Urinary and renal derangements and calculous disorders : hints on diagnosis and treatment / by Lionel S. Beale.

Contributors

Beale, Lionel S. 1828-1906.

Publication/Creation

London ; J. & A. Churchill ; Philadelphia : Presley Blakiston, 1885.

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URINARY AND RENAL DERANGEMENTS

AND

CALCULOUS DISORDERS.

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URINARY

AND RENAL DERANGEMENTS

AND

CALCULOUS DISORDERS:

HINTS ON DIAGNOSIS AND TREATMENT.

BY

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LONDON: J. & A. CHURCHILL.
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URINARY AND RENAL

DERANGEMENTS,

AND CALCULOUS DISORDERS.

HINTS ON

DIAGNOSIS AND TREATMENT.

Of all the products of secretion formed in the human body the urine varies in character in the greatest degree within the range of health; indeed the quantity and relative proportion of some of its most important constituents change from hour to hour. Moreover, these variations must occur, and are a necessity if physiological equilibrium is to be preserved. Great and adverse changes as regards the temperature of the body generally, and alterations in chemical action detrimental and possibly dangerous to health are thus prevented. Considerations in this direction may be further generalized and more widely applied, inasmuch as the formation of the urinary constituents takes place in far distant parts of the organism and in tissues of the most diverse characters. Some of the urine substances are no doubt being perpetually produced in the blood, and are removed from the circulating fluid almost as fast as they are produced. So important is the removal of many of them from the precincts of the most important organs that if they accumulate in the blood for but a few hours the activity of certain nerve centres is impeded or suspended, and unless relief be quickly afforded life may be endangered, if not cut short, and the patient will have to pass through a long and severe illness before the normal state of things can be restored. No wonder then that from the earliest days of medicine the urinary secretion should have been studied with especial care, and that its consideration should constitute one of the most important departments of practical medicine. In these days so extended is the range of our knowledge of urinary diseases

that the subject could not be treated of in a volume consisting of many more hundred pages than the present contains. I shall only attempt to direct the attention of practitioners to the management of those derangements and diseases of the urinary system which frequently fall to the province of the physician to treat. In many cases I can only give hints as to the general line of treatment to be pursued, but as regards some conditions, I hope to offer suggestions based on facts I have observed, or learnt from others, in the course of more than thirty years' practice, which may be useful to the practitioner. I shall not attempt even to enumerate all the remedial measures which have been proposed or carried into effect, but endeavour rather to concentrate attention upon the principles which should guide us in the treatment of the various departures from the healthy state, of which indications are afforded by examining the urine, or by other methods of clinical observation.

Nor is it only in great alterations in the amount of its usual constituents that the urine of health may differ from that secreted in physiological derangements or in structural disease. There are several substances which may be present, of which not a trace can be detected in the secretion in health—biliary, albuminous, and other matters from the blood, sugar—besides many things forming definite and perhaps bulky deposits, of which mere traces, or no indications whatever, exist in the urine in the healthy condition, may be present, and in varying quantity. Of these, some indicate a condition of things which may be expected to end fatally within a short period of time, while others are due only to a transitory disturbance, a temporary and unusual chemical change, or are accidentally present. The practitioner has to bear in mind the distinguishing general features and chemical microscopical characters by which substances which are of great significance may be identified and distinguished from those which are of no clinical consequence.

VARIATION IN THE QUANTITY OF WATER.—IMPORTANCE OF DILUTING THE FLUIDS OF THE BODY, AND OF WASHING OUT THE TISSUES.

All the liquid secretions of the body vary from time to time as regards the proportion of water by which the special constituents are held in solution, but in this respect the urine varies more than any other secretion. At one time the proportion of solid matter to water may be as 1 to 10, at another as 1 to 1,000. Although the quantity of water in the urine is determined mainly by the amount taken, it does not wholly depend upon this circumstance, neither does it vary in direct ratio with the water imbibed, for in hot weather, though an excessive amount of water be taken, the urine will be found highly concentrated, the water removed from the cutaneous surface preponderating over the quantity passing through the renal emunctories.

The action of the kidneys as regards the removal of water from the blood varies from day to day and even from hour to hour. This constant variation is physiological, and is one of the many factors by which a uniform composition of the blood is maintained in spite of the tendency to change consequent upon various actions which determine chemical decomposition. An ever-varying body temperature would necessarily result, but for the compensating changes induced by the action of the skin and kidneys, whereby solid excrementitious matters and water are continually removed in ever-varying proportion, and some alteration in the composition of some of the solid constituents also occasioned.

One is often surprised at the very different amount of liquid persons in good health habitually consume. Some find that a quart, or even less, suffices for their daily requirements and for the satisfying their thirst, while others drink twice or three times as much. One healthy man will walk from morning to night, and though sweating freely the whole time, will not feel any great desire for drink, while another, under precisely the same conditions, will not be able to get on without consuming many pints of fluid. Some consider that water containing various nutritious matters and alcohol (beer !) absolutely necessary if any unusual exercise be taken. In cases where the quantity of water removed by the kidneys is habitually considerable, we shall generally find on inquiry that the patient has gradually acquired the habit of drinking largely of water or other liquids, until at last he cannot get on without continually yielding to the desire to drink. The amount of food as well as liquid taken by an individual in good health is very much a question of habit.

From time to time the most extraordinarily rapid flow of water from the blood takes place. Through emotional influence more than a pint of water may be separated from the blood in ten minutes. In these cases the total amount of urine secreted in the twenty-four hours is not necessarily increased, but in response to rapid changes in the nerve centres, sudden relaxation of the vessels of the malpighian body takes place, and the water transudes through the thin capillary walls with great rapidity. As is well known, the secretion of watery urine follows in the course of a few minutes the imbibition of considerable quantities of liquid. In a man in whom the anterior walls of the bladder were absent, and the orifices of the ureters fully exposed to view, I have seen limped urine distilling drop by drop within five minutes after the man had swallowed a glass of champagne. Those who fancy that albumen of serum ordinarily escapes with the watery part of the blood from the vessels of the glomerulus, have not, I think, given sufficient weight to these facts, which, as it appears to me, tell against their hypothesis ; for is it not difficult to accept the conclusion that in this very rapid operation time is allowed for the reabsorption of the effused albumen by the cells

of the convoluted portion of the uriniferous tube? At the same time one cannot go so far as to hold that this would be impossible under the circumstances referred to.

The importance of water and of dilution and diluents.—Some persons no doubt get into the habit of taking more water than is necessary for their system, or for many reasons desirable. I feel sure that more take too little in proportion to the solid food they consume,—in fact, eat too well and do not take fluid enough to ensure the proper assimilation of much of the solid matter, and effect the free solution and removal of the excrementitious substances formed during the physiological action of the tissues and organs. The consequence is, that as time goes on the deposition of various substances takes place, and contraction and condensation of the tissues proceed faster than they should do, old age being reached years before the natural period of its advent. Not only is free dilution advantageous in many ways, but in this way food is wonderfully economised. Some of those who while really eating sparingly nevertheless gain rapidly in weight, take considerable quantities of fluid with or after taking food. In endeavouring to reduce weight, this important point must not be lost sight of, and the imbibition of large quantities of water must not be permitted. One reason why milk is so fattening is that its constituents are dissolved and suspended in a large proportion of water, for, as is well known, the insoluble fatty matter is very minutely divided, and by a special arrangement evenly spread through the whole bulk of the milk. Many morbid conditions are relieved by the introduction of plenty of fluid at proper intervals. The public have discovered the benefit of considerable, if not excessive, water drinking for a period of one or two months out of the twelve, and the annual expedition to springs in every part of the Continent has become more than fashionable. The value of many of the mineral "waters" seems to be mainly due to the chief and universal constituent of all.

In many forms of illness, which, if they persist for any time, are certain to damage the whole body, and may be painful to endure during the entire period of their existence, all that is really required to restore the healthy condition is to wash out the tissues and organs, so that various noxious substances which have been accumulating, it may be for many years, may be dissolved by the water made to traverse the minute interstices of the textures, and thus removed in solution. To effect this purpose considerable time is often required. A course of one or two months, during which from two to six or more pints of water are taken daily, is often requisite to produce much effect. Although there can be no doubt that alkalies and other saline constituents in natural waters exert a beneficial influence, in many cases an excellent result is obtained by the use of water alone, and especially distilled water, which may now be

obtained pure, or impregnated with carbonic acid gas, of the "Salutaris Water Company," 286, Fulham Road. Many therefore who are unable to spend weeks in a German or even an English watering place, who cannot without losing their position, and perhaps their prospects of earning a livelihood, leave their work in town for a week or even a day, may subject themselves to remedial measures, from which they may derive great benefit, and in a comparatively short time. A fair allowance of fluid per diem not only economises food, but by keeping the fluids in the interstices of the tissues in a dilute state, promotes free interchange, favours oxidation, and prevents the occurrence of many of the so-called degenerations. For these are mainly due to the state of things resulting from the accumulation of substances in an insoluble form in the tissues, which should be rendered soluble by oxidation, and removed in solution and excreted as fast as they are produced in the course of chemical change.

Although not unfrequently we are constrained from inexactness and insufficiency of our knowledge to attribute certain symptoms to a "gouty tendency," "diathesis," "habit of body," "disposition," "peculiarity," or "susceptibility," acquired, inherited, or evolved, which belong to a different category, being due to causes different in their nature from those upon which gout depends, it is certain that a state of system, a state of the blood and the tissues, which often eventuates in gout, is really very common. That this state may be produced in certain constitutions by persisting in a particular mode of life is true, but it is also true that some are so prone to the change referred to, so "susceptible" or "vulnerable" in this respect, that by no plan of diet can they, at least in this climate, wholly avoid it or protect themselves from it. In the great majority, however, the state in which one or more of the many symptoms indicative of the condition of system in question exist, may certainly be prevented by care in the mode of living from the moment the first evidence of disturbed action becomes manifest; and, if already established, the condition may be mitigated or cured by judicious treatment persisted in for a sufficient time. To effect advantageous change in inveterate cases, appropriate treatment should be persisted in for a considerable period of time. Benefit, unquestionably, results from the annual visit to baths, and the altered diet and washing out to which the body is subjected for six weeks or two months, but in too many instances the good obtained is soon neutralised by the patient's return to the injudicious habits which originally occasioned the departure from health, and which if continued will certainly lead to the establishment of pathological changes beyond the possibility of cure.

