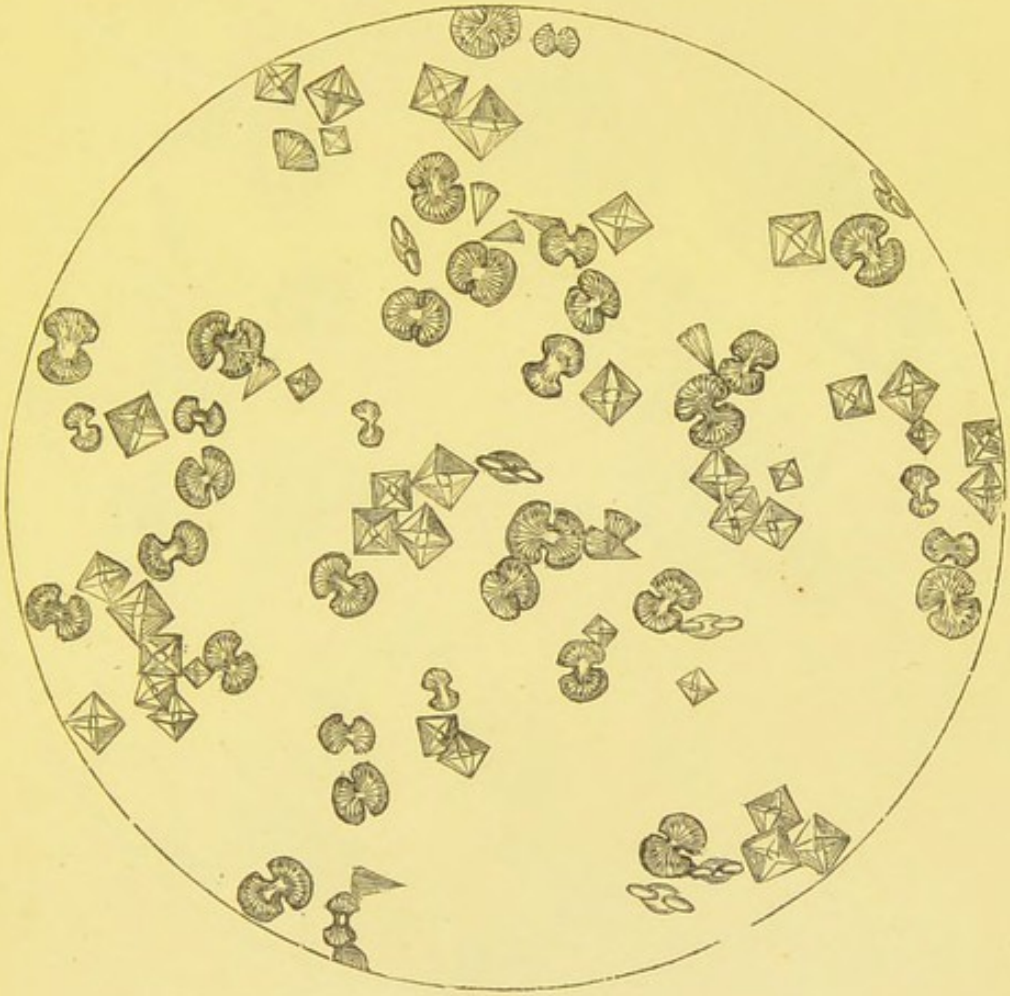

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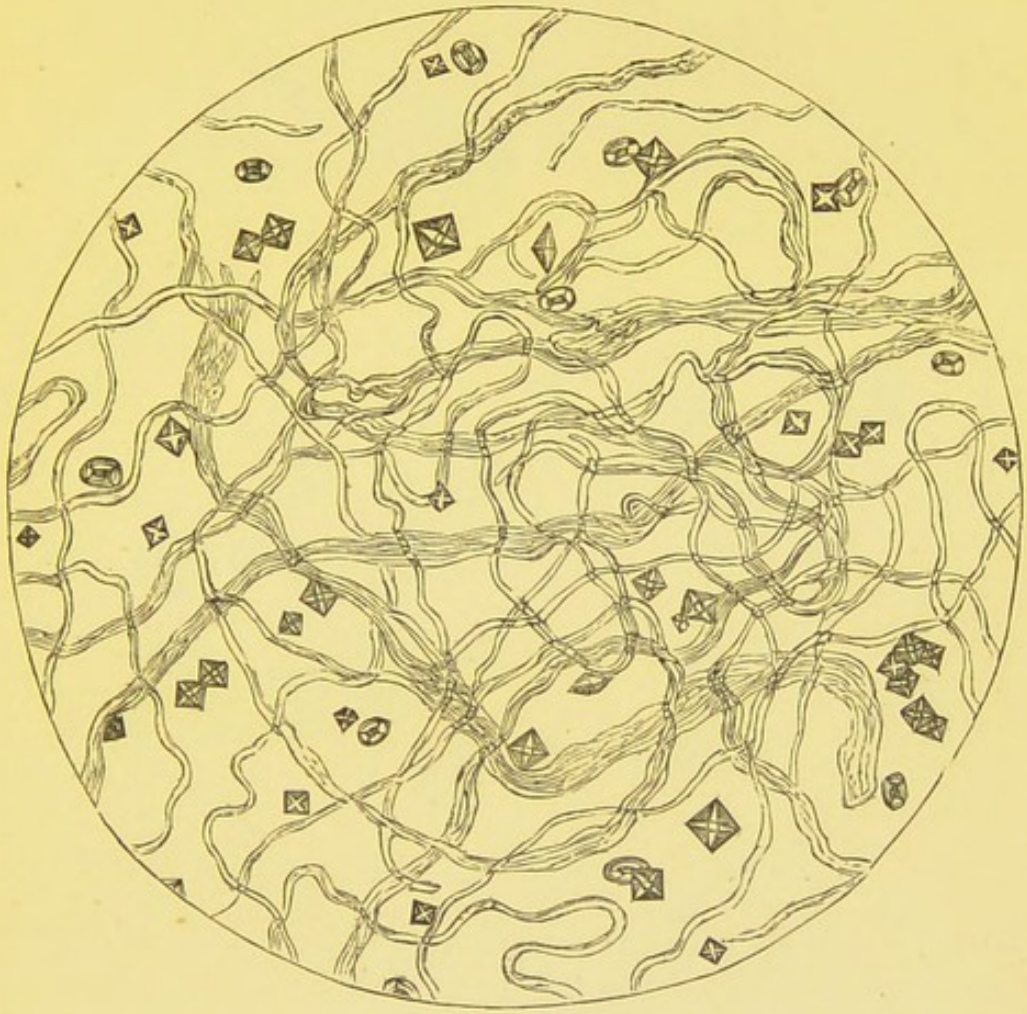

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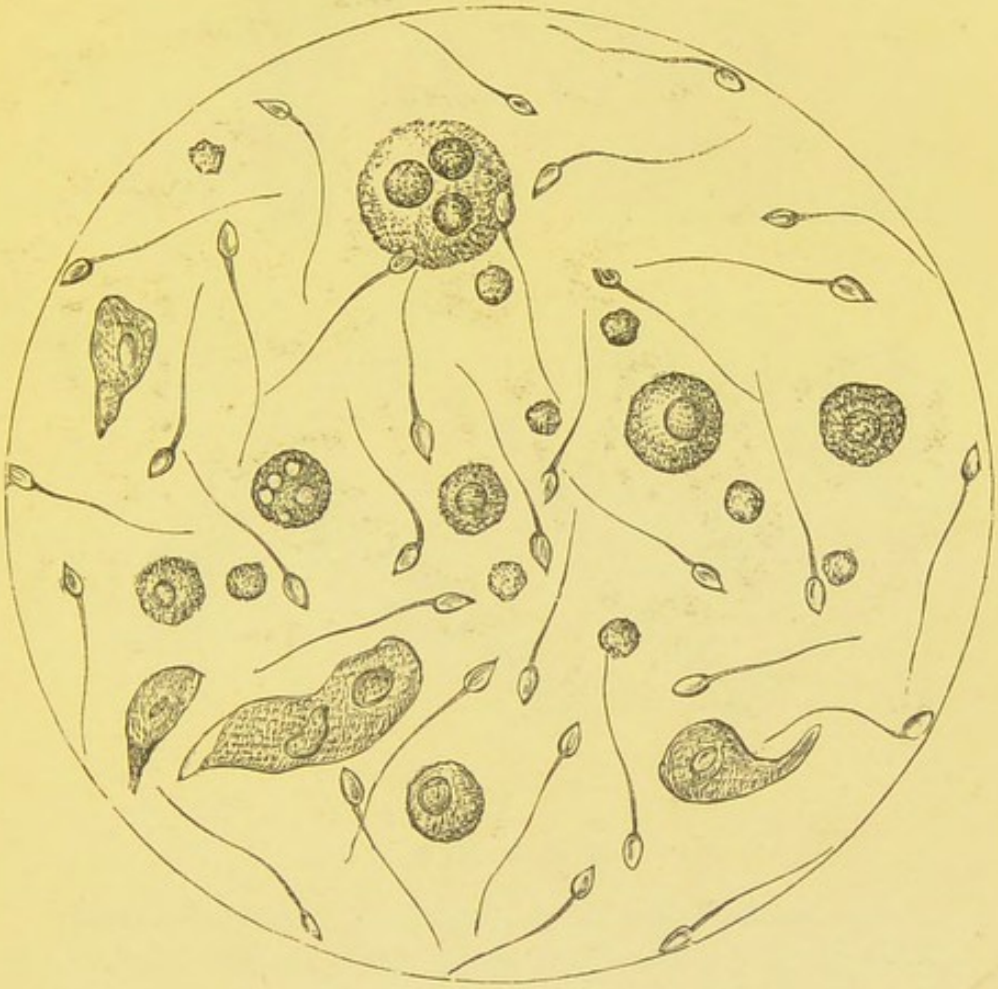

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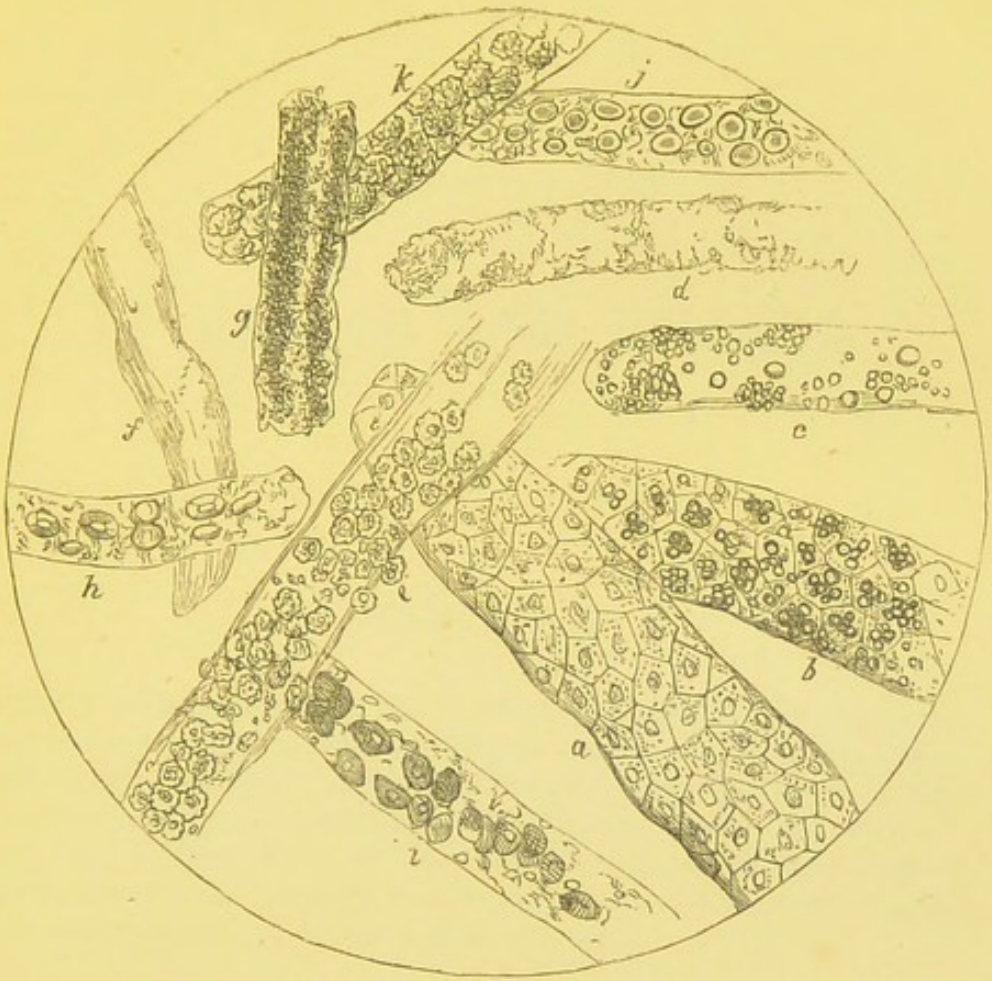

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THE URINE,

IN HEALTH AND DISEASE.

CHAPTER I.

Utility of works descriptive of the functions of organs—Intimate functional connexion between the skin and kidneys—Functions of the skin and of the kidneys described—Composition of the perspiratory fluid; quantity and solid constituents of—Importance of functions of the skin—Mr. Wilson's calculations—Composition of the urine—Classification of constituents—Sources of the chief constituents of healthy urine—Sources of the principal abnormal constituents—Anatomy of the kidneys.

UTILITY OF WORKS DESCRIPTIVE OF THE FUNCTIONS OF ORGANS.

No medical or physiological writings have been productive of greater service to mankind than those which treat of the functions of the human body. We would refer, in particular, in support of this statement, to the benefits which have ensued from the publication of essays and treatises on the functions of the lungs and on those of the skin.

Not many years since, prior to the writings of Combe and Wilson, the mass of the people were in nearly total

ignorance of the nature and importance of the functions of the organs alluded to, and to what an extent bodily health and vigour are dependent upon their healthy performance. Enlightened on these points, what a change has taken place in the habits of life and habitations of the people! Temperance is now more general, and houses are usually constructed with greater regard to ventilation; the windows are larger and more numerous, and the principal rooms are not unfrequently provided with ventilators; again, the use of the sponge-bath has now become almost as common as that of the washhand basin; the result of all this being a greatly-improved tone and condition of health, not to mention the moral as well as physical benefits conferred.

INTIMATE FUNCTIONAL CONNEXION BETWEEN THE SKIN AND KIDNEYS.

Now, the history of the functions of the skin is by no means complete, unless described in connexion with those of the kidneys; and for this very sufficient reason —that the functions of those two organs stand in such intimate relation, that they often take the place, to a great extent, of each other; thus, when the functions of the skin are impaired, those of the kidneys become increasingly active; and in this way a balance or equilibrium necessary to health is frequently maintained. But this compensatory action has its limits, so that the one organ cannot wholly or permanently supply the place of the other.

A few striking illustrations may now be adduced, to show the close connexion which exists between the skin and the kidneys.

In hot weather, the quantity of urine passed is greatly diminished, in consequence of the activity of the skin, and of the increased quantity of fluid which escapes from it in the form of perspiration; while in cold weather the relative proportions are reversed, and the fluid eliminated by the kidneys is much increased—being sometimes nearly doubled. These alternations, to a greater or less extent, are sometimes more than once repeated in the course of the twenty-four hours. The same thing occurs in the variations of temperature experienced in passing from crowded theatres and assemblies into the colder external air.

The same fact is exemplified by what frequently happens after scarlatina, and is hence called one of the sequelæ of that disease—namely, dropsy—and the occurrence of which is to be explained as follows:—scarlatina is an eruptive disease of the skin, giving rise, especially during the period of desquamation of the outer covering of the skin, the epidermis, to obstruction to the escape of the perspiratory secretion; this causes an accumulation of fluid in the system, which the kidneys endeavour to carry off, and successfully for a time; afterwards, however, the extra work thrown upon those organs being more than they can bear, they become affected, congested, and inflamed; in turn, their eliminative functions are impaired, and the fluids taken into the system, not finding ready egress, accumulate therein, giving rise to a temporary form of dropsy.

Again, when the kidneys are extirpated, it has been found that not only is the amount of fluid which escapes by the skin increased, but also that this fluid contains some of those substances which are proper to the renal secretion; thus it is not, as we now perceive, a mere

question of quantity between the two organs, but the one takes upon itself, under certain conditions, and to some extent, the functions proper to the other.

Lastly, in extreme cases of retention of urine, the perspiratory fluid becomes so impregnated with the constituents of the urine, that it acquires a distinctly urinous smell.

These illustrations—and many others might be added to them, if needed—are sufficient to demonstrate the important and intimate relations which exist between the skin and the kidneys.

The connexion which exists between the functions of the skin and the kidneys having been thus briefly shown, what the functions of each of those organs are respectively may next be described.

FUNCTIONS OF THE SKIN.

The principal *functions of the skin* are, to assist in the equalization of the circulation, by carrying off superfluous fluid from the system; to aid in the regulation of the temperature; to serve as a channel for the excretion of certain effete materials and substances; to contribute to the aëration of the blood; to replace, in a measure, and under certain circumstances, the functions of the kidneys; and, lastly, to serve as the seat of the sense of touch.

FUNCTIONS OF THE KIDNEYS.

The *functions of the kidneys* are, to assist in the equalization of the amount of fluid in the system, and to take the place, in a measure, and at times, of the eliminative functions of the skin; but the chief use of the kidneys

is, to serve as the principal channels of excretion of the useless and worn-out materials contained in the blood, derived mainly from the disintegration of the tissues, and, in part, from the food.

COMPOSITION OF THE PERSPIRATORY FLUID.

The *perspiratory fluid* consists of water, holding in solution a variety of substances. It has a saltish taste, and an acid reaction. It contains chloride of sodium, or common salt; occasionally, but rarely, sulphate of soda; and, always, salts of ammonia, especially the hydrochlorate, as well as salts of the organic acids; butyric, formic, acetic, lactic, and carbonic acids; earthy phosphates; a little peroxide of iron; fatty, proteine, and pigmentary matter, and nitrogen; and, when the skin is performing, in a measure, the functions of the kidneys, *urea*, *uric acid*, *urates*, *&c.:* these substances are particularly apt to make their appearance in the perspiration when the eliminative powers of the kidneys are defective, as in cholera, and in uræmia arising from structural diseases of the kidneys.

Quantity and solid constituents of the perspiratory fluid.

According to the observations of Seguin, the quantity of perspiration exhaled from the skin of the human body in twenty-four hours amounts to 15,840 grains, or about 33 *ounces*. According to Anselmino, the sweat contains, on the average, ·088 per cent. of solid matter—100 grains of this solid extract containing 22·9 grains of saline matter: these figures give, for the twenty-four hours, 107·47 grains of *organic matter*, and 81·92 grains of *saline matter*.

Krause calculated that, in the course of twenty-four hours, there were excreted by the sweat of an adult male 791·5 grammes of water, 7·98 of organic and volatile matter, and 2·66 of mineral substance, a gramme being equal to 15·444 English grains.

According to Schottin, the solid contituents amount to 2·26 %.

IMPORTANCE OF FUNCTIONS OF THE SKIN.

These statements and calculations respecting the quantity and composition of the perspiratory fluid, will serve to convey some, but still a very inadequate, idea of the importance of the eliminative functions performed by the skin.

Mr. Wilson's calculations.

The importance of these functions is further shown by the following calculations of Mr. Erasmus Wilson: "I counted the perspiratory pores in the palm of the hand, and found 3,528 in a square inch. Now, each of these pores being the aperture of a little tube of about a quarter of an inch long, it follows, that in a square inch of skin on the palm of the hand there exists a length of tube equal to 882 inches, or 73·5 feet. Surely such an amount of *drainage* as 73 feet in every square inch of skin, assuming this to be the average of the whole body, is something wonderful! and the thought naturally extends itself—What if this drainage were obstructed?" . . . "The number of square inches of surface in a man of ordinary height and bulk is about 2,500; the number of pores therefore is 8,820,000, and the number of inches

of perspiratory tube 2,205,000, that is, 183,750 feet, or 61,250 yards—or nearly 34 miles."

We have dwelt thus particularly upon the mutual relationship which exists between the functions of the skin and kidneys, because, as will be perceived hereafter, many practical questions arise out of a correct knowledge of this relationship.

COMPOSITION OF THE URINE.

The chief constituents of, as well as their ordinary proportions in, *normal* or *healthy urine*, are exhibited in the following analysis by Berzelius:—

Water	933·00
Urea	30·10
Uric acid	1·00
Lactic acid, lactate of ammonia, and extractive matters	17·14
Mucus	0·32
Sulphate of potash	3·71
Sulphate of soda	3·16
Phosphate of soda	2·94
Biphosphate of ammonia	1·65
Chloride of sodium	4·45
Muriate of ammonia	1·50
Phosphates of lime and magnesia	1·00
Silica	0·03
	1000·00

The above analysis does not include all the substances contained even in healthy urine, some of the most important being omitted, as *creatine*, *creatinine*, and *colouring matter;* while, in states of derangement and disease, a variety of additional substances make their appearance, as uric oxide, cystine, indigo, sugar, oxalate of lime, acetic and carbonic acids, albumen, fibrine, fat, chyle, bile, blood, pus, semen, and, lastly, structures belonging to the kidneys themselves.

CLASSIFICATION OF CONSTITUENTS OF URINE.

The various substances encountered in the urine may be thus classified :—

First, into those which are non-essential or accidental, and which are derived from the various articles of food and drink consumed, as the chlorides, and the greater part of the phosphates, sulphates, and, sometimes, the oxalates :

Second, into those which are essential, being derived from the waste and disintegration of the several tissues, as a portion of the phosphates and sulphates ; but especially urea, uric acid, free and combined, creatine, creatinine, and colouring matter :

Third, into those the presence of which is abnormal, and which is due to derangement or disease. This division includes not only hippuric acid, uric oxide, cystine, sugar, oxalate of lime, acetic and carbonic acids, albumen, fibrine, fat, chyle, bile, blood, pus, and semen ; but also, in some cases, part of the uric acid, indigo, as well as other substances, the nature of some of which is not well defined.

SOURCE OR ORIGIN OF THE CHIEF CONSTITUENTS OF HEALTHY URINE.

The more exact source or origin from which each of the chief constituents of the healthy urinary excretion is derived, may next be very briefly noticed.

Urea is formed from the decay and disintegration of those tissues of the body into the composition of which nitrogen enters. The late Dr. Prout inclined to the opinion that it is the peculiar product of the metamorphosis of the *gelatinous* tissues of the body—an opinion

to which the subsequent inquiries of Bischoff afford much support.

Of all the nitrogenous excrementitious constituents of the urine, urea is the most abundant, and probably, therefore, the most important; it is the form under which five-sixths of the nitrogen consumed escapes from the system, after it has contributed to the growth and nourishment of the body—a healthy man passing, on an average, nearly half an ounce daily. The quantity present in the urine may therefore be taken, to a great extent, as a measure of the waste of the nitrogenous tissues of the body. The amount of urea voided is much increased in proportion to the quantity of animal food consumed; and strong bodily exercise has the same effect, to a much less extent.

Next in importance to urea is *uric acid*, either in the free state or combined with bases forming *urates*. This is also a normal excrementitious constituent of the urine. One of its chief sources is in the disintegration of the nitrogenous tissues of the body—it resulting, according to Prout, from the disintegration of the *albuminous* tissues only.

Other sources are—the mal-assimilation of nitrogenous articles of food; excess of such food; and, lastly, impairment of the functions of the skin, whereby the escape of the usual nitrogenous excretions is impeded. The average quantity of uric acid daily excreted may be stated to vary from 6 to 10 grains—quantities which are, however, sometimes much exceeded in certain pathological states.

Creatine, another nitrogenous excrementitious constituent of the urine, is, doubtless, derived from the decay and disintegration of the *muscular tissue*.

Creatinine likewise results from the disintegration of the muscular tissue. There is good reason for believing that part of it is derived from the transformation of creatine into creatinine, in its passage through the system.

The *colouring matter* of the urine—a highly important excrementitious substance, which imparts to the renal secretion its peculiar tints—consists of the colouring matter of the red corpuscles of the blood, modified, and derived from the breaking-down and dissolution of the old and worn-out corpuscles, which are constantly going on in the blood.

Next in order, a few remarks may be made upon the source of *part* of the *phosphates* and *sulphates* of the urine; the greater part of these, it has already been stated, being derived from the food and drink consumed.

Phosphorus is found in the human body principally in connexion with the brain. Now, the combination of this with oxygen gives rise to phosphoric acid, which, uniting with bases, forms phosphates. The elimination of phosphorus from the brain, it has been shown, may be taken, to a certain extent, as a measure of the waste and disintegration of the cerebral substance—a fact of much importance in a pathological point of view.

Sulphur is found intimately associated with the nitrogenous nutritive constituents of the body; combined with oxygen, it forms sulphuric acid, and this uniting with bases, forms sulphates. The quantity of sulphates, therefore, present in the urine, may be taken, to some extent, as a measure of the destruction of the nitrogenous tissues; and hence the sulphates of the urine

become invested with considerable pathological interest and importance.

It should be known, that sulphur itself is sometimes present in the urine; this is especially the case when nitrogenous substances, as albumen, pus, mucus, blood, or bile are contained, in any quantity, in the renal excretion.

SOURCES OF THE PRINCIPAL ABNORMAL CONSTITUENTS OF URINE.

Hitherto, the sources of the chief constituents of normal or healthy urine alone have been noticed; those whence a few of the more important substances found in the urine in states of disease are derived may next be touched upon, as hippuric and oxalic acids, cystine, and sugar.

It must not be forgotten, however, that those constituents and substances natural to healthy or normal urine may be contained in it in such quantities either of deficiency or excess as to become pathological, and to be indicative of either derangement or disease.

Hippuric acid occurs constantly in the urine of the horse, whence its name; it occurs in the urine of most of the herbivora, and, occasionally, in that of the human subject. Its presence, in most cases, is obviously connected with the free use of vegetable or other substances rich in carbon, as milk; and, possibly, its formation is due, in a great measure, to the large quantity of carbon contained in them.

It is not formed directly from the elements of the food consumed; but, like urea, is a product of the metamorphosis of the nitrogenous tissues. According to Liebig and Lehmann, it exists in minute quantities in the normal urine of man.

Oxalic acid is a non-nitrogenous acid, frequently met with in human urine in combination with lime. It exists in many vegetable substances, as sorrel or rhubarb; and when these are consumed as articles of food, it makes its appearance in the urine as oxalate of lime. But, usually, its presence in the renal excretion is independent of the food taken. In some of these cases, its formation is traced to defective action of the lungs, as in cases of pulmonary emphysema, the kidneys, in some degree, acting vicariously for the lungs, a portion of the carbonic acid being eliminated from the system through the oxalic acid formed. Lastly, in other instances, the oxalic acid is due to the decomposition of the uric acid, under the influence of acid conditions of the urine, into urea, allantoin, and oxalic acid.

The source or origin of *cystine* is involved in considerable obscurity: in the large amount of sulphur contained in it, it resembles taurine, a fact which points to the inference that its formation is connected with imperfect elimination of sulphur by the liver.

The last abnormal or pathological substance formed in the urine, upon the source of which a few brief remarks may be made, is sugar.

The formation of glucose or grape *sugar*—found, in cases of diabetes, in the urine—is mainly traceable to the transformation of non-nitrogenous and chiefly amylaceous articles of food consumed. According to the older physiologists and pathologists, this transformation was effected in the stomach; but the more modern researches of M. Bernard and Dr. Pavy prove that the liver is the great seat of this change—substances termed hepatine and glucogen being formed, and which are readily changed into sugar by the action of the saliva and the blood.

ANATOMY OF THE KIDNEYS.

Having, in order to show the importance of the transpiratory functions, given a sketch of the minute anatomy of the skin, an outline of that of the kidneys may here be appended.