Rules cannot be laid down which will apply to all cases, and it will be sufficient to indicate the general principles upon which the treatment of such a case should be conducted. It is advantageous, if not neces-

sary, that the patient himself should be acquainted with these, in order that he may know how to manage himself from day to day, and, if possible, prevent any changes that would interfere with steady improvement. I have often been surprised at the length of the period over which decided and, perhaps, uninterrupted advance towards the healthy state extends. An unmistakable indication of the general disturbance of nutrition, and departure from the normal state of the blood, is often afforded by the presence of patches of eczematous eruption, or of psoriasis in various parts of the body. These morbid conditions of the skin are very obstinate, though they may be slight. It is no uncommon thing to see patches of rough cuticle, as large as a shilling, to the number of ten or twenty in different parts of the body, not unfrequently attended with irritation and itching, especially in the evening and at night, when the cutaneous surface gets warm. They may persist for years—now better now worse. Everything that can be thought of may be tried in vain, and advisers of every kind have, perhaps, been consulted one after the other without avail. The fact is, for the cure of such cases much time is required. The patient may have been put on the right course many times, but treatment for a month or two only is useless, or nearly so. It is only by degrees that health can be restored. Obstinate derangement of the liver and large bowel probably has an important influence in keeping up the state of blood and of the nerve centres which favour the deranged state of nutrition of the cuticle. We may, undoubtedly, help the patient by prescribing small doses of grey powder, or other mercurial now and then, and by the judicious use of alkaline and purgative remedies, with a course of iodide of iron, or by sending him to Carlsbad for a month or six weeks, but he will not be cured, and on his return to his usual habits the trouble will return and get worse from year to year. He will come to the conclusion that he must make the best of it, and bear it as best he may, and possibly he will be assured that it is incurable, while, in fact, if he put himself on proper diet, with plenty of air and an occasional warm bath for twelve months or more, he would not only cure the cutaneous eruption, but would regain general health and vigour to a degree that would surprise him and his friends. It is astonishing how difficult it is to persuade people to act sensibly as regards the management of their bodies continuously for a considerable time. They will try, one after another, all the remedies you recommend; they will live for a time on the simplest fare, take air and exercise by the clock, and subject themselves to hard hygienic discipline for a few weeks, but to get them to act with good sense for six months seems impossible, and I fear, with all our Health Exhibitions, books, lectures, schools, and instruction far and wide among all classes, we are almost as far as ever from getting people to eat and drink and sleep and dress and take exercise without frequent and open defiance

alike of health laws, common sense, and of the ordinary principles of physiology now taught in children's primers.

It cannot be too often mentioned that most of the acute diseases which come on unexpectedly, and the invasion of which seems so sudden, the patient being as it were struck down in the most appalling manner without having been aware up to the very moment of attack that he was not in ordinary and perfect health, have been threatening for weeks or months. For a long period preceding the attack the blood has been getting out of order, excrementitious matters have been accumulating, the interstices of organs whose free action is necessary to health have become occupied by imperfectly soluble matters, the intertextural channels have become clogged, and for a long while there has been frequent interference with proper action and in an augmenting degree, until at last derangement eventuates in temporary stoppage of action and a sudden and desperate shock to every organ in the body, consequent upon a serious change in the blood which cannot be compensated or controlled, results, and weeks or months must pass before the derangement and perhaps actual damage effected can be repaired. It seems possible that almost up to the moment of the "acute attack" active medical interference, according to well recognised principles, might have warded it off, or enabled the patient to escape with perhaps a violent rigor, followed by very free action of the bowels, the skin, and the kidneys.

It is quite certain that in many derangements of the stomach and intestinal canal that the free passage of fluid through them during a period of twenty-four or forty-eight hours is often of great service. The liquid in these cases does not go directly through the canal, but it, or at least the greater part, is absorbed by the stomach, taken into the blood, and again poured out by the secreting glands, and with it some of the excrementitious matters which have been accumulating in the system, perhaps for weeks or months, are got rid of at the same time. In many cases of headache, due to deranged digestion and assimilation, this free dilution of the fluids and washing out of the system is carried out with the greatest benefit, and in many cases a cure is effected in the course of from twelve to twenty-four hours.

As regards the particular diluent, there is often great difficulty in selection. Weak lemonade answers well in many cases; milk or whey and water, or soda water in others; potash water, German seltzer water, Vals, or other effervescing water may be given, or an effervescing draught of tartrate, or citrate of potash, or soda. The so-called effervescing citrate of magnesia is also very good, and makes a very cheap and convenient form of effervescing beverage. These may be iced, but not more than about a wine glassful should be swallowed at once. By suddenly swallowing a tumblerful of ice-cold fluid, people often disturb

the stomach for hours, but if the tumblerful had been spread over a period of five or ten minutes, so as to allow just time for one mouthful of the cold fluid to be slightly warmed in the stomach before the addition to it of a second, no harm or inconvenience would have resulted. What we effect by this plan is the removal of substances which require much water for their solution and the prevention of the formation of a further quantity. The accumulation of various noxious matters in the blood and fluids of the tissues and among the tissues themselves upsets the balance of physiological change, and leads to the initiation of the disturbance which may eventuate in an attack of acute disease. By free dilution, followed by purgation, diuresis, and sweating, there is reason to think that in many cases the acute disease might have been altogether prevented.

It is often said that water acts as a "diuretic," but perhaps it would be more correct to say as a diluent. Water dilutes the fluids of the body, and serves to dissolve matters which are not very soluble, or dilutes solutions which are in a too concentrated state to undergo the further chemical change requisite for their discharge from the body. It must be obvious that when there is structural disease of the organs through the agency of which many of the most important excrementitious matters are eliminated from the system in solution, it is a point of great consequence that the solids should be constantly presented for excretion in a high degree of dilution, and also that the quantity of solids introduced as food should be reduced to the lowest amount consistent with the needs of the system.

In chronic renal disease a considerable amount of liquid should be taken, large in proportion to the amount of the excreted solids. A weak solution of the organic and inorganic matters will filter through the vascular walls almost without the help of any special secerning action at all. This fact is impressed upon the mind by many cases of chronic renal degeneration of various kinds. I have known many a patient who has gone on for some months, or even years, with scarcely any of the renal secerning apparatus in an active state. Taking little solid food, but much water, living, in fact, on milk, beef tea, and things containing much water, leading an invalid life, getting plenty of air, but taking little or no exercise,—the system of the patient has slowly got into a state in which chemical change is reduced to a minimum; and if tolerably free filtration goes on through the vessels of the urinary apparatus, life may last till some accidental sudden and exceptional change occurs, or until, by undue accumulation of excrementitious matters, the balance is destroyed, the living matter of the body is poisoned, and death may occur in the course of a few hours, to the dismay of friends, and often to the astonishment of the practitioner.

As a rule, then, urine containing an unusual proportion of water is

not a matter of much consequence, for it generally depends upon the rapid separation of a large quantity of water from the blood, and may be preceded and succeeded by the secretion of urine of the usual density. This free and rapid discharge from the blood of considerable quantities of water may be due solely to altered blood pressure in the vessels of the malpighian body, determined by changes in the nerve centres, which govern the contraction of the muscular fibre cells of the extensions of the renal artery. As is well known, this part of the nervous system is much influenced by the emotions. Fright, anxiety, or intense interest may, through this mechanism, determine the secretion of a considerable quantity of pale watery urine within a few minutes. In cases, however, where the secretion of a large amount of urine of low specific gravity continues for a considerable period of time, it may be a fact of grave import, and probably depends upon serious structural alteration in the kidneys, which may soon result in death. And it is surprising how suddenly the fatal symptoms appear in some of these cases. The patient may seem to be in the state of somewhat weak or impaired health, which has existed for many months, when, without warning, and, as far as can be ascertained, without any special change in the state of things, terrible exhaustion comes on, and is soon succeeded by complete failure of strength, collapse, and death. In such cases the kidneys are sometimes found reduced to little more than mere capsules of fibrous tissue, with scarcely a vestige of secreting structure left, and the wonder is not that death has resulted, but rather that the fatal result should have been so long postponed.

In one case that came under my care some years ago, that of a lady about 50, who had for years passed a large quantity of highly diluted urine, and died after two or three days' suppression, the cause of the renal degeneration was found to be a stone in the pelvis of each kidney, so situated as to interfere with the free passage of the urine from the pelvis of the kidney into the ureter, but never to completely obstruct it. The renal structure was hard, and there was probably no portion of the cortical part as large as a pea where the normal secretion of urine could be carried on. What is very remarkable is, that this patient had had no renal symptoms whatever at any time of her life. She had often been treated for uterine disturbance, but to within a week of her death had enjoyed fair health. She could walk well, and though never very strong, was active, and able to get through more work than most ladies.

REACTION OF URINE, AND OF THE USE OF ACIDS AND ALKALIES.

I fear it must be admitted that with regard to the action of these simple and highly efficient remedies, acids and alkalies, there are many cases in which we still have to prescribe somewhat empirically, or even in a haphazard manner. We meet with cases in which an acid or an alkali

respectively seems to be indicated. We prescribe—but their symptoms instead of being relieved are heightened. The remedy is therefore changed, and that given which it was thought was contra-indicated. Benefit immediately results, and the patient soon gets well. After a time perhaps he tries the same plan again, and it signally fails, while this time the remedy succeeds which before was useless.