On making a vertical section of a kidney, it is perceived that its substance is divisible into two parts—an outer *cutical* or *vascular*, and an *inner* or *tubular*, portion. The cutical portion consists of convoluted and tortuous tubules, lined with epithelial scales, which are so arranged as to leave a free channel for the passage of the urine. Some of these tubules terminate in blind extremities, around each of which a minute plexus, or twisted coil of blood-vessels, is thrown, forming those spherical bodies known by the name of Malpighian corpuscles, while the tubules themselves, for their whole length, are enclosed in net-works of blood-vessels. Now this outer portion, as the chief secretory portion of the kidneys, is that in which the excretion of the urine takes place; and by the disposition of the parts just described, the blood from which the excretion is formed is brought into close relationship with the true secretory structure of the kidneys, namely, the epithelial cells which line the tubules—a thin membrane, forming the proper walls of the tubules, alone intervening. The remaining structures of the kidney serve mainly for the conveyance to the bladder of the urine already excreted; they consist of bundles of straight tubules, called, from their form, *cones* or *pyramids;* the straight tubes forming these keep uniting with each other—a greatly-reduced number of tubes of larger diameter, but occupying much less space, resulting and constituting at length the apices of the cones or pyramids: the apices of

the cones end in cups, one to each cone—hence called *calyces;* these communicate with three other larger cavities—the *infundibula*, and these again with a single larger cavity—the *pelvis* of the kidney, from which the urine is discharged into the *ureter*, by which it is conveyed to the *bladder*. It is very questionable whether the kidneys are to be regarded as true secretory organs, or whether they do anything more than separate from the blood certain salts and substances previously existing, ready formed, in that fluid: if so, the office of the kidneys may be likened to that of a filter; and very complete, perfect, and beautiful filters they are, assuredly.

CHAPTER II.

Physical properties of the urine—Its quantity, and causes of variation of—Estimation of the quantity of urine voided—Density, and causes of variation of—Estimation of the solids of the urine—Reaction, and causes of variation of—Colour, and causes of variation of—Smell—Characters of the urine in health.

PHYSICAL PROPERTIES OF THE URINE.

HAVING thus obtained some insight into the composition and uses of the renal excretion, we shall proceed to the consideration of certain of the more obvious physical properties of the urine, in health, derangement, or disease, as its QUANTITY, DENSITY, COLOUR, REACTION, and SMELL; but, before doing so, it may just be remarked that a knowledge of the characters and composition of the urine is of the utmost moment, because it is through this fluid mainly that most of the chemical, physiological, and vital changes taking place in the interior of the body, connected with its nutrition and waste, are revealed to us.

Quantity.

Prout estimated the average quantity of urine passed in the twenty-four hours, in this country, to range between 30 and 40 ounces; Dr. Routh found that the average did not exceed 35 ounces; while M. Bequerel fixes it higher than the English observers, namely, at 43 ounces for men, and 47 for women.

Of course, the quantity of urine passed is dependent, to some extent, upon the quantity of fluids drank; the larger this, the more urine will be voided.

Another circumstance, modifying greatly the amount of urine excreted, is the state of the skin; the more freely this acts the less will be the urine, and *vice versâ:* hence, less urine is passed in summer than in winter, and by persons in heated and crowded rooms, than when exposed to the colder external air.

Again, the quantity of urine is increased under the action of certain stimulants and all diuretic substances. Most spirits, and especially gin, on account of the juniper which it contains, exert a diuretic action: beer has this effect with most persons, in a marked degree; as also the chicory-coffee, so extensively consumed in this country, in a less degree. Soda and seidlitz powders, lemon kali, and other similar preparations, are all strongly diuretic.

Independently of the amount of fluids consumed, or the use of diuretic substances, the renal excretion is greatly increased in amount in certain pathological states.

Thus it is greatly augmented in many nervous and hysterical complaints; but it is increased especially, and to an enormous extent, in cases of diabetes, in which as much as from 5 to 10, and even 20, pints of urine may be voided daily.

It is much and suddenly increased under the influence of fear, and other states of mental depression.

It is also increased somewhat in amount in cases in which the urine contains deposits of either oxalate of lime or of the earthy phosphates.

On the other hand, the urine is remarkably deficient in cases of congestion and inflammation of the kidneys;

but particularly so in structural diseases of those organs. It is likewise deficient in inflammatory disorders and active fevers.

Estimation of the quantity of urine voided.

The only method of determining with accuracy whether the urine is passed in normal quantity, is deficient or in excess, is by measurement. The whole of the urine passed in the twenty-four hours should be received into a graduated glass vessel, and the amount noted at the end of the day. No conclusion should be formed from the quantity passed in one day; but it should be measured for several days in succession.

Unless the urine is measured, great mistakes are apt to occur, for very often persons are troubled with irritability of the bladder, and pass water very frequently; and from this frequency they are sometimes led to conclude that they are voiding a larger quantity of water than natural. This is, indeed, sometimes the case, especially in diabetes; but it is by no means commonly so.

DENSITY.

The density of the urine is due to the presence of the solid constituents enumerated in the analysis already given, and in great part to urea, creatine and creatinine. Now, as these constituents are liable to constant variation, depending upon a variety of causes—as the food consumed, and the extent of waste of the tissues of the body—the weight, density, or specific gravity of the urine is of course also subject to considerable variations.

If fluids be freely partaken of, and urine be passed shortly afterwards, it will be of low specific gravity; this description of urine has been appropriately termed *urina potus*. On the other hand, if a considerable interval has elapsed between the taking of fluids and the voidance of urine, and it be passed some time after food, especially a principal meal, such as dinner, it will be of high specific gravity; and such urine has received the name of *urina cibi*. Lastly, the urine passed after a night's rest is also of high specific gravity, although not so high as the after-dinner urine; and this urine has been called *urina sanguinis*.

It is difficult to assign the limit below which the specific gravity of the urine *in health* may not fall, for in some cases it has been found to consist of little else than water, the density being as low as 1,003, that is, three degrees only over water. On the other hand, the density does not often exceed 1,030, the average being about 1,020.

In some states of disease—particularly in that formidable affection, diabetes—it greatly exceeds 1,030, reaching sometimes even to over 1,050.

Estimation of the solids of the urine.

For the estimation of the amount of solid matters contained in any urine, we may adopt the following simple proceeding:—the quantity of urine passed in the twenty-four hours must be ascertained by measurement in a graduated glass vessel, and then its specific gravity must be taken; this being determined by means of a little glass graduated instrument, termed an urinometer.

The specific gravity of the urine passed in the twenty-four hours being known, the amount of solid matter contained in every 1000 grains of that urine is seen by a glance at the following table :—

Sp. gr.	Solids.	Water.	Sp. gr.	Solids.	Water.
1,001	2·33	997·67	1,021	48·93	951·07
1,002	4·66	995·34	1,022	51·26	948·74
1,003	6·99	993·01	1,023	53·59	946·41
1,004	9·32	990·68	1,024	55·92	944·18
1,005	11·65	988·35	1,025	58·25	941·75
1,006	13·98	986·02	1,026	60·58	939·42
1,007	16·31	983·69	1,027	62·91	937·09
1,008	18·64	981·36	1,028	65·24	934·76
1,009	20·97	979·03	1,029	67·57	932·43
1,010	23·30	976·70	1,030	69·90	930·10
1,011	25·63	974·37	1,031	72·23	927·77
1,012	27·96	972·04	1,032	74·56	925·44
1,013	30·29	969·71	1,033	76·89	923·11
1,014	32·62	967·38	1,034	79·22	920·78
1,015	34·95	965·05	1,035	81·55	918·45
1,016	37·23	962·72	1,036	83·88	916·12
1,017	39·61	960·39	1,037	86·21	913·79
1,018	41·94	958·06	1,038	88·54	911·46
1,019	44·27	955·73	1,039	93·87	909·13
1,020	46·60	953·40	1,040	93 20	906·80

By multiplying the whole quantity of urine, as determined by weight, passed in the twenty-four hours, by the solid contents of 1000 grains of that urine, and dividing the quotient by 1000, the weight of the solids in the whole quantity is determined.

The following is a very useful table, calculated by the late Dr. Golding Bird from Dr. Christison's formula; it shows the number of grains of solid matter contained in,

and the weight of, one fluid ounce of urine of every density, from 1,010 to 1,040 :—

Sp. gr.	Weight of 1 fluid oz.	Solids in 1 fluid oz.	Sp. gr.	Weight of 1 fluid oz.	Solids in 1 fluid oz.
		Grains.			Grains.
1,010	441·8	10·283	1,025	448·4	26·119
1,011	442·3	11·336	1,026	448·8	29·188
1,012	442·7	12·377	1,027	449·3	28·265
1,013	443·1	13·421	1,028	449·7	29·338
1,014	443·6	14·470	1,029	450·1	30·413
1,015	444·0	15·517	1,030	450·6	31·496
1,016	444·5	16·570	1,031	451·0	32·575
1,017	444·9	17·622	1,032	451·5	33·663
1,018	445·3	18·671	1,033	451·9	35·746
1,019	445·8	19·735	1,034	452·3	36·831
1,020	446·2	20·792	1,035	452·8	37·925
1,021	446·6	21·852	1,036	453·2	38·014
1,022	447·1	22·918	1,037	453·6	39·104
1,023	447·5	23·981	1,038	454·1	40·206
1,024	448·0	24·051	1,039	454·5	41·300

In this case, in order to ascertain the quantity of solids passed in the twenty-four hours, it is only necessary to determine the amount of urine voided and its specific gravity, and to multiply the solids of every fluid ounce, as shown by the table, by the number of ounces passed. A curious coincidence will be observed to exist between the figures expressing the densities of the different urines, and the weight of the solids in each ounce of urine; this is more particularly the case for those densities which do not exceed 1,030.

Taking the average specific gravity of the urine in health at 1,020, and the average quantity at 40 ounces, we learn from this table that 831,680 grains, or nearly two ounces, of solid matters of all kinds are, on the average, excreted by the kidneys in twenty-four hours.

It has been stated, that the average specific gravity of the urine in health is about 1,020, water being 1,000, different samples ranging between 1,010 and 1,034; a urine below 1,010 might be called a watery urine, and one above 1,034 would certainly show a considerable excess of solids. Ordinarily, the specific gravity of after-dinner urine is about 1,026, and morning urine 1,022. Now, the after-dinner urine, *urina cibi*, owes its high specific gravity partly to the larger proportion of urea which it holds in solution, while in the morning urine, *urina sanguinis*, the salts of the blood are in excess.

Now, the weight, density, or specific gravity of urine, is subject to very great variations, as the result of both functional derangement and disease; thus, it is of very low specific gravity in many hysterical and nervous affections, in chlorosis, &c., it sometimes having a specific gravity of 1,003 or 1,004, being, in fact, but little else than *water*.

Again, the urine is of very low specific gravity in structural diseases of the kidneys; the reason of this is, that the structure of the kidney being impaired, its eliminative power is lessened, and the urea and some other of the urinary constituents are retained in the blood. Not only in such cases is the urine of low gravity, but its quantity is likewise greatly diminished, and it contains more or less albumen.

The retention of the urea, and other excrementitial substances, in the blood, in consequence of disease of the kidneys, gives rise to a train of morbid symptoms, amongst the most prominent of which are sleepiness, stupor, and dropsical effusions, symptoms indicative of a retention in the blood of effete and hurtful substances.

On the other hand, the specific gravity of the urine is

sometimes greatly increased from excess of urea; but the disease in which the increase of weight is the most remarkable is diabetes, in which disease the urine contains a large quantity of that description of sugar known as grape sugar or glucose. In this affection, not only is the density of the urine much increased, but the quantity of urine is likewise greatly augmented.

Further, there is an increase in the gravity of the urine to a less extent in cases in which either the earthy phosphates or oxalate of lime are deposited.

In the absence of sugar, then, a urine of high specific gravity is usually indicative of the presence of much urea; and this again is an evidence of the extent of the disintegration of the nitrogenous tissues.

REACTION.

Human urine either has an acid or alkaline reaction, or is neutral, that is, is neither acid nor alkaline. In health it is ordinarily acid, the degree of acidity being subject to great variations, depending frequently, but not always, upon differences of food and drink, upon correct digestion, and the amount of urine secreted. But sometimes, even in health, the urine is neutral, and occasionally, for a short period, alkaline. The urine is always most acid when the contents of the stomach possess the greatest acidity, and least so when those contents are least acid. Thus, the urine passed the longest after food is generally the most acid, that passed during digestion three or four times less acid, and even sometimes alkaline. Dr. Jones has shown that the diminution of acidity is greatest and most persistent when animal food only is partaken of, it in some cases becoming even alkaline.

The acidity of the urine is principally due to the presence of acid phosphates; but, in some cases, lactic and carbonic acids contribute to the acidity.

The character of acidity may be said to be essential to the urine, for it is by means of that acidity principally that the earthy phosphates are kept in complete solution; and by it also the urine is prevented from passing with too great rapidity into a state of decomposition, and of becoming alkaline.

This change frequently takes place in urine which has been set aside for two or three days and exposed to the air, especially in hot weather; it gradually loses its acidity, becomes neutral, and ultimately alkaline. The urea of the urine is decomposed into carbonate of ammonia, owing, probably, to the putrescent mucus acting as a ferment, and so occasioning the transformation of the urea; the excess of phosphoric acid combines with the ammonia, setting free the carbonic acid, and thus the earthy phosphates become precipitated—the phosphate of magnesia in combination with ammonia.

Now, the reaction of the urine varies not only in accordance with the state of digestion and the nature of the food consumed, but also as the result of certain deranged or pathological conditions, either of the whole or parts of the system.

Thus, sometimes the urine is preternaturally acid. This is often the case when the functions of digestion are much disordered, and in rheumatism and gout.

In other cases, the urine, when passed, is either neutral or alkaline. This occurs in some cases of great weakness and prostration, independent of any special disease; in typhus fever; and in cases where the earthy phosphates are deposited.

Again, in other instances, the urine, as excreted by the kidneys, possesses its normal acidity, but becomes alkaline while contained in the bladder, and previous to being passed. This happens often in old people, in whom the prostate gland is enlarged, and is thus to be explained: the enlargement of the gland, and the impediment thus occasioned to the free passage of the urine, prevents the complete evacuation of the bladder; part of the urine is retained, and speedily undergoes the fermentive and decomposing changes already described.

The same alkaline condition of the urine occurs in cases of paralysis of the lower extremities, although the explanation here is somewhat different. It is not only the retention of the urine for a longer period than natural which causes the alkalinity of the urine; but, owing to the deficient nervous energy of the bladder, much alkaline mucus is secreted by the mucous membrane of that viscus, and this, speedily undergoing decomposition, induces fermentive changes in the urine itself.