Many of the derangements in which acids and alkalies are prescribed, depend upon highly complex changes which are little understood as regards their origin and causation. The contents of the stomach may be acid, and the "acidity," as well as the patient's discomfort, increased by giving alkalies, while relief may quickly follow the exhibition of a mineral acid. On the other hand, a case of what would be regarded by some as alkaline dyspepsia, accompanied by the discharge of an alkaline fluid from the stomach, may be cured by an alkali, but caused to return, and in a more severe form, if an acid treatment be persisted in for too long a time. One can only learn how long to prescribe, and when to withhold such remedies, by the careful study of individual cases, and by experiments on one's own organism. The practitioner will often find in cases which do not improve upon any plan of treatment he has adopted, that benefit will be obtained by judiciously reducing, or by completely withholding food for a time, or by giving one particular kind of food only—in some cases nothing but milk, in teaspoonfuls at a time, and iced; in some, beef tea only; in some, a diet limited to farinaceous food. Indian corn or lentil flour, made into the consistence of gruel with water or milk, and well boiled for a quarter of an hour or longer, often answers. In advising such a course, caution must be exercised, for some patients quarrel with us at the mere suggestion of a diet which they regard as starvation, although to us it might seem fairly liberal. But many who would rebel on the first mention of a plan of treatment, considered by us to be necessary, will gradually fall into our views and adopt our recommendations if we only allow them a little time to think about it, and lead them, by degrees, to adopt a restricted diet, instead of insisting that they should pass abruptly from the enjoyment of all the luxuries that money and skill can obtain, to the bare necessaries of existence, without sauce or flavour to tickle the palate. In teaching self-denial to people who have foolishly indulged their appetites to the detriment of their tissues and organs, the medical adviser must be content to work gradually towards the desired end. Sudden conversions to common sense are as rare, if not as impossible, as sudden restoration to health after years of injudicious eating and drinking and silly management of the body.

The characters of the urine are much influenced by the digestive process; and by the administration of acids or alkalies great changes in its composition as well as in the sensation resulting from the contact of the

secretion with the highly sensitive mucous membrane of the urinary organs may be quickly effected.

Acid urine.—The mucous membrane of both the stomach and bladder is kept in a healthy state by contact with secretion, which although varying in the intensity of its reaction, is in its normal or healthy state acid. The epithelium on the mucous surface remains healthy, and is replaced by new cells at the proper rate, only as long as it is bathed with the acid secretion, and it suffers much, while a long time is required to restore it to its usual condition, if, as not unfrequently happens, particularly in the case of the bladder, the secretion becomes decidedly alkaline. If the latter condition lasts for some time, and especially if the urine becomes highly alkaline, the epithelial surface is practically destroyed, in which case, although the surface may improve up to a certain point, it cannot be restored to its original condition. A highly alkaline state of urine is engendered by the setting free of carbonate of ammonia, by the decomposition of the urea, in cases in which the bladder does not thoroughly empty itself; and if the state of things causing this retention is not remedied, the erosion and destruction of epithelium, of the mucous membrane in its entire thickness, and not unfrequently of structures beneath it, are terrible. Now such a state of things may be prevented, or if it has not been allowed to persist for too long a period, greatly improved or even cured, as far as the working of the organ is concerned, in a very simple way. If the water be drawn off twice or three times a day, and the bladder be carefully washed out once daily with water of the same temperature as the urine—that is a little under 100° Fahrenheit,=37·7 Cent.—great improvement will result in a few days, and in many cases the patient's distress will be quite relieved in the course of a week. Perhaps in another week the bladder will act for itself, and the urine need only be drawn off once a day, or the operation given up for a time altogether, especially if the patient is instructed to micturate on his knees, the body being bent forwards.

The process of pus formation upon the surface of the genito-urinary mucous membrane often begins in the urethra in an attack of gonorrhea in early life, which soon gets well, but leaves a slightly altered epithelial surface. Here and there a few pus corpuscles continue to be formed, and are from time to time found in the urine. In any slight derangement of the health the process is apt to spread, and it not unfrequently extends into the bladder, and sometimes to the ureters and so on to the pelves of the kidneys. If a patient with these tender patches of epithelium takes cold, the process of pus formation becomes very active and a catarrh of the mucous membrane is the consequence. The morbid action may be established and reach a high pitch of intensity in the course of a few hours, but weeks may pass, especially if the patient be advancing in years, before things return to their general state, for the

perfectly normal or healthy condition is seldom quite regained after the age of forty or five-and-forty is passed. The treatment of this condition, and further remarks upon its nature, will be found under the head of "Pus in the urine."

Bence Jones showed that in health when the gastric juice was most acid the urine was least so, and vice versâ. Before meals the acid reaction of the urine is most intense. After meals the urine is feebly acid, and it not unfrequently becomes alkaline about three hours after food. This change is associated with disturbance in the system, and feelings are often experienced which are very unpleasant to the patient. Headache, fulness, chilliness, and langour are often experienced, and it is by no means uncommon to find persons made quite wretched by the disturbances consequent upon deranged chemical changes.

Sleep and fasting, during which the exhalation of carbonic acid is diminished, "are attended by a rise in the acidity of the urinary secretion" (Ralfe). Highly acid urine very commonly accompanies certain forms of dyspepsia, especially the kind to which those of a gouty tendency are subject, and it is not unusual to find that the means adopted to reduce the acidity of the urine are effective in improving or restoring the action of the stomach. There is still some difference of opinion concerning the way in which the acid of the gastric juice is produced. The question is well considered in Dr. Ralfe's little book "On the Morbid Conditions of the Urine, dependant upon Derangements of Digestion," to which I must refer the reader who desires to go more fully into the question. Most probably the hydrochloric acid of the gastric juice is set free during the mutual decomposition of neutral sodium phosphate and calcium chloride. Acid sodium phosphate appears to be the cause of the acid reaction of the urine in many cases, but uric and hippuric acids contribute. In speaking of varying degrees of the acidity of the urine we estimate the acid as oxalic acid. The acid of the urine secreted in twenty-four hours in health is equivalent to about two grammes of oxalic acid.

Although the blood is invariably alkaline, from the presence probably of alkaline carbonates, many of the secretions of the body which are formed from matters taken from the blood are of a decidedly acid reaction. Probably from 300 to 500 grains of acid (irrespective of carbonic acid), calculated as oxalic acid, are formed in the body in twenty-four hours. As I have already remarked, the urine and the gastric juice are usually in health very decidedly acid, but the degree of acidity varies much, and in the intensity of their acid reaction these two secretions alternate with one another, and sometimes when one is intensely acid, the other may be even alkaline. Some of the acids upon which the acid reaction depends are formed within the body. During muscular action, carbonic as well as other acids are formed. Volatile fatty acids, formic acid,

acetic acid, lactic acid, and some others, result from changes in the contents of the alimentary canal, and are probably ultimately removed as carbonic acid, but some of them or their compounds may reach the blood and undergo further intermediate chemical changes prior to their elimination. When the action of the liver is deranged there is an accumulation of acid in the system, either from the formation of excess, or from interference with the neutralisation of as large a proportion of that which is produced as ought to be thus taken from the whole amount of acid formed. In rheumatism an unusual formation of acid takes place. Acetic, butyric, formic, and valerianic are among the acids produced. The same acids are often set free by chemical decompositions occurring in the contents of the stomach.

If bicarbonate of potash be taken before meals, the intensity of the acid reaction of the urine is diminished for some hours, but on the following day "the acidity was considerably higher than it was the day before the salt was taken. But when it was administered during the process of digestion the acidity of the urine entirely disappeared" (Dr. Ralfe, "Morbid Conditions of the Urine," pp. 54 and 143). If, then, we desire to increase the acid reaction of the urine, we must give the bicarbonate of potash when the stomach is empty, while, if we wish to diminish its acidity, the bicarbonate should be given after food. Whenever alkalies are prescribed, the patient should be instructed to continue them for a definite time only, otherwise harm, instead of good, may result. Advantage is often obtained by a course of acids before meals, and a course of alkalies after meals alternately, and I have often found hydrochloric, nitric, or phosphoric acid before two meals in the day, and bicarbonate of potash or soda an hour or two hours after the same two meals, of great use. Such treatment may be continued for a fortnight, or longer, at a time.

From numerous experiments, varied in many ways, Dr. Bence Jones came to the conclusion that ammonia in the organism was partly converted into nitric acid. Urea and caffein, and other substances containing nitrogen, give rise to the formation of a small quantity of nitric acid. Although Lehmann has failed to confirm these results, he has not, I think, succeeded in shaking the evidence adduced in favour of the conclusions. Lehmann attributed the action upon the iodide of potassium to the presence of *sulphurous acid.* Jaffé performed some experiments in Lehmann's laboratory, and obtained sulphurous acid, but no nitrous acid from healthy urine and from urine passed after taking ammoniacal salts. Dr. Bence Jones subsequently repeated his experiments, and found that Jaffé's experiments did not invalidate Price's test for nitrous acid as Lehmann supposed (*Proceedings of the Royal Society*, vol. VII, p. 94). Dr. Bence Jones brings forward several cases of healthy persons whose urine did not yield a trace of nitric acid; but, three or four hours after

they had taken carbonate of ammonia, evidence of the presence of the acid was afforded by the starch and also by the indigo test. After twelve hours, only a trace could be detected; and, in twenty-four, even this ceased to be perceptible. The urine was examined in precisely the same manner in every case. We must therefore conclude that a small amount of ammonia in the organism is converted into nitric acid; and it is not improbable that, under certain circumstances, the quantity of nitric acid formed in this manner may be very much increased.