Again, in the disease of old people known by the name of catarrh of the bladder, the urine is frequently alkaline. In this disease much ropy mucus is secreted, which speedily becomes decomposed in the urine while still retained in the bladder.

It follows, from the varying acidity of the urine even in health, that we must never determine upon the administration of either acid or alkaline remedies simply from the reaction of a single specimen of urine. The reaction of several samples, procured at different periods, should be ascertained, or that of the entire quantity of urine passed in the twenty-four hours determined.

The deposits occurring in urine frequently serve to point out the nature of the reaction of the urine, and

whether acid or alkaline remedies are indicated. Thus, a deposit of uric acid—known by its sandy appearance and colour, and hence called popularly "gravel"—indicates an acid condition of the urine, and calls for the administration of alkaline remedies. Again, a deposit of earthy phosphates, distinguished by its white lime-like appearance, indicates a feebly acid, neutral or alkaline urine, and demands the administration of the mineral acids.

SMELL.

Normal urine possesses only a faint characteristic urinous odour when first passed. If it be decidedly acid, it retains this smell for some time; but if alkaline, it soon begins, in consequence of decomposition, to smell offensively.

Sometimes, and indeed frequently, when it is decidedly alkaline as passed, it smells thus offensively when first voided—a certain sign of its alkalinity.

But, independently of smelling offensively, as the result of its more or less decomposed state, it sometimes emits other and peculiar odours.

Thus, in some cases, when digestion is much at fault, the urine emits a peculiar and fishy smell.

Again, certain articles of food impart characteristic odours; this, as most persons must have noticed, occurs particularly after eating asparagus.

COLOUR.

Many useful indications as to what is passing within the system, may be gathered by attention to the colour of the urine.

The colour, of course, varies with the quantity and density of the urine voided. Ordinarily, but not always, the higher the specific gravity, the deeper the colour of the urine.

Urine passed soon after copious imbibition is usually of a very pale straw colour, as also is that voided in many hysterical and nervous affections, and under the influence of mental depression.

That made after digestion is of an amber colour, while that passed after some hours' abstinence from food is of a deep amber or even reddish tint.

Again, the urine passed in hot weather is usually of a deeper tint than that voided in cold weather; and the same is the case after strong bodily exercise.

Independently of the quantity of fluid drank, of the density of the urine, of weather, and of hysterical and nervous affections, variations in the colour of the urine are caused by several other circumstances.

The chief of these is the condition of the great decarbonizing organs—the skin, lungs, and liver; whenever the action of these is defective, and when, consequently, an excess of carbon is eliminated from the system through the kidneys, the urine is often very deeply coloured—being, more or less, reddish brown. This occurs in some affections of the skin, of the liver, as in drunkards; and of the lungs, as in phthisis.

The urine is highly coloured in most inflammatory diseases, and active fevers.

In jaundice, the colour of the urine is remarkably affected, it becoming sometimes almost black, or greenish black, from the presence of biliary matter. The occurrence of *black urine* was formerly regarded with much and singular interest.

When the quantity of bile in the urine is very small, the colour of the urine is but little affected; but if more than a trace be present, it will be sufficient to impart a peculiar yellow tint to the crystals of triple phosphate, which form in all urines after exposure for a day or two in an open vessel. This is a very delicate and satisfactory microscopic test of the presence of bile.

In most structural diseases of the kidneys, the urine is very pale. In diabetes, it is remarkable for its pale, but bright, amber tint, the urine being usually as bright and clear as well-fined wine; in some exceptional instances, however, the urine is of a dark reddish-brown colour. In chlorosis, it often has a pale greenish hue.

Lastly, the colour and appearance of the urine is a good deal influenced by the nature of any deposits which may be present in it: with depositions of uric acid, it is usually high coloured; with earthy phosphates, pale; and with blood, more or less reddish, according to the quantity.

Occasionally, urines are passed of a *blue* colour; more frequently, they gradually acquire this colour a few days after being voided. This colour is invariably due to the presence of indigo, as was shown by me in a communication published in the *Transactions of the Royal Society*.* The composition of indigo, a substance containing a large proportion of carbon, clearly points to the physiological or pathological conditions tending to its formation — namely, defective action of the great decarbonizing organs, especially the lungs. It is a modification of the colouring matter of the blood.

* "On the Frequent Occurrence of Indigo in Human Urine."

CHARACTERS OF THE URINE IN HEALTH.

To sum up, the urine in health possesses the following characters:—it has an average specific gravity of about 1,020; it exhibits an acid reaction, and is of a straw colour or pale amber tint; is perfectly clear and transparent, even when cold; and, after standing for some hours, deposits only a very slight cloud of mucus.

By ascertaining, therefore, the quantity of urine passed in twenty-four hours, its specific gravity, its reaction, its colour, and whether free from deposits or not, much valuable information is obtained as to the state of health. Now, nothing can be more simple than the means by which these several particulars are arrived at.

The quantity passed in the twenty-four hours is determined by measurement; the density or specific gravity, by means of a little graduated glass tube, to be purchased at almost any chemist's, called an urinometer; the reaction, by means of blue and reddened litmus paper, or acid and alkaline solutions of known strength; to judge of the colour, smell, and freedom from deposit, the eye alone is usually necessary.

CHAPTER III.

Deposits occurring in urine—Excess of urea—Creatine—Creatinine—Hippuric acid—Sugar—Albumen—Classification of deposits—Uric acid deposits and urates—Cystine—Deposits of phosphates—Triple phosphate of ammonia and magnesia—Bibasic phosphate of ammonia and magnesia—Phosphate of magnesia—Phosphate of lime—Carbonate of lime—Oxalate of lime—Kiestein—Organized deposits—Mucus—Pus—Blood—Seminal fluid—Epithelial scales and tubes of the kidneys—Renal casts—Sugar fungus.

DEPOSITS OCCURRING IN URINE.

It has been stated, that normal urine, even after having been allowed to stand at rest for some hours, should contain only a slight cloud-like deposit of mucus, derived from the bladder; but very frequently, in disturbed or pathological conditions of the system, *deposits* of various kinds are found in it.

Some substances are so soluble in the urine, that although present in it in great excess, they become visible as a deposit, only when the urine is evaporated wholly or in part; the chief of these necessary to notice are urea, creatine, creatinine, hippuric acid, and sugar. The presence of excess of these may be most readily recognised. If the urine be of high specific gravity—as from 1,025 to 1,030, or even 1,034—and does not contain sugar, *urea* is most probably present in large amount. If a little urine be evaporated in a watch-glass, and then a small quantity of nitric acid being

added, a crystalline substance, *nitrate of urea*, appears, excess of urea is undoubtedly present. (Plate III.)

But a more simple method of determining whether urea is present in excess in any urine, is, to evaporate two or three drops on a glass slide, when, if it contain much urea, a crystalline glistening crust, formed of needle-like crystals, will remain, and which is so characteristic that it cannot be mistaken. (Plates I. and II.)

Creatine, when present in the urine in any quantity, may be detected by simply allowing two or three drops of urine to evaporate spontaneously on a slip of glass, when it will be deposited in the form of transparent, brilliant, and nacreous crystals, having the form, variously modified, of the right rectangular or right rhomboidal prism. (Plates IV. and V.)

The recognition of *creatinine* in the urine is still more easy; the form of its crystals being usually more or less navicular, and the manner in which they are grouped being highly characteristic. (Plates VI. and VII.)

Hippuric acid, when present in large excess in urine, may occur as a deposit. (Plate VIII.) Ordinarily, however, it only becomes visible as such on the addition of hydrochloric acid. The urine must be evaporated to about one third its bulk, and when cold the acid must be added; in a few hours, linear, and, usually, branched crystals appear, ramifying through the liquid. Hippuric acid may be readily procured from the urine of the horse or cow.

The detection of the presence of *sugar* in urine, in cases of diabetes, is equally simple and decisive. Thus, if it have a specific gravity of over 1,040, sugar is almost sure to be present; and if, on being boiled in a common test-tube with about one third part of a solution

of potash, it turns of a dark sherry or molasses brown colour, sugar is undoubtedly contained in it.

There is yet another condition of the urine, indicated by the occurrence in it of a deposit only after the urine has been boiled, with the method—extremely easy—of detecting which the reader should be made acquainted. In many diseases, especially after scarlatina and cholera, but more particularly in structural diseases of the kidneys, the urine contains more or less *albumen*, one of the most important of the nutritive constituents of the blood. The presence of this substance is indicated, if, on boiling two or three drachms of the urine over a spirit-lamp in a test-tube, a deposit—which, if considerable, often resembles white of egg—appear, and if this deposit remain undissolved on the addition of a few drops of nitric acid. When the urine is alkaline, the albumen, if present, does not coagulate on boiling the urine: in this case, the urine must be acidified with a drop or two of nitric acid previous to boiling.

But a variety of very important substances and compounds make their appearance in the urine as deposits; without this being subjected to any previous treatment, the majority of these present such characteristic appearances, that they may, with a little practice, be recognised with the unassisted eye alone, and all of them may be discriminated with the greatest ease, by a mere tyro, by means of the microscope.

Classification of deposits.

Of these DEPOSITS, some are coloured, some colourless, some crystalline, others pulverulent; and others, again, consist of organized particles or cells.

They are best procured by allowing several ounces of the urine to stand at rest for a few hours in a conical glass, when the deposit, if any be present, will collect at the bottom, and its colour and other physical properties may be noted.

Uric acid deposits and urates.

If the deposit be of a yellowish or brownish colour, and has a sandy texture, it doubtless consists of crystals of *uric acid;* the form of the crystals, which may be either single or aggregated into clusters, is always some modification of a rhomb. (Plates IX., X., XI., and XII.)

If the deposit, in place of appearing sandy and crystalline, is pulverulent; and if, on warming the urine in a test-tube over the flame of a spirit-lamp, it disappears, it consists of some *urate* that is of uric acid in combination with a base, as soda, potash, lime, or magnesia. The great test of the urates is their solubility on the application of heat; but their colour and pulverulent character are alone sufficient to distinguish them, without, in general, having recourse to either heat or the microscope. The colour of this deposit varies from bright pink to pale fawn. Occasionally, in place of being amorphous, it is in the form of *globules.* (Plate XIII.)

Cystine.

If the deposit consist of *cystine*, it will be of a light-brown or fawn colour; and, viewed under the microscope, it will be found to be made up of flat six-sided prisms, either single or compound. (Plate XIV.) Independent of the microscope, this deposit is sufficiently distinguished by its solubility in ammonia. It is of rare occurrence.

Deposits of phosphates.

If the deposit be *white*, *limy*, and *crystalline*, it will consist of some form of the *earthy phosphates*.

Of these there are several varieties, the most common form being *the neutral triple phosphate*, or *phosphate of ammonia and magnesia*, which consists of well-defined crystals, often of considerable size, and presenting some modification of a three-sided prism. (Plate XV.)

If the phosphatic deposit consist of *bibasic phosphate* of *ammonia* and *magnesia*, the crystals will appear in the form of four-rayed crosses; the six-rayed stars seldom, if ever, occur naturally, but are chiefly formed artificially, on the addition of ammonia to almost any urine. (Plate XVI.)

If the deposit consist of *phosphate of magnesia*—rather a rare deposit—the crystals will appear as lengthened six-sided prisms, with oblique dihedral summits. (Plate XVII.)

If composed of *phosphate of lime*, the crystals will be of small size, and wedge-shaped; their broad extremity will have the form of oblique six-sided prisms; and they will occur either separately, or, more commonly, variously aggregated into fasciculi and rosettes. (Plate XVIII.)

All these phosphates are not only distinguished by their white and lime-like appearance, but chemically, by becoming of a golden yellow colour when touched with a solution of nitrate of silver.

Carbonate of lime.

Another deposit, common in the urine of the horse, but rare in that of man, consists of *carbonate of lime*.

This is very readily distinguished—first, by its occurring in the form of spherules and dumb-bells of large size; and, second, by the solubility of the deposit, with effervescence, in acids. (Plate XIX.)

Oxalate of lime.

If the residue deposited, after standing for some hours, consist of *oxalate of lime*, the crystals will be either in the form of octahedra, single or aggregated, or they will be in the shape of a dumb-bell, more or less perfect. (Plate XX.)

Kiestein.

Another very interesting deposit, termed *kiestein*, makes its appearance in the urine in pregnancy; it consists of a fat-like pellicle, which collects on the surface of the urine after it has been allowed to stand for a time: this is composed of a granular basis or matrix of an animal substance, giving out the odour, and having some of the characters, of casein, or cheesy matter, in the midst of which globules of oil or fat are dispersed, as well as numerous well-defined crystals of triple phosphate.

This is often a very valuable test of the existence of pregnancy in the early months.

Organized deposits.

A few remarks may, in the next place, be bestowed upon the *organized deposits* occurring in the urine, as those of mucus, pus, blood, and seminal fluid.

Mucus.

It has already been stated, that when normal urine is permitted to stand at rest for a few hours, a slight transparent cloud-like deposit of *mucus* appears. This consists of shreds of mucus, with a few mucous corpuscles and epithelial scales. The epithelial scales are of two kinds; one derived from the mucous membrane of the bladder, and being rounded or caudate; and the other from the mucous membrane of the urethra, or vagina, being flat and scaly. (Plate XXI.) The proportion of this last kind of epithelium is greatest in the urine of women, being derived from the vagina.

Now, under circumstances of irritation or inflammation of the mucous membrane of the genito-urinary organs, the quantity of mucus passed is often greatly increased, and a very considerable deposit occurs. This happens, to a greater or less extent, in irritation or inflammation of the bladder, as from stone, paralysis, or chronic catarrh of that organ, from stricture, from inflamed or irritable prostate gland, &c.

When the mucus secreted by the lining membrane of the bladder is in excess, and it is examined carefully with the microscope, it is found to consist in part of minute fibrilæ of fibrin of variable diameter, usually more or less compound, and presenting the characters represented in Plate XXII.

With the outward and physical characters of mucus most persons are acquainted. It is a transparent, tenacious, glairy fluid, containing more or less granular or mucous corpuscles and epithelial cells or scales, the urine depositing it being usually acid.

Pus.