Irritable Bladder.—In some cases, the deposition of uric acid, and the secretion of a highly acid and perhaps concentrated urine, persist for many years, and the derangements arising from this state, both as regards the urinary organs and the system, are often difficult to cure. Among the most common ailments which are due to a highly acid state of urine, is "irritable bladder." Without there being any actual disease of the coats of the bladder, the surface of the mucous membrane often becomes unduly sensitive, so that the mere contact of highly acid or concentrated urine excites an unpleasant feeling, and sometimes actual distress, which soon assumes the form of an uncontrollable desire to immediately empty the bladder, and although the organ may nearly empty, this occurs again and again, causing much suffering and inconvenience. In some cases the patient cannot retain his urine for more than an hour; and the pain is so great that the case is sometimes mistaken for inflammation of the bladder. The acid urine sometimes occasions the deposit of urates and uric acid in the bladder, and may thus give rise to stone. In some of these cases there is severe intermittent pain at the neck of the bladder and along the urethra, with frequent micturition and an almost constant feeling of a desire to make water. So severe are these symptoms, that the patient is prevented from discharging his ordinary duties, and is almost afraid to leave his own private room. He is ready to do anything or suffer anything in the hope of getting relief. Remedy after remedy is tried in vain, and he may fall into injudicious hands. Nitrate of silver, or some other strong caustic, may be applied to his urethra, not only without permanent relief, but his present suffering may be increased by this and other expedients most confidently recommended as being certain to effect his cure. Instead of this, changes perhaps take place in his urethra which may at a future time result in stricture, and necessitate constant surgical attention.

The pathology of many cases of irritable bladder is obscure. In some there is undoubtedly catarrhal inflammation of the mucous membrane, but not unfrequently the condition seems to be due to, or is complicated with, an irritable state of the sensitive nerves of the mucous membrane and disturbances of the nerve centres most difficult to relieve. The practitioner will, however, often find that in many a case of what to the patient seems to be most terrible irritability, accompanied by even

severe pain, a mercurial purge, repeated at intervals of a few days, will be of great service, although all the ordinary remedies which have been tried for his relief have failed. Sometimes the symptoms are actually caused, or greatly increased, by a concentrated state of the urine, with excess of urea, and an unduly acid condition of the urine invariably causes increased suffering. Very free dilution of the urinary secretion is indicated. Two pints or more of linseed tea, flavoured with lemon juice, distributed over the twenty-four hours, should be ordered, and be kept up for a week or ten days. If the patient gets tired of linseed tea, barley water may be taken, or mucilage of gum, or infusion of triticum repens, or even pure water, or water flavoured with orange or lemon juice.

In many cases, the salts of the vegetable acids (citrates, acetates, tartrates) will be found more efficient in counteracting this acid state of the urine than alkalies or their carbonates, and are less likely to interfere with the digestive process. There are, however, low conditions of the system in which the acid state of the urine, and a tendency to the deposition of uric acid in large quantity, are not relieved by this method; on the contrary, such cases are often much benefited by an opposite plan of treatment—tonics and the mineral acids before meals, a nourishing diet, with a moderate supply of simple stimulants with a little alkali, or with alkaline waters. Many of these cases seem to be intimately connected with impaired digestive power, and I have frequently found pepsine a valuable remedy ("Slight Ailments," 2nd edition, p. 89).

Some of the most obstinate forms of the malady under consideration occur in women. I have seen cases under the age of thirty, in which all sorts of devices had been employed without avail, yield at once to moderate purgation, alkalies, and plenty of linseed tea or barley water. In the treatment of such maladies, and in the management of the sufferers, we must be careful not to be influenced by the increasing tendency to prescribe remedy after remedy, to introduce various instruments, and to prosecute different methods of examination with the idea of immediately curing what is really a chronic malady. Sometimes, however, a careful consideration of the facts leads the practitioner to suggest a simple and efficient plan of treatment which may prove successful within a few days of its adoption, although all sorts of extraordinary and out of the way expedients have been resorted to without relief having been obtained.

Of all the remedies employed for relieving a highly irritable bladder depending upon very acid urine, with or without presence of excess of urea, or of a deposit of uric acid, *liquor potassæ* is the most efficacious, but it must be given with due care, and not continued for too long a time without intermission.

Alkaline Urine.—An *alkaline condition* of the urine may be due to several circumstances, and requires therefore to be treated on different plans. The connection between an alkaline state of the urine, depending upon fixed alkali, and the secretion of a highly acid gastric juice, has been already referred to. In such cases, attention must be paid to the state of the digestive process; and when this is set right, the urine will usually regain its normal characters. Dr. Bence Jones alludes to three cases of dyspepsia with vomiting of a very acid fluid (two of them rejecting sarcinæ) in which the urine became alkaline from the presence of fixed alkali when the quantity of acid set free at the stomach was very great; but when this was small the reaction of the urine was acid. It must, however, be borne in mind that the very acid nature of the materials rejected in many cases of vomiting, and especially in cases of sarcina ventriculi, arises, not from the secretion of an acid fluid by the glands of the stomach, but from the decomposition or fermentation of the food, when acids are developed, among which may be mentioned acetic, lactic, and butyric acids. At the same time, there can be no doubt that, in some cases of dyspepsia, the feebly acid or alkaline condition of the urine arises from the secretion of an abnormal amount of acid by the stomach. The degree of the acidity of the urine, says Dr. G. O. Rees, may, to a certain extent, be regarded as a measure of the acidity of the stomach.

Dr. Rees long ago drew attention to a large class of cases in which he thought the alkaline condition of the urine was to be explained as follows:—Urine which is highly *acid* at the time of its secretion, irritates the mucous membrane of the bladder, and causes it to secrete a large quantity of *alkaline fluid*. This mucous membrane in health secretes an alkaline fluid, to protect its surface, just as occurs in the case of some other mucous membranes. Under irritation, more alkaline fluid than is sufficient to neutralise the acid of the urine is poured out; and hence the urine, when examined, is found in some cases to have a very alkaline reaction. In such cases, this highly alkaline condition is removed by giving liquor potassæ or some other alkali, or a salt of a vegetable acid which becomes converted into an alkali in the system. The urine is not secreted so acid, and, therefore, according to Dr. Rees, does not stimulate the mucous membrane to pour out as much alkaline fluid. I know no observations to disprove this explanation of the fact, that in some cases *alkalies cause the urine to become less alkaline, or even restore its acid reaction;* yet one would hardly expect, if this be the true explanation in cases generally, that the natural reaction of urine would be acid. If there was danger of the healthy mucous membrane suffering from the contact of a fluid only a little more acid than that destined to be continually touching it, should we not expect it to have been of such a character as to resist this action like the mucous membrane of the

stomach, instead of being excited to secrete a fluid which in excess might seriously damage it? It must be remembered that the mucous membrane of the bladder bears very well the contact of acid fluids which sometimes have to be injected; and it cannot be denied that patients may for years pass intensely acid urine, without there being any evidence of the secretion of the excess of alkaline fluid from the mucous membrane, which is postulated.

When there is fermentation in the contents of the stomach with a setting free in large quantity of many organic acids, the urine is often only feebly acid or it may be decidedly alkaline in its reaction. Under these circumstances oxalate of lime will often be found in the deposit; but that the oxalate is not due in any way to the stomach changes, is proved by the fact that it is often found in large quantity in cases where the stomach performs its work perfectly well, while in many cases in which the action of the stomach is very seriously deranged no deposit of oxalate of lime takes place. Alkalies taken just before a meal sometimes act advantageously, partly because they stimulate the increased secretion of gastric juice more decidedly than an acid, and partly because by neutralising organic acids set free by the decomposition of some of the ingredients of the food, the secretion of normal gastric juice is promoted.

The practitioner must not fail to bear in mind that great derangement of vesical action and even actual and severe inflammation of the bladder may result from carrying alkaline treatment too far, and it is very necessary to caution patients who have experienced benefit from alkalies and alkaline waters on this head. I have seen many cases of most troublesome bladder disturbance caused by foolishly persisting in the use of alkalies. Patients generally know nothing of physiology, and having found what they call "a good thing" in the way of a remedy, are too apt to persist in its use even after its action is obviously detrimental. This effect being attributed to some other circumstance, the pet remedy is continued until real illness is induced, and it becomes absolutely necessary to call in the medical adviser, who would have given the patient such directions as would have saved him much suffering and trouble, and perhaps prevented a long and tedious illness, had he been consulted before the patient took upon himself the responsibility of his own medical management.

The persistently alkaline condition of the urine occasionally met with is very difficult to successfully treat, and may continue in spite of large doses of acid persisted in for many weeks at a time. Indeed no amount of acid that can be taken without risk will alter the reaction of the urine in some instances. The alkaline condition is usually associated with the deposition of earthy phosphates, and sometimes in very considerable quantity. In such cases, without very careful management, a

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distressing state of things may result. The earthy salts are often deposited upon the surface of the mucous membrane, not only of the bladder but upon that of the ureters and pelvis of the kidney. This process not unfrequently results in complete disorganization of the mucous tract, and generally leads to a serious state of things—not uncommonly portions of the deposit become detached, and receiving earthy phosphates upon their surface layer after layer, concretions of a soft and very brittle character, but not unfrequently of considerable size, may be formed. The injection into the bladder, from time to time, of very dilute acid (one part of strong acid to one hundred of water), with frequent washings out of the viscus with tepid water, generally affords relief.

VARIATION IN QUANTITY AND IN THE RELATIVE PROPORTION OF THE SOLIDS OF THE URINE.