Now mucus is a natural secretion, thrown off from the surface of mucous membranes, without necessarily any breach of the continuity or lesion of that surface; but *pus* proceeds from some damaged or ulcerated surface. It may proceed from almost any part of the genito-urinary mucous membrane, from that of the kidneys, bladder, prostate, or urethra—especially in gonorrhœa: it is an opaque cream-like fluid, of a yellow or greenish colour; and, in place of containing few granular corpuscles, as does mucus, it abounds in very similar corpuscles. When an alkali, as solution of potash, is added to pus, it becomes tenacious and transparent, assuming many of the characters of mucus. The same change occurs when urine, containing pus, is itself very alkaline. Urine mixed with pus is often slightly acid only, or somewhat alkaline; and amongst the pus corpuscles, crystals of triple phosphate may usually be seen.

Blood.

A deposit of *blood* is sufficiently distinguished by its colour; when, however, there is reason to suspect its presence in minute quantity, recourse may be had to the microscope, by which the very characteristic blood corpuscles may at once be distinguished if blood be present, even in the most minute quantity. Blood, like mucus and pus, may proceed from any part of the genito-urinary surfaces.

Seminal fluid.

Seminal fluid, deposited from urine, has so much the

characters of mucus, that recourse must, in general, be had to the microscope for its discrimination. It is at once identified by the presence of the peculiar and well-known animalcules. (Plate XXIII.)

Epithelial scales and tubes of the kidneys—Casts of the tubes—Sugar fungus.

Other deposits which sometimes occur in the urine are —*the epithelial scales of the tubes of the kidneys; the tubes themselves*, either in the normal condition or altered by fatty degeneration; and *casts* of the cavities of those tubes (Plate 24). Lastly, animal and vegetable productions become developed in the urine soon after its emission, especially when exposed to the air. One of these is of much interest—namely, the yeast, or *sugar fungus* —and is developed in urine containing sugar. It is not necessary, in a work like the present, to give descriptions of these several deposits and living developments; such details are more suitable for larger systematic works. (*See* "A Practical Course of Lectures on the Diagnosis and Treatment of Urinary Disorders," by the Author, published in the *Lancet* for 1858.)

CHAPTER IV.

Practical facts and conclusions deducible from a knowledge of the functions of the kidneys and of the composition of the urine—Recapitulation of the functions of the kidneys and uses of the urine—Increased frequency of diseases of the kidneys—Causes of this increase—On the preservation of the functions of the kidneys in a natural and healthy condition—Necessity of attention to the skin, air, exercise, suitable clothing, bathing, and friction —Necessity of attention to the quantity and nature of the fluids consumed —Necessity of attention to the composition of the urine, and the state of the system as affecting the quantity of the urine—Indications of treatment afforded by the density of the urine—Indications of treatment afforded by the reactions of the urine —Indications afforded by the colour of the urine.

PRACTICAL FACTS AND CONCLUSIONS DEDUCIBLE FROM A KNOWLEDGE OF THE FUNCTIONS OF THE KIDNEYS AND OF THE COMPOSITION OF THE URINE.

From all that has now been advanced regarding the functions of the kidneys and the nature of the renal secretion, it is obvious that those functions are of immense and primary significance, and that any deviation or derangement of them cannot fail to be followed by either disorder or disease.

Recapitulation of the functions of the kidneys and uses of the urine.

Previous to proceeding to dwell on certain practical facts and conclusions, the functions of the renal organs,

and the purposes served by the excretion of the urine, may be very briefly recapitulated.

It is by means of digestion and assimilation that the body is maintained and nourished; but, following this assimilation, there is a constant and hourly disintegration of the various tissues of the body; the constituents or elements of these resolving themselves into a variety of compounds, all of which are essentially excrementitial, and many of them, when retained in the system, productive of hurtful results. Now, the chief outlet of these compounds from the system is through the kidneys, as is shown by the circumstance that it is in the urine that they are in health constantly present. It is, therefore, obvious that the kidneys belong to the class of depurating organs; and of these they are undoubtedly the most important.

Although this eliminative function is the grand office of the renal organs, they yet subserve several other purposes.

Thus, not only do they serve as the channels of excretion of compounds, resulting from the normal disintegration of the tissues, but also for various other compounds and substances.

Some of these result from the abnormal or irregular disintegration of the tissues.

Others are formed in the system, or in the blood, as the result of various pathological influences and conditions.

Others result, again, from mal-assimilation of the elements of the food.

Others are introduced into the system through the various articles of food and drink consumed, and, being useless, are rejected by the kidneys.

Further, it is by the kidneys that a whole host of

medicinal remedies taken into the circulation are chiefly excreted—a most salutary office; for, were it not for this, life could not, in many cases, be carried on for any length of time. This operation of the kidneys is especially valuable when hurtful or poisonous substances have been introduced into the system, whether by accident or design. When this happens, the renal organs usually set to work vigorously, to expel the poisonous intruder.

Again, the kidneys assist in the equalization of the amount of fluid in the system; much of the excess quickly passing off through these excretory channels.

Lastly, they replace, in a measure, and where the necessary conditions exist, the eliminative functions of the skin.

A knowledge, then, of the characters and composition of the urine, reveals to us the nature of most of those chemical, physiological, and pathological changes which are continually in progress in the system, and at a knowledge of which, but for the urine, it would have been difficult to have arrived.

These facts being clearly impressed upon the mind, we shall be the better able to appreciate the force of the remarks about to follow.

Such being the important and various functions performed by the kidneys, and so complex and variable the composition of the urine, it is clear that when any one of those functions is defectively performed, various deranged, abnormal, and pathological states and conditions must ensue.

It must be also clear that a knowledge of the functions of the renal organs—when this knowledge is followed, as all knowledge should be, by its legitimate and practical consequences and deductions—affords the best, and

indeed, in many cases, the only means of avoiding the deranged and pathological results above alluded to.

That a knowledge of the functions of the skin—which has of late years been more generally diffused—has led to great improvement in health and to a diminution of skin disease, cannot be denied.

The more general diffusion of this knowledge has likewise led to the more careful construction of our dwellings, and to the attention which is now paid to light, air, ventilation, friction, bathing, and other means of maintaining the healthy performance of the functions of the skin.

The effect of scrupulous cleanliness in diminishing cutaneous diseases, is proved by the circumstance, that it is amongst the dirty and the squalid that itch and many other forms of skin affections are chiefly encountered.

INCREASED FREQUENCY OF DISEASES OF THE KIDNEYS.

Now, we regret to give expression to our conviction that, in regard to what are properly called diseases of the kidneys, independent of derangements in the composition and characters of the urine, the opposite condition exists, and that diseases of the renal organs are more prevalent, especially in cities, than formerly.

Causes of such frequency.

And why are they so prevalent? The causes are, doubtless, various; but, in part, this prevalence may be attributed to the general ignorance which prevails in regard to the functions of the kidneys, and which igno-

rance is the cause of many persons neglecting to adopt those precautions which otherwise they might observe.

A few observations may be made in this place upon the subject of the prevalence of renal disease in cities, restricting our remarks to structural diseases of those organs, and excluding for the present the consideration of those general bodily diseases and derangements as revealed by the condition of the urine.

First, we would observe, that it cannot be matter of surprise that organs, which are in a state of such ceaseless activity as the kidneys, should be the frequent subjects of disease; the wonder rather is, that those organs generally continue to perform their functions so regularly for a long series of years, without more commonly becoming diseased. But, independently of this general reason, there are other special reasons why structural disease of the kidneys should be more frequent amongst the inhabitants of large cities.

Thus, the health of persons living in cities is, as a class, much deteriorated; and whatever tends to lower the health, predisposes to organic disease, and especially of those organs whose functions, like those of the kidneys, are both important and active.

The causes operating to the deterioration of health, it is unnecessary to dwell upon at any length: they are, *insufficient air and exercise*, *impure air*, *unwholesome and adulterated food*, *late hours*, *unhealthy occupations*, *dissipation*, *and intemperance.*

The last-named cause—namely, intemperance—is a very powerful one, acting in two ways in the production of renal disease. First, the abuse of intoxicating drinks impairs all the bodily functions, and lowers the health generally; and, secondly, much extra work is thereby

thrown upon the kidneys—they are overworked, and hence become more prone to disease. This latter remark applies especially to the abuse of gin, which is the spirit of the masses of the English people, and which is a stimulating diuretic.

Unwholesome and adulterated food operates as a cause of renal disease, more particularly in two ways. First, many of the substances employed in the adulteration of food are themselves injurious to health—some by impairing and deranging the primary and important function of digestion: second, other articles used for adulteration reduce the nutritive and other valuable dietetic qualities of the articles consumed, and thus they yield less nourishment and support to the body.

Examples of these effects are furnished by the prime articles—bread, milk, and coffee; but numerous other examples might be adduced.

Rice, so commonly added to *bread*, contains scarcely more than half as much gluten as wheat-flour, and, causing the bread containing it to hold more water, the nutritive properties of that staff of life are, of course, greatly impaired—a consideration of the utmost moment in the case of the poor and labouring population, whose health and strength is their whole stock-in-trade; and also in that of navies, armies, hospitals, prisons, workhouses, and other public institutions. Again: the use of alum in bread—added chiefly for the purpose of whitening it—is injurious, by the derangement of the digestion which it occasions, resulting from its effects upon the gluten of the bread, the acidity produced by it, and its constipating effects.

The chief adulteration of *milk* is with water. Now, milk is a highly nutritious fluid; it is the type of all

food, for it contains in itself all the elements and principles necessary for the complete and perfect nutrition of the body; it is obvious, therefore, that the addition of water—a non-nutritious substance—must greatly reduce the nutritive properties of this most important article of diet. The serious nature of this adulteration becomes evident, when we reflect upon the tens of thousands of infants and children that are fed, either in part or entirely, upon the milk of the cow—the numberless invalids—and also how largely milk is consumed, in some form or other, by almost every adult.

Lastly, the adulteration of *coffee* with beans, wheat-flour, chicory, &c., is injurious, and this also by reducing the strength and natural properties and effects of the beverage prepared from the coffee-berry. Coffee owes its chief virtue to an active principle called *caffeine:* now, in proportion as the substances above enumerated are added to ground and roasted coffee, so is the value of the beverage made from it impaired. But the addition of chicory to coffee is injurious in another way. Chicory is an aperient and diuretic, and is also stated to be productive, when constantly used as a beverage, of a form of amaurosis, or blindness.

Another instance of injurious adulteration may be cited, in the last place; namely, that of *gin* with cayenne or tincture of capsicum—a very common adulteration. The compound of ardent spirit, of a powerful acid and an irritating stimulant like capsicum, is one the effects of which no human stomach can long resist without injury.

It is easy to understand the effect of *unhealthy occupations* in pre-disposing to renal diseases, especially of those employments which entail the working in ill-lighted, ill-ventilated, crowded, and heated rooms. The

two following circumstances powerfully illustrate the effects in producing disease resulting from the withdrawal of light only:—It is well known that the livers of animals —birds, rabbits, &c.—shut up in a dark room or cellar, speedily become affected with fatty degeneration. Again: the leaves of living and growing vegetables, as celery, chicory, and kale, placed in the dark, in place of becoming green, are perfectly white and colourless.

Such is a very brief and cursory allusion to a few of the more frequent and ordinary causes, by the operation of which the prevalence of *structural diseases of the kidneys* may be explained.

ON THE PRESERVATION OF THE FUNCTIONS OF THE KIDNEYS IN A HEALTHY CONDITION.

We now pass on to offer some observations on the means by which the *functions* of the kidneys may be preserved in a natural and healthy condition.

It has already been explained, that a very intimate relation exists between the functions of the skin and the kidneys; that when the functions of either of these organs are impaired, the other endeavours, by increased and compensatory activity, to perform its office. When the excretory functions of the skin are impeded, more water and more solids escape by the kidneys, and *vice versâ*.

Necessity of attention to the skin.

This fact, alone, shows how all-important is attention to the condition of the skin, not merely for its own sake, but in order to relieve the kidneys of offices which do

not properly belong to them, and which they cannot long and efficiently perform.

The skin, then, must be kept in a healthy state; and the general means for the accomplishment of this object are, exercise, suitable clothing, bathing, and friction.

In cold weather, as previously stated, the perspiratory functions of the skin are less active than in warm weather—a much larger quantity of fluid escaping by the kidneys. This clearly proves how necessary it is to clothe warmly in winter, so that the activity of the skin may be maintained, and the kidneys, in an equal measure, relieved. Again, the excessive and inordinate action of the skin in summer, whereby much of the fluid, which would otherwise pass by the kidneys, escapes by the skin—the urine being thereby rendered of too high specific gravity—furnishes a very conclusive reason why, in hot weather, the clothing should be light and cool, and such as not to encourage the action of the skin.

Again, when, independent of temperature, the excretory functions of the skin are deficient, as in scarlatina, the propriety of the occasional use of the warm bath is clearly indicated.

Those, then, who desire to avoid derangements or diseases of the renal organs, should pay particular attention to the state of the skin, that it be neither inactive nor over-active.

The quantity of urine and of contained solids varies, not only with the condition of the skin, as influenced by temperature and disease, but likewise with *the amount of fluids consumed, the nature of those fluids, with the composition of the urine, and the state of the system.* We will now enlarge a little upon each of these particulars.

Necessity of attention to the quantity of fluids drank.

In the normal condition of the system and of the renal organs, when much drink is swallowed, much urine is voided; and when little fluid is taken, the urine is, in a corresponding degree, diminished. Now there are evils attached to the consumption of both too much and too little fluid. When too much, additional work is thrown upon the kidneys to get rid of the excess, and then there is a strain upon those organs; and this, when the habit of partaking freely of liquids is a constant one, may, in some cases, prove injurious. Again: when too little liquid is taken, the specific gravity of the urine is sometimes rendered so great, and the proportion of water, which acts as a solvent, is relatively so much reduced, that the sparingly soluble constituents of the urine, as the uric acid and urates, become precipitated almost as soon as the urine is excreted, either in the tubules of the kidneys themselves, or in the bladder; and it is in this way, sometimes, that renal and vesical calculi arise.

Too much, as well as too little, liquid must, therefore, be avoided. We believe that it is more common to take too much than too little liquid. It is not easy to lay down any very exact rule as to the quantity of liquid which should be consumed; as one individual, owing to certain peculiarities, may require more fluid than another. We may, however, form some idea of the quantity of fluids, of all kinds, which should be consumed in the twenty-four hours. Thus, taking the average amount of the urine formed in that time at 40 ounces, and the quantity of fluid excreted by the skin at 33 ounces, gives 73 ounces as the average amount of liquids consumed in the course of the day. But, when we consider that bread, vegetables

(including the potato), and meat, all contain large quantities of water, it is obvious that this estimate is too large. Bread contains about 45 per cent. of water; potatoes 75, and meat 78, per cent. of water. Allowing 1 lb. of bread, 1 lb. of potatoes, and three quarters of a pound of beef, per day for each person, there would be contained, in the solid food consumed, about 28 ounces of water. Then, on the other hand, much water is exhaled by the lungs, the quantity being estimated at about 12 ounces for twenty-four hours. Considering all these circumstances, 57 ounces per day may be regarded as an approximation to the amount of fluids of all kinds proper, in most cases, for a day's consumption. Our own feelings very often afford a very correct guide as to how much liquid should be taken.

Necessity of attention to the nature of the liquids drank.

The nature of the fluids consumed exercises great influence over the quantity and quality of the urine excreted.

Thus, beer, wine, spirits—especially gin—and chicory-coffee, act as diuretics.

The materia medica contains a very large number of diuretic substances, both vegetable and mineral.

On the other hand, the preparations of opium diminish remarkably the excretion of urine; and hence these remedies, as well as the diuretics, are, in many cases, found to be most serviceable in the treatment of renal affections.

The use of diuretics is indicated especially in dropsies, and in inflammatory and sthenic fevers, when the excretion of urine is much diminished; and of opiates, in

diabetes and certain nervous affections, in which the urine is greatly in excess.

These few particulars furnish two rules for our practical guidance—namely, first, that all diuretic articles of consumption should be avoided in cases in which too much urine is eliminated by the kidneys; and, second, that astringent articles should be equally avoided where an opposite condition exists.

Necessity of attending to the composition of the urine as affecting its quantity.

It has been found, that where certain substances are present in the urine in excess, the quantity passed is always over the normal average; thus, more urine is always voided when it contains an excess of earthy phosphates, and oxalate of lime; but it is principally in those cases in which sugar is present in the urine, as in diabetes, that the greatest increase in the amount of urine passed occurs. In some of these cases, more than 400 ounces are passed in the twenty-four hours; 40 ounces being the average amount.

In diabetes, two of the general indications of treatment are, to cut off the supply of those articles of food, as the various kinds of flour and starch, which are most readily capable of conversion into sugar, and to restrain the elimination of urine by small doses of opium.

Necessity of attention to the state of the system in connexion with the quantity of urine passed.

In the last place, the state of the system exerts a marked influence over the quantity and quality of the urine. In most conditions of the system characterized

by nervousness and debility, as in hysteria, chorea, chlorosis, &c., much more than the ordinary amount of urine is passed.

In these cases, the great object of treatment is to remove the cause upon which the excess depends; and, generally, this is accomplished by the exhibition of appropriate tonics.

INDICATIONS OF TREATMENT AFFORDED BY THE DENSITY OF THE URINE.

A few remarks may, in the next place, be offered upon the indications of treatment afforded by the *density* of the urine.

A high density of the urine is mainly due to the presence of either excess of urea or of sugar—the simple methods for the detection of which have already been pointed out.

Excess of urea denotes undue waste of tissue; the amount of animal food consumed contributing greatly to this waste, and consequent formation of urea. The prime indication in this case is to lessen the waste and transformation of tissue by the removal of the cause, having special regard to the nature of the diet.

Two of the principles to be followed in the treatment of diabetes have already been adverted to.

INDICATIONS OF TREATMENT AFFORDED BY THE REACTION OF THE URINE.

With regard to the *reaction* of the urine, the indications to be attended to in the treatment of persistent and over acid and alkaline conditions of the urine are

briefly these :—An extremely *acid condition* of the urine ordinarily is occasioned by the nature of the food consumed, but mainly depends upon some error of digestion and assimilation: hence, the first indication is to rectify the state of the digestive organs; and, secondly, to administer alkaline remedies to neutralize the excess of acidity of the urine.

A persistent alkaline condition of the urine may sometimes be traced in part to the diet, but more generally to general or local debility; and hence the administration of tonics and mineral acids, which in these cases act as tonics, is demanded.

It is not frequently that urines are met with that are strongly and persistently alkaline when first passed; but it very commonly happens that they are only feebly acid when voided, speedily losing that slight acidity, and becoming alkaline. Now, it is of importance that the fact should be recognised, that these cases require to be treated in very nearly the same manner—namely, by tonics and acids—as those of persistently alkaline urine.

The circumstance of the varying acidity and alkalinity of the urine, at different periods of the day, and in accordance with the hours at which food is taken, has already been noticed.

INDICATIONS AFFORDED BY THE COLOUR OF THE URINE.

It is very necessary that the *colour* of the urine be observed, as it furnishes some very important indications of treatment.

It has been already stated, that the colouring matter of the urine is derived from that of the blood contained

in the red corpuscles, and is furnished by the decay and dissolution of those corpuscles, which is continually in progress. This single fact furnishes us with the clue to the whole pathology deducible from the varying tints and colours of the urine.

Now, this colouring matter may be deficient or in excess: it is deficient in all pale urines, when these are not greatly diluted, as in hysteria, chlorosis, &c.; and it is in excess whenever the urine is high coloured.

The urine is high coloured in all active diseases, inflammations, and fevers; also, wherever the action of the great decarbonizing organs—the skin, liver, and lungs—is defective; wherever, also, the circulation is much disturbed, as in most diseases of the heart.

Much valuable information may therefore be derived from attention to the colour of the urine, and a knowledge of the causes by which it is influenced.

Valuable information may likewise be obtained by examining not only the colour of the urine, but also that of the urates so frequently found in it as deposits, especially where serious functional or organic disease exists. The bright pink, almost scarlet, colour of the urates occurring in hectic fever with suppuration, as in phthisis, is well known: they are often coloured to nearly the same extent in rheumatic fever, and in most diseases of the heart.

When the urine is very high coloured, the red tint of the urates is often much obscured and altered; so that it is safest, in order to judge correctly of their colour, to collect them on a filter, which may be done, with a piece of blotting-paper, in a few minutes.

In all cases, then, in which the urine is unnaturally pale or high coloured, we must determine to which of

the causes just enumerated the abnormal colour of the urine is due, and shape the treatment accordingly.

It sometimes happens that the colour of the urine is due to other causes than the altered colouring matter of the blood: this is so in jaundice, in which the urine becomes coloured yellow, green, or nearly black, with bile, according to the quantity present. The colouring matter of rhubarb and some other articles also make their way into the urine, affecting its colour.

CHAPTER V.

Principles of treatment of the chief urinary constituents and deposits—Treatment of excess and deficiency of urea—Treatment of excess of creatine and creatinine—Treatment of hippuric acid—Treatment of sugar, or diabetes—Treatment of albumen—Treatment of uric acid deposits—Treatment of deposits of cystine—Treatment of deposits of the earthy phosphates—Treatment of deposits of carbonate of lime—Treatment of deposits of oxalate of lime—Organized deposits—Treatment of mucus—Treatment of pus—Treatment of blood—On seminal fluid in the urine, and on the treatment of spermatorrhœa—On the medical treatment and diagnosis of stone in the bladder.

PRINCIPLES OF TREATMENT OF THE CHIEF URINARY CONSTITUENTS AND DEPOSITS.

It is not proposed to describe at any length, and in detail, the treatment to be pursued in the case of each of the urinary constituents referred to in the previous chapter as occurring, under certain circumstances, as deposits; it is more in accordance with the design and objects of this work to confine our remarks to a description of *the chief indications or principles* upon which those deposits should be treated.

Treatment of excess and deficiency of urea.

The occurrence of urea in the urine, in such excess as that it becomes deposited as a crystalline glistening crust on the evaporation of even a single drop of urine on

a slip of glass, is by no means uncommon. These cases have not, however, as yet, been sufficiently studied: it does not appear that any very strongly-marked or peculiar train of symptoms characterizes the presence of excess of urea in the urine. In those cases which have fallen under my observation, there have been fever, thirst, quick and tumultuous action of the heart, perspiration, and wasting.

The wasting, we should naturally expect, from what has been already remarked as to the principal source or origin of urea, namely, in the disintegration of the nitrogenous tissues, would be a prominent symptom; and, indeed, whenever this occurs we should look for the occurrence of urea in the urine in excess.

The grand principle of treatment, therefore, is to lessen this inordinate waste of tissue, from whatever cause this may proceed; and the causes leading to this waste are various, as most active fevers and diseases, and probably also excess of nitrogenous food.

This last cause, as has been already shown, increases, in a very marked and extraordinary degree, the amount of urea formed and excreted. If it be true, as there is much reason for believing, that it is the gelatinous tissues chiefly which yield urea, then should the diet be regulated accordingly.

The special disease in which urea is in excess is in meningitis, in which, according to Heller, the whole urine becomes solidified on the addition of nitric acid. It is also in excess in pneumonia, pleurisy, acute tuberculosis, and in rheumatism, especially when accompanied with endocarditis, in diabetes insipidus, and in urine depositing oxalate of lime.

On the other hand, the quantity is diminished in

chronic nervous affections, neuralgia, hysteria, and most other convulsive diseases; in paraplegia and hemiplegia, in anæmia, chlorosis, and chronic maladies of the liver.

In all these cases of deficiency of urea, tonics are indicated, together with an abundant nitrogenous diet.

The urea is, of course, diminished in structural diseases of the kidneys, which impede, mechanically, the passage of the urea. Here the principles of treatment must be to facilitate the escape of the urea accumulated in the blood, both by the bowels and the skin, and to endeavour to restore the renal organs to a healthy condition.

Treatment of excess of creatine and creatinine.

The fact that creatine and creatinine take their origin in the disintegration of the muscular tissues, at once furnishes the clue to the principle upon which cases of excess of these substances in the urine should be treated. Where their amount is abnormal, there must be undue waste and disintegration of the muscular tissue; this may proceed from over exertion, or from the wasting induced by disease, as in marasmus, active inflammatory and hectic fevers.

Acting on this view, the line of treatment becomes obvious. Over action of the muscular tissue must be moderated; and, where there is considerable wasting, this must, as far as possible, be reduced. The exact character of the treatment to be adopted must, of course, depend upon the cause of the wasting.

Treatment of hippuric acid.

It has elsewhere been stated, that hippuric acid is of constant occurrence in the urine of the horse, the

cow, and other herbivora—it replacing, to a great extent, urea, and, like it, being formed at the expense of the nitrogenous tissues.

Its formation is, in many cases, closely connected with excess of carbon in the food. This is certainly so in the herbivora, and also in some of the cases of its occurrence in the human subject. Thus, in one of these cases, it was found in the urine of a girl who lived upon apples, bread, and water, but disappeared on her resuming a mixed diet. In other cases, its presence, both in adults and infants, was obviously connected with a milk diet.

Hippuric acid is also found in excess in the urine, in some cases, independently of diet, where the functions of the great emunctuary organs are impaired,—as the lungs, skin, and liver.

Hippuric acid is, therefore, probably a medium for carrying off from the system an excess of carbon.

These several facts point clearly to the principles upon which the treatment of excess of hippuric acid in the urine should be conducted.

First, it must be ascertained whether the food consumed contains an excess of carbon—whether vegetables or milk enter too largely into it; and, if this be the case, the diet must be regulated accordingly.

Second, if no fault in the diet exists, we must look to the state of the great decarbonizing organs, and direct our treatment to the restoration of that organ, the functions of which are impaired.

The urines in which excess of hippuric acid has been detected have been of low specific gravity (from 1,006 to 1,008), and but slightly acid or neutral: the quantity of urine is usually in excess in these cases.

Treatment of sugar, or diabetes.

There are three indications to be fulfilled in the treatment of diabetes.

The first of these has reference to the diet, and is most important. Although the transformation into sugar takes place in the liver, it yet cannot be questioned that non-nitrogenous, and especially amylaceous, articles of food furnish the material from which the sugar is chiefly formed: hence, every article containing starch, in any proportion, should be entirely interdicted, not partially, but wholly and completely. Thus, bread, potatoes, arrow-root, rice, sago, oatmeal, and puddings, must form no part of the diet of the diabetic.

On the other hand, meat, including fish, poultry, and eggs, should be freely partaken of twice or thrice daily, as also the green vegetables, as cabbage, asparagus, spinach, water-cresses, mustard and cress, French beans, and scarlet runners, but not green peas and broad beans; milk and butter may likewise be eaten in moderation, while, for bread, bran biscuits must be substituted; the ordinary brown biscuits of the shops by no means answer the purpose, as they all contain a large proportion of starch: the meal from which they are made should be specially prepared, so as to free it entirely from starch. These prepared biscuits may be procured of Mr. Smith, baker, of Gower Street North.

We thus perceive that, notwithstanding the essential restrictions to be imposed in the diet of the diabetic patient, a considerable variety of articles still remains for his consumption. The effect of strict attention to these rules in regard to diet, even in the absence of medicine, on the quantity and specific gravity of the urine, is usually quite marvellous.

The second indication is, to diminish, as far as possible, the inordinate quantity of urine voided. The mere alteration in the diet effects this object to some extent, but other means must be resorted to. An urgent symptom of diabetes is the constant thirst which prevails. Now, this must be indulged as little as possible, and liquids must be refrained from as far as practicable. Again, it is known that opium diminishes greatly the secretion of urine; small doses of this remedy should therefore be administered. The free use of the green vegetables, including water-cresses, will often be sufficient to counteract the constipating action of the opium.

The third indication is, to maintain the bodily strength and vigour as much as possible under the malassimilation, exhaustion, and drain upon the system. This object is fulfilled by means of a generous nitrogenous diet, and tonics, especially quinine. Since the liver is the seat of the formation of the sugar, special attention should be paid to the condition of that organ.

With regard to drinks, it is best to limit these to water, tea, and coffee; but, where stimulants are really needed, the safest is a little cold brandy-and-water, or a glass or two of sherry. The saccharine wines and beer should be avoided.

I would state my conviction, derived from my experience in hospital practice, that cases of diabetes are of much more frequent occurrence than is commonly supposed, the nature of the ailment being often overlooked, alike by the patient and his medical attendant. A circumstance which goes far to account for this disease being overlooked is, that some persons experience only an attack or attacks of the disease at long intervals, the symptoms sometimes subsiding of themselves.