Amongst the commonest derangements of the urinary secretion within the healthy range is an increase of the solid matter in proportion to the liquid present. In a given quantity of urine the solids may be found to be double that of the ordinary amount, and other specimens within twenty-four hours may contain much less than the ordinary percentage of solid matter. In the case of a secretion like the urine, which is always changing, at least as regards the quantity of its constituents, it is not possible to adduce a standard analysis which shall represent its normal composition. We may arrive at an average by making analyses of a portion of the mixed urines of the twenty-four hours, and instituting comparisons between the urines of a number of healthy individuals. In this way we are able to point to what we may call a healthy standard, but in nature variation is constant with reference to this and in both directions. It is to the considerable and constant variation in the composition and quantity of the urinary constituents that what may be spoken of as the capacity of maintaining a steady even state of health is to be attributed.

Urea is the most important of the solids of the urine. It is always present and in greater proportion than any other of the constituents of urine. The amount varies greatly within the physiological limit, and in slight departures from the healthy state it is not uncommon to find the urea amounting to double as much, or to not more than one-twentieth of what is stated to be its normal amount. The quantity of urea excreted by a healthy man during each period of twenty-four hours may be roughly stated to be 500 grains, and corresponds to about 3½ grains per pound of the body-weight. In many cases, however, it does not amount to nearly so much. Some organisms are exceptionally economical "machines," and do not consume even half as much food in the per-

formance of the same amount of work as seems to be necessary in the case of the majority. Even in engines the greatest difference exists in this respect, and engineers are continually discovering new means of economising fuel. As compared with an engine, however, the most extravagantly feeding man is a very economical machine.

A good deal of urea found in the urine is produced in the liver. In some diseases of this organ the quantity of urea formed in the twenty-four hours is lessened. It is probable that far too little consideration has been given to the action of the liver in the treatment of disturbances resulting in the formation and excretion of more than the normal amount of urea and uric acid. In some of these cases our attention should be mainly directed to the action of the liver and intestinal canal, and we shall often find that as soon as the work performed by these organs is properly discharged, the urine will return to its normal condition.

The large proportion of urea excreted in fevers and inflammations has been supposed by some authorities to be proof of excessive oxidation, and to be necessarily connected with the high temperature of the body. In spite of the blood being stagnant in the vessels, and the air-cells of the lungs choked up, this ill-considered theory has been so forced upon us, that it will probably be some time before any view more in accordance with well-known facts will be accepted. It need scarcely be said that a rise in temperature may be brought about in many ways, while it may be regarded as certain that the increased heat in fever and inflammation, and the increased quantity of urea formed, do not depend upon peroxidation; indeed it will be found that there is usually a very large excretion of urea in diseases in which the activity of the processes concerned in oxidation is much reduced instead of being in excess. The amount of urea excreted is often very great. Vogel mentions a case of pyæmia, in which 1,235 grains of urea were removed in the course of twenty-four hours. Dr. Parkes obtained as much as 885 grains in a case of typhoid fever. These quantities are very large, if the patients did not exceed the average weight of adult men; but, unfortunately, their weight was not recorded.

Excess of Urea.—This phrase is not restricted to those cases in which the total quantity excreted in the twenty-four hours is greater than in health; but a specimen of urine which yields crystals of nitrate of urea when an equal bulk of nitric acid is added to it in the cold, without having been previously concentrated, is said to contain "excess of urea." The quantity of urea dissolved in the fluid is so great, that nitrate of urea is formed, and crystallises just as if the urine had been concentrated by previous evaporation. This result may be brought about in several ways. In cases in which but a small quantity of fluid is taken in proportion to the urea to be removed; when an unusually

large amount of water escapes by the skin and other emunctories; as well as in many cases in which an unusual amount of urea is *formed* in the organism, we shall frequently find excess of urea in a specimen of the urine.

"Excess of urea" is frequently found in the urine of persons suffering from acute febrile attacks. It is very common in cases of acute rheumatism, and is often met with in pneumonia and acute febrile conditions generally, in which cases there is also an actual increase in the quantity excreted in the twenty-four hours. In England, we meet with cases of "excess of urea" very frequently; but, on the Continent, they appear to be so rare that many authorities seem to doubt the truth of what English observers have stated on this point. Lehmann, I think, states that he had never seen a case in which crystals of nitrate of urea were thrown down upon the addition of nitric acid, without previous concentration.

Urine containing excess of urea is generally perfectly clear, of rather a dark yellow colour, and of a strong urinous smell. Its specific gravity is about 1,030, and it contains 50 or 60 grains, or more, of solid matter per 1,000. At ordinary temperatures, an aqueous solution which forms crystals of the nitrate upon the addition of nitric acid without previous evaporation will contain at least 60 grains of urea per 1,000; 50 grains of urea per 1,000 hardly gave the slightest precipitate after the lapse of a considerable time. But it would seem that the salts, extractive matters, &c., in urine, favour the crystallisation of the nitrate when even a smaller quantity of urea than 5 per cent. is present. It should be mentioned that the above experiments were performed in the summer, in very hot weather. In one case, in which the urea readily crystallised on the addition of nitric acid, the urine had a specific gravity of 1,028, and contained—

ANALYSIS.

Water	940·18
Solid matter	59·82
Organic matter	50·57
Fixed salts	9·25

Urine containing excess of urea is generally acid, but I received a specimen from Dr. Fergus, of Marlborough, which was alkaline, and contained crystals of triple phosphate. It came from a patient, 18 years old, who was feverish with gastric and biliary disturbance. The urine was highly coloured, sp. gr. 1·033, and became nearly solid upon the addition of an equal bulk of nitric acid, from the formation of crystals of nitrate of urea. (April, 1862.) There are some peculiar and not very common cases in which the urine persistently contains more than the healthy amount of urea. The patient is weak, and grows thin, in spite, it may be, of taking a considerable quantity of the most nutritious food.

He feels languid and indisposed to take active exercise. In some cases digestion is impaired; in others, the patient eats well, experiences no pain or uneasiness after food, and perhaps has a good appetite. Sometimes there is lumbar pain. It would seem that most of the substances taken as nutrient material become rapidly converted into urea, and are excreted in that form. The waste of the tissues is not properly repaired, and the patient gets very thin. To refer these symptoms to the existence of a particular diathesis, affords no explanation of the facts, but it must be admitted that the pathology of these remarkable cases has not yet been satisfactorily made out. Mineral acids, rest, shower-baths, and good air, often do good; but some of these patients are not in the least benefited by remedial measures, and they continue for years very thin, passing large quantities of highly concentrated urine, while the appetite remains good, and a considerable quantity of nitrogenous food is digested. In some which have resisted the usual plans of treatment, benefit has been derived from the use of pepsine, with diminished quantity of meat, and a larger amount of farinaceous food. Sometimes it is necessary to keep the patient on milk and farinaceous food only for several days together, not allowing him any meat or even soup or fish.

It is very remarkable, that in many instances the secretion of the urine, which is so rich in solid constituents, occurs only at one time during the twenty-four hours. It is therefore necessary if we desire to estimate the total quantity of the various solid matters passed in the day, to mix all the urine passed in the twenty-four hours, and having carefully measured it, to analyse a portion of the mixture. The variation in the activity of the secreting process is very great. At a particular period of the day, usually in the afternoon and evening, the patient will complain of coldness of the surface of the body generally. This is soon followed by lumbar pain, and some congestion of the kidneys. The secretion of urine of very high sp. gr. soon takes place, and not unfrequently a small quantity of albumen is found in it. When the patient gets warm and freely perspires the symptoms pass off, and the free secretion of normal urine follows. Some of these cases are closely allied to ague, and are cured by those remedies which act favourably in intermittents generally. Quinine in five or ten grain doses is often of use.

When the formation of urine containing "excess of urea" has gone on for a considerable period, no change in diet for a short time will alter the condition. There seems to be a tendency to the excessive formation of urea in the system, and this often persists for a considerable time. It cannot be explained, but it may be compared with the "tendency" to the formation of sugar or cystine. The facts cannot be accounted for by supposing that an accumulation of urea in the system has taken place, and that it is gradually removed. To discourage or prevent this excessive formation of urea, it is necessary for the patient

to diet himself with care and regulate his exercise for several weeks if any good and lasting benefit is to be obtained. The meat consumed should be reduced to three or four ounces daily or less, and advantage will result from the substitution of fish for meat on at least two days in the week. Farinaceous puddings and stewed fruit may be taken, and baked apples, stewed prunes, and various kinds of jam may be obtained even in the winter months. Benefit also results from taking lettuces, mustard and cress, and watercresses in this condition.

There is no doubt that, as long ago observed by Prout, in many cases that come under our notice, an actual excess of urea in proportion to the body-weight is habitually, and, under ordinary circumstances, excreted. In some of these cases it is remarkable, that although little nitrogen is taken in the food, an unusually large quantity of urea nevertheless passes away from the organism. It would seem probable that substances from which urea may by chemical change be readily produced may go on accumulating in the blood, and possibly in the interstitial tissue-fluids for some considerable time, and that then some special chemical disturbance is started, and the nitrogen of these substances goes to form urea, instead of many other nitrogenous compounds as well as urea. For many days larger quantities of urea are excreted than can be accounted for by the ordinary changes. This formation of urea may be associated or not with febrile symptoms. After a time, at least in most of the cases that come under observation, this free excretion of urea becomes reduced and the patient returns to his normal state of health.

In another class of cases there can be no doubt that a large quantity of the urea excreted is actually formed from the tissues of the body. The tissues accordingly waste, and this process may continue for a considerable period of time. No matter how much food the patient may take, he continues to get thin and loses considerably in weight. The nitrogenous constituents of the food, instead of supplying the tissues and compensating for the tissue-waste, are themselves resolved into urea, and thus the quantity formed is largely increased. Why the food which is usually appropriated and applied to the nutrition of the body is in certain cases resolved into urea, or into this and other excrementitious matter without being employed at all in the nutritive processes, I cannot say, but I have no doubt that this is so in a number of cases, the exact nature of which is still obscure, as well as in many cases of fever where the removal of large quantities of urea is associated with extreme weakness and continued emaciation.