On the treatment of albumen.

The first point to ascertain is the nature of the cause determining the presence of albumen in the urine; of these causes, some may be described as temporary, others, as structural diseases of the kidneys, as permanent. First, the albumen detected in the urine may be due to the presence in that fluid of either blood or pus; second, it is found in the urine in cases of congestion or inflammation of the kidneys, as in scarlatina, cholera, and inflammation of the renal organs themselves, &c.; third, cases of its occurrence are sometimes met with connected rather with faulty digestion and assimilation than with any special organic diseases; fourth, and lastly, albumen is contained in the urine in nearly all structural diseases of the kidneys. Whenever the albumen proceeds from the kidneys themselves, we have the evidences of its doing so in the presence in the urine of casts of the tubes, and of the tubes themselves with the epithelium which lines them.

Before, then, we proceed to the treatment, and also before we are in a position to pronounce any opinion as to the significance to be attached to the occurrence of albumen in the urine, we must ascertain the cause which determines its presence. It may be stated, generally, that the prognosis will be favourable in every case in which the occurrence is not due to confirmed structural and disorganizing diseases of the renal organs themselves. In the more simple cases of the occurrence of albumen in the urine, as from blood or pus, in small quantities, astringent remedies will often be sufficient, as gallic acid, sulphuric acid, alum, and the tincture of the sesquichloride of iron.

When its presence depends upon congestion and inflammation of the kidneys themselves, recourse must be had to bleeding, leeches, blisters, the warm bath, and appropriate constitutional remedies. Of course, the extent to which these remedies are employed must depend upon the nature and violence of the attack; thus, in simple congestion, the warm bath and diaphoretics will usually be sufficient.

In those cases in which the presence of the albumen is dependant rather upon faulty assimilation than degeneration of the renal organs, the following indications must be carefully attended to:—the diet must be strictly regulated, but must, at the same time, be nutritious and of ready digestibility; the mode of living and the habits of life must be such as are conducive to health; and tonics, especially quinine and iron, and astringents, must be administered. I have now under my care a very remarkable case of this description—a youth aged about eighteen years. To my own knowledge, his urine has contained, for the last two years, such a large amount of albumen, that, when boiled, it becomes white, and sometimes almost solid, like white of egg; and yet, with this persistent condition of the urine, and this enormous drain upon the system, in place of being stunted and contracted, he has grown up to be a well-developed and rather fine young man, although not, of course, robust and hardy, yet capable of considerable physical exertion. In this case, the urine often smells of the food consumed; and, nearly throughout, it has preserved its normal specific gravity.

In the fourth and last class of cases, where there is structural degeneration of the kidneys, although the prognosis is so unfavourable, the principles of treatment are

tolerably obvious. The general health must be improved in every known way—by living in a salubrious and suitable locality—by pure air, moderate exercise, friction, and attention to diet, clothing, and general habits of life.

On the treatment of uric acid deposits.

The presence of free uric acid, as a deposit in the urine, may be simply an evidence of an over acid condition of the urine; and, therefore, its occurrence in this form in small quantities by no means proves that the uric acid is formed in excess. In such cases, the treatment is very obvious: first, the cause of this over acidity of the urine should be determined; this will be found usually either in the state of the organs of digestion or else in the nature of the food consumed, or, perhaps, both these may be at fault. The diet, should, therefore, be carefully regulated, and the digestion improved by appropriate tonic and alterative remedies. Lastly, ant-acids should be freely administered; of these, the best are carbonate of potash, acetate of potash, and the borates and phosphates of soda. The mere administration of alkaline remedies is not alone sufficient; as, although these may cause the deposit of uric acid to disappear, yet they will not correct the original fault or error which occasioned the deposit.

There are four sources to which, as elsewhere stated in this work, the formation of uric acid, free and combined, may be traced; one or more, as the case may be, of these sources being in operation at the same time: these, explained in as few words as possible, are—the disintegration of the nitrogenous tissues (the chief source), the malassimilation of nitrogenous articles of food, excess

of such food, and, lastly, impairment of the functions of the skin. We must then first determine which of these sources or causes are most concerned, and shape the treatment accordingly.

It is obvious, however, that whatever may be the cause most at fault, there are certain leading points which should be attended to in all cases; these are—the nature of the diet, especially as regards animal food, which must not be used in excess, and acid and astringent wines and drinks, which tend to increase the mischief, should be avoided,—the state of the organs of digestion, especially of the liver, must be remedied by tonics, alteratives, including especially small doses of mercury, taraxacum, and colchicum,—the condition of the skin demands the use of bathing and friction,—and, lastly, alkaline or solvent remedies are nearly always required.

Deposits of combined uric acid, or of *urates*, call for nearly the same principles of treatment. As, however, the occurrence of urates is often associated with fever or inflammation, more or less active, antiphlogistic and febrifuge remedies are often needed; in many instances, sudden deposits of urates are occasioned by checked action of the skin, as from a chill, or cold; in these cases, the deposits quickly disappear under the use of diaphoretics and the warm bath. Lastly, inasmuch as with deposits of urates the urine is usually less acid than with those of free uric acid, the employment of alkaline remedies is not needed to the same extent.

When there is reason to suspect that the deposit is kept up by a gouty or rheumatic tendency, colchicum will, in general, be found to be a most valuable remedy: this may be given with bitters and an alkali, or the

acetous extract of colchicum may be used, combined, or not, as may be indicated, with small doses of blue pill.

On the treatment of deposits of cystine.

The pathology of cystine being still involved in so much obscurity, the precise indications to be followed in the treatment of this deposit are not very obvious. The fact of its possessing a composition approaching to taurine —it containing more than 25 per cent. of sulphur—points especially to the liver; and hence, doubtless, in all cases of the occurrence of this deposit, the condition of that organ should be closely watched. In the cases actually recorded, there does not appear to have been any evidence that the liver has been peculiarly at fault; thus, it has been observed that this deposit is apt to occur in the urine of chlorotic women; also, that it sometimes occurs hereditarily in members of the same family; and Dr. Bird believed that he traced a connexion between cystine and the scrofulous diathesis. These facts rather point to the formation of cystine being associated with some general fault or error of nutrition.

The general therapeutical indications are—to correct the condition of the liver, if at fault; to improve the state of the assimilative functions; to attend to the health in every way—as by diet, air, exercise, and sea-bathing; and to endeavour to render the cystine soluble in the urine.

In the cases of its occurrence in connexion with chlorosis, the preparations of iron are especially called for; and, for the purpose of aiding in the solution of the deposit, the use of nitro-hydrochloric acid should be persisted in, although it does not always prove successful.

On the treatment of deposits of the earthy phosphates.

Although there are several varieties of the earthy phosphates, the principles upon which they should be treated are alike in all cases.

We would premise, that the mere fact of the occurrence of a deposit of the earthy phosphates by no means proves that these are always formed in excess; but, like the occurrence of a deposit of uric acid, in some instances, merely indicates an over acid condition of the urine: so that, of the earthy phosphates, many prove only the existence of an alkaline condition of the urine.

Neither, on the other hand, does the absence of any deposit of earthy phosphates show that they do not exist in the urine in excess; we put out of consideration here, altogether, the alkaline phosphates, as they frequently are in excess in acid urines, and yet no deposition of them occurs.

What we have, then, to consider in this place, is not whether the phosphates are in excess, but whether they are deposited, or not, in consequence of the alkalinity of the urine, the causes of that alkalinity, and the treatment.

It has already been remarked, that the urine is persistently alkaline; and deposits of phosphates occur in many states of debility, especially where this is extreme, and where the nervous energies are at fault. In these cases, two indications in the treatment have to be followed: the first is, to remove the debility; and this is effected by avoiding whatever causes contribute to that debility—as all causes of an exhaustive character; overlabour of body or mind; anxiety; food, insufficient in quantity or not nutritious; and by the administration

of tonics, coupled with a generous diet. The second indication is, to counteract the over alkaline condition of the blood and urine, by the administration of the mineral acids. These remedies fulfil, indeed, in a great measure, both indications, since they do not only correct the alkaline condition of the urine, but likewise act powerfully as tonics.

It sometimes happens that the urine is acid when secreted by the kidneys, but is yet neutral or alkaline when voided. This occurs, as previously stated, from several distinct causes, as enlarged prostate, stricture, paralysis of the lower limbs, and catarrh of the bladder. In each of these cases, a somewhat different plan of treatment is required.

Where the alkalinity of the urine, evidenced by the deposition of the earthy phosphates, proceeds from enlarged prostate, not only must the treatment be of such a character as to tend to diminish the size of the prostate, but acid and soothing remedies must be resorted to; and, if necessary, the bladder must be completely emptied, from time to time, by means of the catheter.

The treatment of phosphatic deposits from stricture is the same, in principle, as that for enlarged prostate.

When the alkalinity arises from deficient nervous energy, the result of paralysis of the lower extremities, recourse must be had to suitable nervine tonics, to strychnine, galvanism, the use of mineral acids, and to a generous diet; and, indeed, the general health and the nervous energies must be improved as much as possible, by strict attention to hygiene, to air, exercise, friction, and clothing.

Lastly, in *catarrhus vesicæ*, accompanied by deposi-

tion of the earthy phosphates, astringent and demulcent remedies must be employed, as well as tonics and acids.

Now, the actual occurrence of the deposition of the phosphates may take place, either in the bladder or not until after the urine has been voided; when the urine is decidedly alkaline, it usually occurs while the urine is still retained in the bladder; but, when the urine is subacid or neutral, or not strongly alkaline, the deposition sometimes does not take place until a day, or even two, subsequent to its emission. Now, this last class of cases is very numerous; and the deposit of phosphates occurring in urine which is subacid or neutral, and some hours after it has been voided, requires to be treated on just the same principles as when the deposition occurs within the bladder, and in which the urine is more decidedly alkaline.

Urine which is subacid, neutral, or feebly alkaline, always produces considerable irritation of the genito-urinary mucous surfaces. This explains the urgent desire to pass water in these cases, the greater frequency, the pain, and the excess of mucus, not unfrequently streaked with blood; and even, in extreme cases, the occurrence of pus mixed with the mucus.

On the treatment of deposits of carbonate of lime.

Carbonate of lime occurs, in small quantity, as a deposit, in a granular form, and mixed up with the earthy phosphates, in most decidedly alkaline urines, the carbonic acid being derived from the carbonate of ammonia formed by the decomposition and transformation of the urea. More rarely, it is met with as a distinct deposit,

in the shape of spherules and dumb-bells: in such cases, it has a different origin. When not due to the administration of alkaline carbonates, it is probably formed under the same circumstances as in the herbivora, in the urine of which class of animals it is of constant occurrence, the carbonic acid being formed from the carbon which forms so large a part of the food consumed.

The treatment consists in the regulation of the diet, and in the administration of tonics and acids.

On the treatment of deposits of oxalate of lime.

In all cases of the occurrence of oxalate of lime in the urine, the first thing to be done is to ascertain whether it proceeds from the food or not, as there are certain articles which habitually contain oxalic acid, as rhubarb and sorrel; and when these are eaten, the oxalic acid invariably appears in the urine in the form of oxalate of lime.

Supposing its presence cannot be explained by the nature of the food consumed, we must look to the condition of the lungs; as, if the action of these is much impaired, as in pulmonary emphysema, part of the carbonic acid formed is apt to escape by the kidneys in the form of oxalic acid.

In these cases, the great indication of treatment is to remove the excess of carbonic acid contained in the blood, by maintaining a free action of the other great decarbonizing organs—the skin, liver, and bowels.

But, in a third class of cases—and this, where the deposit is persistent, is the ordinary source—the oxalic acid found in the urine is derived from the disintegration of the tissues; it proceeding, according to some chemists,

from the decomposition of the uric acid into urea, allantoin, and oxalic acid: certain it is, that uric acid very readily yields oxalic acid as one of the products of its decomposition. This source of its production, taken in connexion with the general symptoms, when oxalic acid occurs as a deposit unmixed with uric acid—namely, with debility, dyspepsia, and wasting—points out that the chief indications of treatment consist in attention to the diet and the administration of tonics; and, especially, nitro-hydrochloric acid—the use of which, in these cases, should be continued for a considerable time.

The debility and wasting occurring in cases of persistent oxalic acid deposits, are explained, in a great measure, by the circumstance, that in the urine containing these deposits there is always a great excess of urea.

When oxalate of lime occurs in the urine, mixed with uric acid, there is reason to believe that, in some cases, it proceeds from the decomposition of the uric acid itself, under the influence of acid conditions of the urine. This circumstance would explain the frequent occurrence of oxalic acid in urine which has been voided a day or two, when none could be detected in it a few hours after it had been passed.

Whether oxalic acid is ever directly formed from articles of food consumed, like sugar, has not been distinctly proved. Dr. Bird held the opinion that it is thus formed in some cases, as shown by the following remarks:—"From the symptoms presented in cases of this disease, there is no difficulty in proving to a demonstration the positive and constant existence of serious functional derangement of the digestive organs, especially the stomach, duodenum, and liver; and further, that the quantity of oxalic acid generated is, to a very

considerable extent, under the control of diet; some articles of diet, quite free from oxalic acid, at once causing the excretion of this substance in very large quantities, whilst others appear to have the effect of nearly totally checking it."

From the resemblance which exists in the chemical composition of sugar and oxalic acid, it might have been supposed that there would have been traced some intimate relation between the occurrence of those two substances; no such connexion has however yet been detected, although sugar and oxalic acid may, and do sometimes, occur together in the same urine.

ORGANIZED DEPOSITS.

On the treatment of mucus in the urine.

Whenever the urine is of an irritating character, as, for example, when it is alkaline, it ordinarily contains an excess of mucus, which is thrown off by the irritated mucous membrane. In these cases, the treatment consists in obviating the condition of the urine, whether this proceed from constitutional or local causes, upon which the excess of mucus depends.

In the catarrh of the bladder of old people, in which mucus is largely secreted by the mucous membrane of the bladder, astringent remedies — as gallic acid, Bucha and Pereira brava, and demulcents — as well as tonics, must be administered.

On the treatment of pus in the urine.

When pus is present in the urine, the first endeavour

must be to ascertain the source whence it proceeds, whether from the kidneys, the bladder, the prostate, or the urethra. In effecting this discrimination, we are guided chiefly by the seat of the pain, or other uneasy or abnormal sensations. In some few cases, the microscope will be found useful in determining whether the pus proceeds from the bladder or kidney; as it sometimes happens, when it comes from the kidney, that a few renal tubes or casts may be detected in it; this, however, is by no means commonly the case.

Whatever may be the source of the pus is of less consequence, as affecting the treatment, than the determination of the cause which gives rise to the formation of the pus; it may originate in inflammation of the kidneys, tending to an abscess; in inflammation and ulceration of the mucous membrane of the bladder, or of the prostate; or it may originate in the presence of a calculus, either in the kidneys or the bladder; or the irritation, inflammation, and ulceration may be caused by an alkaline, and consequently irritating, condition of the urine. According to the cause, so must the treatment be shaped; but, in nearly all cases, the free exhibition of astringent remedies is required, including especially gallic acid, sulphuric acid, alum, tincture of the sesquichloride of iron, and sulphate of copper. In some cases, in which the pus proceeds from ulceration of the mucous membrane of the bladder, the cure may be promoted by suitable astringent injections.

On the treatment of blood in the urine.

In these cases, again, we must determine, in the first place, the source of the hæmorrhage; and, in the second,

its cause. The symptoms, local and constitutional, furnish the clue to both these points.

All the causes which give rise to the presence of pus in the urine may also occasion that of blood. There are two or three causes, however, to which the presence of blood in the urine may in general be referred, namely, calculus, either in the kidney or the bladder, malignant disease of either of those organs, or ulceration of the bladder. Of course, the treatment must vary accordingly; but, in most cases, when the hæmorrhage is extensive and persistent, astringent and styptic remedies, as well as injections, must be employed.

Valuable information as to the source of the hæmorrhage is sometimes derived by observing whether, in voiding the urine, the blood comes first or last, whether it is uniformly distributed throughout the urine, or whether it escapes in clots, and the form of these clots. If it comes away before the urine, or with the first portion passed, the seat of the hæmorrhage is, most probably, in the urethra, the prostate, or the neck of the bladder; if it comes with straining at last, in clots of irregular size and shape, it proceeds from some part of the mucous surface of the bladder; and if it is uniformly diffused throughout the urine, and partly in long narrow shreds, as though moulded in the ureter, the hæmorrhage will usually be found to proceed from one or other of the kidneys, rarely from both. Lastly, in some cases, the source of the hæmorrhage may be determined by means of the microscope. If blood casts be found in the urine, then no doubt can be entertained as to the source of the hæmorrhage.

On seminal fluid in the urine, and on the treatment of spermatorrhœa.

We have the satisfaction of stating, as one of the results of a tolerably extensive experience, that seminal fluid is much less frequently contained in the urine than is ordinarily supposed, either by the medical man or the patient.

When a patient, especially if nervous and dyspeptic, and losing flesh, observes that his water is thick, cloudy, or otherwise out of condition, he is exceedingly apt to fancy that the cause of his ailment is to be found in the loss of seminal fluid by the urine, and the consequent ruinous drain upon his system.

Now, if such a case happens to fall, as it too frequently does, into the hands of a quack, and the patient imparts to him his suspicions and his fears, he is almost sure to have them confirmed, and his alarm still further excited, although not the slightest foundation may exist for the patient's fears. Unhappy, indeed, is the case of such a one in the hands of those remorseless impostors, who, too frequently, rob him both of money and health. For the comfort and assurance of such patients, I am enabled to state that I have not found seminal fluid to be present in one tenth of the cases in which it has been supposed to be contained in the urine.

It is, however, undoubtedly true, that many cases do occur in which the spermatic fluid does escape with the urine.

There are three classes of cases in which it is sometimes found:—

First, in the robust and plethoric—a partial escape of

semen takes place at intervals in passing water during straining at stool. The discharge occurring under such circumstances is of the least consequence of any, and is to be regarded as an effort of nature to relieve the engorgement and over-distension of the parts.

Second, in the nervous and irritable, a partial discharge of semen with the urine sometimes occurs, the result not, as in the previous case, of general health and plethora, but of a local excitement and plethora only. In some persons of irritable temperament, whose brain and sexual organs are much excited, a determination of blood takes place periodically to the organs of generation, a secretion of much thin and watery semen takes place, and which is apt to escape under excitement or exertion, such as straining at stool—the parts in this case being also somewhat debilitated.

Third, in the debilitated from disease or abuse, a discharge will sometimes take place with the urine. In these cases, there is little plethora, but much relaxation of parts, so that they cannot retain any considerable amount of the seminal secretion.

The plan of treatment of these three classes of cases is essentially different.

The treatment, in the case of the robust and plethoric, consists in the careful regulation of the diet, especially avoiding all exciting and stimulating articles both of food and drink, in the exhibition of cooling and aperient remedies, and in cold-bathing.

In the case of the nervous and irritable, the diet must be light and nutritious, and suitable tonics and anodynes, as hyoscyamus, administered; but, above all, over work and excitement of the brain and nervous system, and especially sexual excitement, must be avoided.

By indulgence, this form of the malady is sure to increase.

In the third class of cases, those occurring in the weak and debilitated, the treatment should consist in the adoption of every means by which the bodily strength and energies are improved; nutritious diet, moderate exercise, pure air, friction to the skin by means of horse-hair gloves, tonics and anodynes, especially quinine, sometimes combined with iron and the mineral acids.

In many of these cases, especially where there is great relaxation of parts, cauterization of the membranous and prostatic portions of the urethra, according to the method of M. Lallemand, with nitrate of silver, will be found to be highly beneficial.

With regard to cold-bathing, we are convinced that, valuable as this remedy is when employed in suitable cases, its indiscriminate adoption does much harm. With many persons, especially those whose nervous system is much depressed, cold-bathing—although, at the time, it appears to refresh and invigorate—really produces a most depressing and exhausting effect, and hence does much harm in place of good. Cold-bathing is, therefore, a remedy which requires to be used with caution and discrimination.

Now, the three classes of cases, the chief features of which I have sketched out, and in which spermatic fluid is apt to be passed along with the urine, are just those in which seminal emissions, nocturnal and diurnal, frequently occur; and the treatment required for which is similar in principle to that indicated when the semen comes away partially with the urine.

In the treatment of cases of spermatorrhœa, too great stress cannot be laid upon the necessity of attention to

the state of the digestive organs, and of the brain and nervous system. In many cases, the root of the mischief may be traced to weak and faulty digestion, and the cerebral irritation therewith connected. In other cases, the brain and nervous system are more at fault than the digestion; and hence the condition of the nervous system requires, usually, our special attention.

When spermatorrhœa is treated on sound principles, and when that treatment is steadily pursued, there are few cases that cannot be cured—there being no special art or mystery in the necessary treatment. We make this remark for the encouragement of students and medical practitioners, some of whom are apt to look upon these cases as almost hopeless; and who, therefore, fail to bestow upon them that care and attention which their importance deserves; and the consequence is that, too frequently, they fall into the hands of unprincipled quacks.

TREATMENT AND DIAGNOSIS OF STONE IN THE BLADDER.

It has long appeared to me that stone in the bladder is one of the most artificial and unnatural affections to which the human subject is liable; and that the very circumstance of its occurrence affords a convincing proof of the incompleteness of the present state of medical science.

That this view is correct, will become apparent, as we consider the circumstances under which stone is formed.

First, the very words, "stone in the bladder," sound unnatural—a stony substance, usually rolling about freely

in the cavity of a viscus having a communication with the exterior of the body.

Again, the formation of stone in the bladder is not a sudden occurrence—is not the work of a few hours, days, or weeks, but occupies ordinarily months, and even years. Neither is a calculus formed in the bladder without there being a very evident manifestation of the risk and probability of such a catastrophe.

There is, invariably, a persistent condition of the urine going on for months or years obvious to the unaided sight, and which ought to attract the attention of both patient and physician: that is, for a very long period prior to the formation of a stone, there is a very sensible and obvious deposit in the urine; for it is only those substances, be it remembered, which are but sparingly soluble in the urine, which ever form calculi.

Now this deposit, in the great majority of cases, although observed by the patient, is allowed to continue and to go on unchecked without his seeking for medical advice; and it is only when symptoms of stone have presented themselves that he is led to seek for aid; but then great mischief is already done, and the physician is called upon to treat not only the condition of the urine which has occasioned the stone, but has to endeavour to act, by his remedies, upon the stone itself. This is generally regarded as a task so difficult that the physician usually abandons it in despair, and the case is handed over to the surgeon, the stone being removed ordinarily by the extreme and heroic remedy of vivisection and forcible extraction.

In ordinary cases, then, the physician and the patient are alike ignorant of the impending calamity; or if they entertain any suspicion that the condition of the urine is

one likely to tend to the formation of stone, they do not usually attach sufficient importance to it to make it the subject of active and immediate treatment. The presence of a stone is usually first determined by the surgeon. Again, when even the calculus is discovered, the physician is rarely called upon to put into operation the resources of his art; but the treatment generally pursued is strictly surgical.

Now, I contend that the physician ought to take a prominent position in the treatment of stone. The conditions of the urine leading to calculi are chemical, physiological, and pathological, for all which reasons medical treatment is required.

Further, the medical treatment pursued should not be limited to the period of the actual presence of a stone; for then, although more can be accomplished medically than is usually supposed, the best opportunity for medical treatment has passed. In fact, the treatment should be anticipative and preventive, and not merely palliative or curative. That is, every person whose urine contains an habitual and persistent deposit should seek medical advice, with a view to the correction of that non-natural condition of urine which predisposes to the formation of calculi.

The particular nature of the treatment demanded is determined, of course, by the nature and composition of the deposit, and need not here be described; that for persistent deposits of uric acid, the urates and cystine, has already been fully detailed in my Lectures, published in the *Lancet* for the first half of the current year. We would in this place limit the observations we have to make to some few general particulars relating to the treatment of stone itself when actually formed; and,

first, we would treat of solvent and especially alkaline remedies.

These remedies, as ordinarily employed, are not exhibited to anything like the extent to which they ought to be given. As usually prescribed, they are administered in doses of from ten, twenty, to at the most thirty grains, two or three times a day.

This fact has been forced particularly upon my attention by the analysis of a quack remedy called "*constitution water*," and which has acquired some celebrity in the treatment of some forms of stone. It consists of impure carbonate of potash, and the dose is the eighth part of a bottle about the size of a wine bottle, four doses to be taken daily—equal to about 184 grains, or upwards of three drachms of carbonate of potash—a quantity which in some cases may be greatly exceeded with advantage.

Now, the doses of the other alkalies, alkaline carbonates, citrates, acetates, and tartrates, and indeed of nearly all the solvent remedies employed in the treatment of stone, may be increased in like proportion, and with similar advantage.

Another very important deficiency in the present mode of treating stone is, that the remedies resorted to, being usually only administered by the mouth, are conveyed to the stone in the bladder by the circuitous route of the circulation: in the blood, of course, these remedies become much diluted, so that they reach the bladder in a greatly weakened form. Again, administered freely, alkaline remedies are apt to disorder the general health, modifying, as they do so materially, the vital and physical properties of the blood, as well of the various fluids secreted from it.

Now, these disadvantages may be obviated, by employ-

ing the solvent remedies used in the form of *injection;* these should not only be strong and frequently repeated, but they should be retained in the bladder as long as possible, or should be injected in a continuous stream.

I am, of course, aware that injections have been tried occasionally in the treatment of stone, with more or less success; but they are not resorted to nearly so frequently as they ought to be, nor have they been employed in the manner most conducive to success.

I would not be understood as recommending the use of vesical injections, to the exclusion of constitutional treatment; this, of course, should be persevered in as well.

Again: in some cases, medical may be combined with surgical treatment: that is, the stone having been reduced to fragments by the lithotrite, the solution of the fragments should be attempted by the employment of suitable remedies, both through the medium of the constitution and locally by injection.

The conditions of the urine tending to the production of stone which call for treatment, are those in which that fluid contains persistent deposits of uric acid, urates, oxalate of lime, cystine, and the earthy phosphates. The calculi ordinarily met with are composed entirely or in part of one or other of these compounds; those composed of uric oxide, silicic acid, and carbonate of lime, are of such rare occurrence that it is scarcely necessary to take them into consideration at all.

The following figures show the relative frequency of the occurrence of the calculi most commonly met with:—

Of 1000 calculi, the composition of which has been ascertained, 372 consisted of *uric acid,* alone, or mixed with small quantities of the urates and oxalate or phos-

phate of lime; 253, of the *earthy phosphates*, chiefly fusible calculi; 233, of varying layers of *uric acid*, *oxalate of lime*, and *earthy phosphates;* 142, of *oxalate of lime.*

The urinary deposits and calculi most readily acted upon by solvent remedies are, the several earthy phosphates and cystine; and, therefore, it is in these cases especially that the greatest amount of success is to be anticipated from the treatment here recommended.

I have now a few remarks to make on the subject of the *diagnosis* of calculi.

In general, but few attempts are made by the surgeon to determine, either during the existence of a calculus or prior to an operation, the chemical composition of the calculus, and yet the microscope affords a ready and satisfactory means by which this object may generally be accomplished. Thus, the composition of the stone may frequently be determined with considerable accuracy by ascertaining, by means of the microscope, the ordinary deposit or deposits occurring in several consecutive samples of the same urine. The determination of the composition of the calculus is not, indeed, often a matter of much importance to the surgeon who is about to remove the stone by operation; but to the physician, proposing to treat the case medically, it is a point of the utmost moment, because it is only upon this knowledge that the proper and exact line of treatment to be pursued can be based. There is yet another way in which the composition of calculi may be determined—namely, by a chemical examination of the fragments usually passed after the operation of crushing by the lithotrite.

Berzelius, in his *Handbook*, makes these remarks respecting the solution of vesical calculi:—"The attempts which have been made to dissolve concretions in the

bladder have not succeeded as we might have expected. However, I am perfectly convinced that they have not been often enough reported to enable us to find out and remedy those obstacles which we are unable to foresee, and which frequently increase the difficulties of their application."

An article on the same subject in the *British and Foreign Quarterly Review* contains these words:—"So much has already been done as to hold out every inducement to perseverance, and perseverance must of necessity be crowned with success in a certain proportion of cases."

THE END.

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