The copper test for sugar, known as Trommer's test, Fehling's solution, and other tests of the kind, afford indications of the presence of sugar in many specimens of urine which contain a large quantity of urea. The reduction of the copper does not, however, depend upon

sugar. The presumption that the change in question was due to the presence of sugar has led some observers to believe that there was a tendency for cases in which an unusual quantity of urea was formed in the body to pass into the diabetic condition. As far as has been ascertained, there is however no very conclusive evidence in favour of this view, and it is very doubtful whether there is really any causative relation between the state of system in which diabetes occurs and that which is characterised by the formation of large quantities of urea, or by the frequent secretion of urine in a highly concentrated state and containing a high percentage of urea. In testing the urine of cases supposed to belong to one of these classes, the greatest care must be taken not to be misled by the change in the copper test above referred to. It has happened to me on more than one occasion to have to prove to a medical friend who had frightened himself into the idea that he had diabetes that his chemical skill only was at fault, and that urea or some other constituent had caused the reduction of oxide of copper which had alarmed him. And although it is satisfactory to convince a friend that he is more likely to live to be old and to enjoy better health than he had concluded had fallen to his lot, it is not pleasant to have to convict him of a blunder, though it be chemical only.

Deficiency of Urea.—Sometimes the quantity of urea excreted is very small. A lady suffering from an ovarian tumour only excreted 75 grains of urea in 200 fluid drachms of pale faintly alkaline urine in the course of twenty-four hours. (Thudichum.) In a case of cancer of the uterus, under the care of Dr. Arthur Farre, only a few drachms of fluid were passed from the bladder during a week; and this contained a small quantity of solid matter, in which no urea could be detected. In a case which proved to be complete degeneration of the kidneys from stones in each pelvis, while the patient yet seemed to be in good health, less than half a pint of urine of very low sp. gr. (1·004) was formed for many days at a time, and there was no evidence to show that the urinary constituents passed off by the bowel. The probability is that the chemical changes ordinarily resulting in the formation of urea were reduced to the minimum consistent with life.

In chronic structural disease of the kidney, the urine is of very low specific gravity, and but a very small proportion of urea is excreted in the twenty-four hours. This arises from the alteration in the gland-structure, and the amount of urea separated may be regarded as a rough indication of the extent of the organ involved. In some cases, the morbid condition affects the whole structure; but in others the greater part of the kidney remains healthy. In the latter case a fair amount of urea will be excreted; and, although the urine contains albumen, the case may be looked upon as of a hopeful class,—cases of the kind often living for twenty years or longer.

In certain cases, urea almost entirely disappears from the urine, and is replaced by leucine and tyrosine. Frerichs mentions a case of acute yellow atrophy of the liver, in which only a trace of urea could be detected, while a very large quantity of leucine and tyrosine crystallised from the concentrated urine. ("Klinik der Leberkrankheiten." Erster Band. Seite 221.) In low forms of typhoid fever, the urine also frequently yields leucine and tyrosine in considerable quantity. In a case of chronic yellow wasting, which came under my own notice (F. C., vol. VI, p. 37), the liver was of a yellow colour, and weighed only 1 ½ lb. The patient was a young woman, age 26. Jaundice had existed for six weeks, but urgent symptoms—delirium and coma—had only supervened a few days before death. Leucine was obtained from the urine by evaporation, but only in small quantity. In a remarkable case of enlarged spleen (leucocythemia) under my care, much leucine was found in the urine. In many cases there is a deficiency of urea in the urine in consequence of it not being formed in the body. This is remarkable in cholera, in which disease only a mere trace of urea is sometimes produced during many hours.

Uræmia is the term applied to that condition of the system which soon results from the retention of the excrementitious urinary substances in the blood. Long-continued organic disease of the kidneys often ends in uræmia, but it may depend upon acute disease. The nervous phenomena are generally considered to be caused by the accumulation in the blood of urea, but later researches have shown that neither Urea, Carbonate of Ammonia, nor Nitrate of Potash injected into the blood of animals proves speedily fatal, unless the kidneys be previously extirpated (Hammond). If, however, the quantity of urea injected be very large, death does take place. Stannius, on the contrary, states that urea injected into the blood is harmless; and Petroof has injected a large quantity into the blood without causing coma. Dr. Hammond has shown that *the urine, as a whole*, is more poisonous than a simple solution of urea. He has proved most conclusively that Frerichs' notion, that the urea became decomposed into Carbonate of Ammonia, is erroneous; and Johnson, Richardson, and others are of the same opinion. Hoppe finds that in uræmia the extractives are increased to three times, and the Creatine to five times the normal amount. In many cases of severe uræmia there is, however, no urea to be detected in the blood, and various hypotheses have been, from time to time, advanced to explain the fact, but none of them are entirely satisfactory. The extractives are very much increased in some cases, and their relation to the albumen rises from 5 : 100 to 40 : 100, according to Schotten. It is possible that in some cases in which a large quantity of urea is detected, the formation of this substance has been going on actively for some time and has accumulated in the blood or has even passed, after

its passage into the uriniferous tube, directly into the blood by the rupture of the upper part of the tube and adjacent capillary or capillaries, or through the lymphatics, its escape into the pelvis of the kidney having been prevented. In those cases of death from uræmic coma, in which no urea is to be detected in the blood, it is most likely that the secreting structure of the liver, and probably also that of the kidney, has ceased to be active altogether, and that urinary constituents are not even formed. In such a case it is probable that death results from the accumulation in the blood of those materials which it is the duty of the kidneys to separate, or from the presence of compounds resulting from the decomposition of these. In considering this question, it must be borne in mind not only that the renal disease has gradually advanced, and the kidneys, perhaps, have become almost inefficient, but that most important alterations have been slowly taking place in the blood, and in the action and reaction of the various organs supplied by it. Many tissues in the organism must be secondarily affected, and must have gradually become much altered in structure. At present we are but very imperfectly acquainted with the normal changes occurring in the blood, or with the consequences immediately resulting to the tissues, especially the nervous system, from the retention of certain excrementitious matters, independently of urea; and we know very little of the remote or immediate effects resulting from excrementitious substances not being formed at all. The question is a more difficult one than it appears at first sight, and requires more searching chemical and microscopical investigation than it has yet received. One writer on this subject concludes a very elaborate essay thus: "Enfin, cette altération chimique du sang est encore mal définie, et la science attend sur ce point de nouvelles recherches." ("De l'Urémie," Thèse, par Alfred Fournier, 1863.) Possibly "uræmia" may depend not upon the presence of one single constituent of the urine only, as urea, in the blood, but rather to the accumulation of a number of products resulting from the disintegration of tissue which ought to be separated by the kidneys. This is the general conclusion arrived at by one of the more recent writers on the subject, M. Rommelaere, whose memoir contains records of valuable original observations. ("De la Pathogénie des Symptômes Urémiques," par Dr. W. Rommelaere. Bruxelles: Henri Manceaux, 20, Rue de l'Etuve.) I shall have to refer again to uræmia under the head of acute inflammation of the kidneys.

But whatever difference of opinion there may be as to the exact nature of the uræmic state and the mode as well as the order of the causation of the several pathological phenomena which accompany it, or of which it is a consequence, there can be none whatever as to the proper treatment of the condition. It is here that the principle of rapid elimination must be promptly acted upon and actively carried out.

Free purgation must be brought about, and aided by free diaphoresis, if this can be excited. Diuresis cannot be regarded as advantageous in these cases, for the kidneys being in a state of inflammation and the capillary vessels congested, the organs must not be stimulated to increased action, but rather assisted to rest for a time, their work being thrown upon other organs, especially the bowels and the skin, until the kidneys are restored to their normal state, when free diuresis often takes place, and many substances which have been accumulating for some time are excreted, and the patient soon becomes convalescent. This subject will be further considered when the treatment of acute inflammation of the kidneys is discussed.

Ammonia.—Numerous experiments seem to show that in health a small quantity of ammonia escapes in the urine. Neubauer has conclusively proved that certain ammoniacal salts pass through the organism, and may be detected in the urine unchanged. Ammonia, as is well known, is very easily produced and in large quantity by the decomposition of the urea. It is, however, almost certain that a small quantity may under some circumstances pass into the urine from the blood.

In many bladder cases the quantity of ammonia present in the urine is often so considerable that it may be smelt all over the room in which the patient lies, but it arises in some of these from the decomposition of the urea after the urine has left the bladder, and in others it is decomposed even while it yet remains in this viscus, not in consequence of its formation in and removal from the blood, but from the chemical decomposition of the urea. It is doubtful whether a large amount of ammonia under any circumstances can accumulate in the blood afterwards to be excreted in the urine, as it is probable that, if formed, it would escape more rapidly from the lungs or from the intestinal canal than from the kidneys.

Uric Acid and Urates are present in varying proportion in healthy urine, but in disease a large increase is very frequently observed. The proportion in health is about half a grain in 1,000 of urine and is often less than the $\frac{1}{30}$ per cent. Uric acid and urates usually form urinary deposits, either from existing in too large a proportion to be dissolved in the urine when cold, or, as is probably the case in the majority of instances, from the development of an acid in the urine, which causes them to be precipitated from their solutions. But occasionally much more than the normal amount is held in solution. Whether there is really more uric acid formed and excreted than in health may be ascertained by mixing the urine passed during twenty-four hours and estimating the uric acid in a small quantity, and calculating the amount in the whole.

In many acute febrile conditions, the proportion of uric acid is increased, and the period of resolution of the inflammation is marked

by diminished frequency of the pulse and respiration, by a fall in the temperature, by free perspiration, and by a very abundant deposit of urates. In health, not more than from 5 to 8 grains of uric acid are excreted in twenty-four hours; but, in some acute diseases, the proportion may amount to 20 grains. In a case of fever, Dr. Parkes found that 17·28 grains of uric acid were excreted in twenty-four hours. Dr. Sansom has estimated the quantity of uric acid in 1,000 grains of the morning urine in health and several cases of disease. The results are as follows :—

	Grain.
Health	·250
Acute gout	·830
Acute rheumatism	·802
Heart disease	·711
Erysipelas	·679
Phosphatic urine	·140
Chronic gout	·120
Excessive debility	·078

Urate of soda is easily caused to yield crystals of uric acid. If the amorphous urate deposit be merely dissolved in warm water or by warming the urine, the urate may become decomposed. As the solution cools, crystals of uric acid are deposited. In some cases, the quantity of uric acid held in solution is so great that, upon the addition of a drop of nitric acid to the urine, an abundant amorphous precipitate, exactly resembling albumen, is at once formed. Such precipitate has many times been mistaken for albumen, and, even if examined under the microscope *immediately* after it is formed, its nature cannot be made out. If, however, it be allowed to stand for some time, the amorphous particles gradually increase in size, and assume the well-known crystalline form of uric acid. The instances in which I have met with urine exhibiting these characters have for the most part been cases of liver disease. Although the reaction of the urine is acid, no precipitate takes place upon the application of heat, by which fact urine of this character may at once be distinguished from albuminous urine.

In some cases, although the urine be perfectly clear or only slightly opalescent with no distinct deposit, an unusually large quantity of uric acid or urates or both may be held in solution. Upon the addition of an acid the uric acid is set free in abundance. Such cases require to be treated upon the same principles as those in which visible deposits of uric acid and urates are frequent. Patients having urine of the character above indicated often take for weeks together considerable doses of alkali with advantage, but persons adopting this treatment should always be cautioned against continuing the alkali for too long a time without an interval, during which a tonic mode of treatment is adopted or medicine of every kind withheld.

The presence of an increased quantity of uric acid in the urine shows that more of this substance or its salts is being excreted than in health. A large proportion of the uric acid resulting from the disintegration of albuminous substances taken as food, or forming constituents of the blood or tissues, combines with ammonia, soda, or lime, forming urates of these bases, which are excreted in the urine. In cases where considerable excess of nitrogenous matters are taken in the food, much of the excess passes away as uric acid.

In gout, the presence of uric acid in the blood has been shown to be constant by Dr. Garrod, who considers that in this condition "the kidneys lose, to some extent, their power of excreting uric acid, although they eliminate urea as in health." In many cases of gout although there is no albumen in the urine, that series of changes which ends in structural disease has already commenced, and the normal power of elimination interfered with. *During* the attack of gout there is less uric acid in the urine than in health; but *after* it is over, a large quantity of uric acid and urates are often carried off from the system.

In cases characterised by a tendency to the formation of much uric acid, the principal objects to be attained by treatment are, to favour oxidation, and to promote the solution of the uric acid and urates already existing, and their elimination from the blood. Good air and moderate exercise, with attention to the action of the skin, will fulfil the first object; and the solution and elimination of the urates will be encouraged by giving alkalies in solution in a considerable quantity of water. Seltzer, Vichy, and Vals waters, which contain carbonates of potash and soda, or Lithia water may be given with advantage. Even plain water does good if as much as three or four tumblers be taken daily for a week or two at a time. Lemonade is sometimes advantageous, and cider and perry suit some persons who suffer from excess of urates.

The satisfactory change which in chronic gouty and rheumatic cases frequently ensues from following some of the much vaunted "systems," or going through a course of drinking waters and bathing in Germany or elsewhere, obviously arises from the increased action of the skin, and the improvement of the health generally, brought about under the influence of exercise, good air, simple diet, and temperance, wisely enforced in the establishments. If patients could be induced to retire to a pleasant part of the country, where they could take moderate exercise and be free from mental anxiety, meet with agreeable society, live regularly, take small doses of alkalies, and soak themselves for an hour or two a-day in warm water in which some carbonate of soda had been dissolved, they would probably get as much benefit as they do by travelling several hundred miles to a famous watering-place, and at much less trouble and expense. I am convinced that there are many

patients who would prefer to carry out such a simple plan, rather than submit themselves to the needless routine and tiresome formalities compulsory in many of the professed universal systems, compliance with which cannot but be extremely repugnant to their common sense, submission not unfrequently involving the patients being claimed as converts to and supporters of doctrines which no sensible person can really accept. There are however not a few who, for the sake of the advantages derived from the regular system of living, air, exercise, &c., are ready to be regarded as believers in doctrines and propositions which they know are absurd, and which have no real foundation in fact.

The nature of the derangement of the physiological processes should be carefully considered before any plan of treatment is suggested. We should ascertain in what points the condition differs from the healthy state, and then consider how the deranged actions may be modified. It is obviously quite useless to attempt to relieve the patient by giving drugs, without enforcing attention to all the circumstances which are likely to improve his health, and it will therefore be well for us to consider more in detail the principles which should guide us in the management of many of these cases.

Dr. Latham considers that the glycocine formed in the liver is under ordinary circumstances resolved into Urea, while in the deranged action of the organ, uric acid is produced, and if the kidneys do not excrete this freely from the blood, the uric acid accumulates in the system and interferes with the action of many tissues and organs. ("*On the formation of Uric Acid in Animals; its relation to Gout and Gravel.*" Deighton, Bell, & Co., 1884.) These views are supported by what is observed in the action of remedies. If during and after middle age the kidneys continue as active as they are in early life, the uric acid is got rid of as fast as it is formed; but if, as is generally the case, as age advances, they act less freely, the uric acid accumulates in the system and is slowly deposited in various tissues which suffer in consequence both as regards their nutrition and action. The main object therefore of treatment should be to prevent the formation of glycocine, and favour the decomposition and excretion of that which already exists, and there can be no doubt that the most successful mode of treating many forms of gouty affections is calculated to effect this.

Where the deposition of uric acid in the urine is of frequent and perhaps of almost daily occurrence it is, above all things, necessary for the patient to change his mode of life as well as take remedies which are known to interfere with the formation of the deposit, and it is desirable to warn him that the altered course of diet and the use of proper remedies must be persevered in for some time before any very decided beneficial change will be evident. A complex course of chemical decomposition which has become habitual in the organism has to be

altered, and it is sometimes weeks before any perceptible effect is produced in cases where a complete cure is ultimately secured. Patients are still too apt to credit us with occult powers by virtue of which we are supposed to be able to exert some mysterious and very powerful influence akin to that supposed power of charming away maladies with which our representatives in times long gone by were credited by many besides the ignorant and foolish. They expect the one bottle of medicine to stop at once, or alter for good and all, a series of abnormal chemical changes which has persisted for years, and which has been initiated and maintained by injudicious living for a period of perhaps twenty years or more. Nor will many give us even a fair chance of affording them relief. Unless they can eat and drink as they have long been in the habit of doing, they will not feel satisfied, and if you recommend a moderate diet, they will tell you that if they are to submit to the regimen of a German bath, they might as well go to one for a month or so; but if you suggest that the mode of life adopted during that short period of penance should be persisted in during the whole year, they may assure you that in their opinion life would not be worth having on such terms. Nevertheless it is certain that not only those who are ailing, but many of us who consider ourselves in good health, would be far healthier and live longer than we do if we adopted a regimen compared with which that of many a German bath must be considered even liberal.

In the treatment of a case in which some organ absolutely necessary to life is the seat of morbid change—more especially where this change under ordinary circumstances is progressive, the practitioner must take into his careful consideration a number of matters bearing upon the general work and change going on in the body in health. First of all as regards the fluid to be taken—How important is the simple question of the action of water in the economy, but how difficult it is to determine what is the proper amount which should be taken during each period of twenty-four hours. There is no matter pertaining to diet and daily habit in which men differ from one another more than in the quantity of fluid they take. Some healthy people drink more than five times as much as others. Some are always thirsty; others—as regards their ordinary daily life—hardly know what the sensation of thirst is like. Again, one man can work hard all day and perspire profusely without experiencing any very great demand for drink; another can hardly walk half a dozen miles on a hot day without an actual need of water or some other liquid to quench his terrible thirst, accompanied by dryness of throat and a general feeling of want of power—undoubtedly relieved for a time, but for a time only, by the imbibition of fluid. A considerable quantity of fluid is advantageous, but not equally so to all persons. Other things being equal, a moderate amount of food will go

farther if a considerable quantity of water be taken than if only a small amount of liquid be introduced; also it has been found that the increase of fat is favoured by a large quantity of liquid in proportion to the solids of the diet.

But the daily proportion of water should vary according to the quantity and character of the food taken. When this is of a nature to yield considerable quantities of urates and other substances not very readily soluble, more water is required than when food of a different kind is taken, but this recommendation cannot be acted upon as a general principle, inasmuch as it is liable to exception should there be any great change in temperature. In fact with regard to the quantity of fluid required there are so many disturbing causes that it is impossible to lay down any but the most general directions. In truth each individual must endeavour to ascertain for himself the average quantity required, and vary it from time to time. In these days of cycling, the quantity of water taken is often enormous, and the cyclist during work may really require five or ten times as much in the twenty-four hours as when he is following his ordinary duties. Happy is the cyclist who has discovered that water dissolving nothing more solid or nutritious than the soluble constituents of tea, coffee, or cocoa, or lemon, or orange, or other flavour, and that malt and alcohol are no more required than pounds of beef or mutton to supply muscle and nerve waste. The daily amount of water required must therefore not be disregarded by the practitioner when considering the proper course of diet and regimen to recommend to his patient.

The beneficial effects of an occasional washing out of tissues is well known, and people past middle life often find out the value of a course of "waters" for themselves, but while there are some morbid conditions which require for their good management a dilute state of the blood and the free and frequent change of fluid in all the tissues and organs, there are others in which a state of things the very reverse is needed. The experiment is being perpetually tried for the advantage of the practitioner who will be at the pains of observing. Patients who have blindly followed the fashion without thought and without advice will return after a course of the most "celebrated and never-failing waters" worse than when they commenced the ill-advised system, which for them no one in his senses, and who possessed any knowledge of physiology, would have recommended,—little rather than much water being required in their case, and simple rest instead of constant change for their over-wrought tissues.

Among the alkaline remedies which are of advantage to those who suffer from gout or from that state of system which under favourable circumstances leads to the development of gout, or at least to symptoms which are distinctly due to a gouty habit or tendency, the salts of

Lithia have been of late years prescribed. Since the researches of Dr. Garrod, who showed that lithia was an excellent solvent of uric acid, the carbonate and the citrate of lithia, as well as lithia water, have been in great and deserved favour, but the practitioner must not expect to find that lithia or any other substance which is effective in the treatment of some cases, will be equally potent in all. In treating such conditions it is well to be provided with a number of remedies which can be changed from time to time; for in taking physic as well as wine it is to the advantage of the patient to change, since it is certain that many a remedy which may be very useful if taken for a short period of time loses its effect if taken for long, and that benefit may be obtained by substituting for it another, although this last was not efficacious when it was previously given. Preparations of potash, soda, and lithia may be ordered alternately with advantage. The practitioner will find that some patients receive most benefit from one alkali, others from another. Soda seems to suit some people better than potash, and although lithia is often beneficial it does not do some patients as much good as soda or potash, or the two combined. In many cases, I find that carbonate of ammonia is a valuable remedy if given in sufficiently large doses. Ten grains of Howard's volcanic carbonate of ammonia dissolved in an ounce or more of water may be taken every three hours for a week or longer at a time.

So too in prescribing alkaline remedies, it is necessary to pay attention to the degree of dilution, and to the time of their exhibition. As a general rule free dilution is desirable, and the best time to take the remedy is about an hour after meals and at bed time, but sometimes the patient finds that this plan does not suit him, and it is necessary to alter the time to midway between two meals. Free dilution with cold water often disturbs the stomach and may even stop digestion. In that case warm or tepid water should be given, and the patient should be directed to swallow the draught by small mouthfuls one at a time, and he should not drink off the whole dose of a quarter of a pint or more at once. Sometimes a few drops of essence of ginger, or a little peppermint water, or a few drops of chlorodyne added to the mixture will enable a patient to take the alkaline remedies who was unable to take them in the ordinary form.

But if alkalies as generally prescribed disagree, the proper dose of liquor potassæ, bicarbonate of soda, or potash may be added to soda, Seltzer, Vals, or Vichy water with or without three or four drops of dilute hydrocyanic acid and essence of ginger. Not unfrequently if the draught be iced and taken in small quantities or even sips at a time, it will be found to answer, and the patient will no longer complain of its disagreeing with him in any way.

Lastly, it is found that gentle exercise after taking considerable

quantities of water, cold or warm, favours its absorption. The experience of centuries at the most celebrated baths here and on the Continent has proved that to be the case, and to this day the practice is carried out. Active exercise, and long walks are not advisable, but the gentle walk while the band is playing seems to be just what is required, and there can be no doubt that this sort of easy promenade several times daily in the open air is very conducive to the health of middle-aged and old people who have spent the greater part of their lives in cities in sedentary work, with perhaps much anxiety and considerable wear and tear of the nervous system. Many work under actual, and frequently severe, pressure during the greater part of the year, and in order to mitigate the feeling of fatigue and the lassitude they experience the majority find they cannot get on without wine. Most get into the habit of taking more food than their system really requires if they do not exceed in alcohol; nor indeed is it wonderful that men who work hard and live under pressure and almost constant bother should look forward with cheerfulness and satisfaction to the dinner hour as the chief event and the pleasantest part of the day, especially during the greater part of our year, when the weather is uncongenial and the days are short. Still, it will be found that in the great majority of instances a penalty has to be paid, and unless the same sort of regimen, carried out for the month or six weeks in a German bath, be adopted on several days during the week or for a month at a time three or four times a year, good living cannot be indulged in with impunity. Important organs and many delicate tissues must suffer and become the seat of degenerations which not only shorten life but make activity and enjoyment of existence impossible while life lasts. Men who have to live under the very disadvantageous circumstances referred to should at the least make a rule of spending a few weeks during the winter months at Bath or Leamington, and in the summer make a pilgrimage of six weeks' duration to some place abroad where food is restricted, exercise enforced, and the system cleansed by washing out with alkaline waters.

Extractive Matters.—Dr. G. O. Rees more than thirty years ago discovered in the urine, in certain cases, an extractive matter which drained away from the blood, and which is distinguished by producing an abundant precipitate with tincture of galls. Now, although in many cases albumen exists in the same specimens of urine, this blood-extractive sometimes escapes without albumen; and thus the exhaustion and emaciation, in some obscure cases in which there is no hæmorrhage or escape of albumen, are to be accounted for. The conclusions at which Dr. Rees has arrived are as follows:—

1. That whenever albumen was present in quantity in the urine, it was always accompanied by the extractives of the blood in large proportion.

2. That the cases in which the extractives of the blood were in the urine in large proportion, were generally those marked by debility.

3. That cases of anasarca with disease of the heart, and *unconnected with albuminuria*, also showed the extractives of the blood to be excreted by the urine in quantity.

4. That cases of chlorotic anæmia and hysteria give copious precipitates.

5. That when, in albuminuria, the albumen became deficient in the urine, which we know often happens in advanced cases, the blood-extractives also decrease in quantity.

6. That, in cases of anæmia, the proportion of blood-extractives observed in the urine diminished as the cure was proceeding, under the use of ferruginous tonics (Lettsomian Lectures, "Medical Gazette," 1851).

In many cases where the urine contains an abnormal quantity of water, the proportion of blood-extractives is unusually great. Schotten proved that in uræmia there was a large increase of extractives in the blood, and I have found this also to be the case in many forms of febrile disease. The elimination of this excess of extractive matter has to be promoted. In cases of kidney disease, the relative proportion of extractive matter to the urea is very much greater than in healthy urine. It would seem that extractives merely filter from the blood in certain cases, and that these substances might escape into the urine when the structure of the kidney was impaired; but that for the separation of the urea, a healthy condition of the secreting structure is necessary.

The extractive matters are not capable of being converted, by further oxidation, into urea, carbonic acid, or ammonia; and must, therefore, be regarded as excrementitious substances. Scherer ("Würzburg Verhandl.," b. II, Heft III, s. 180) found that the urea, salts, &c., in the urine of a madman who took no food, were very much diminished, while the extractive matters, although less than in healthy urine, were not diminished in nearly the same proportion as the other urinary constituents.

We have much to learn concerning the circumstances under which the extractive matters may be formed in greater quantity than in health, and the precise changes which would result from their accumulation in the blood. In cases of uræmia, in most of the severe fevers and probably even in slight febrile diseases and in pneumonia and other acute diseases, the quantity of extractive matters is increased.

I have no doubt that the benefit following the use of many remedies which promote the removal of excrementitious matters is in many cases due to the discharge of extractive matters from the blood. Seeing the large increase of such substances in the blood in cases of fever, low pneumonia, acute rheumatism, and many more in which derangement of the blood has existed for a considerable time, and considering the

long period required for convalescence from these diseases, and the re-establishment of the healthy state—it is only reasonable to suppose that during the prevalence of the morbid state, and very probably for some time before its accession, extractives were accumulating in the blood and interstitial fluids of the tissues and organs, and that the presence of these had something to do with the symptoms, and that their elimination was necessary for the restoration of the blood to its normal healthy condition. If the removal of these offending extractive matters can be facilitated and expedited, then return to health will probably be hastened. As regards the means, it is probable that the various medicines and methods of treatment already recommended for promoting elimination and exciting the emunctories to increased action, are also effective in causing the discharge from the blood of extractive matters which have perhaps been accumulating in the circulating fluid as well as in the interstitial juices of the tissues for a considerable period of time.

EXCESS OR DEFICIENCY OF THE INORGANIC CONSTITUENTS.

In certain morbid conditions the inorganic salts vary much in quantity, and in some they are very deficient. In cases of diabetes, there is sometimes but a mere trace of fixed salts. This deficiency may depend upon the nature of the food, or it may be due to the *formation* of a reduced proportion of some of the salts in the organism.

In some states of the system, when much disintegration of tissue or red blood corpuscles takes place, a greater quantity of sulphur and phosphorus is oxidised, and sulphuric and phosphoric acids are formed in unusually large proportion, and afterwards removed in the urine. In certain inflammatory conditions it would appear that the common salt is required in considerable quantity at the seat of the inflammatory change, and does not pass away from the system in the urine. In some states of renal disease, in which the secreting structure of the kidney is so much impaired that the separation of urea and organic matter is interfered with, the solids consist almost entirely of saline matter, and in most cases of prolonged structural disease the proportion of the saline to the organic constituents is very much increased.

Chloride of Sodium. Deficiency or Absence in the Urine in Pneumonia.—The fluctuations observed in the quantity of common salt excreted in the urine are very great even in health. The circumstances which influence the amount of chloride of sodium are very numerous and varied, but it will be generally observed that when inflammatory exudation takes place from the blood very little chloride is passed off in the urine. It was first noticed by Redtenbacher, that in pneumonia the quantity of chloride in the urine gradually decreased as the inflam-

mation advanced; and that in many instances, when the lung became hepatised, not a trace of salt could be detected in the urine. In 1852, I determined quantitatively the amount of chloride in the urine from day to day in several cases of acute pneumonia. ("Med. Chir. Trans.," vol. XXXV.) This remarkable change in the quantity of salt excreted in pneumonia and its diversion from all parts of the body to the seat of inflammation, has always seemed to me one of the most interesting points in pathological chemistry—since it is evidence of the importance of an inorganic salt filtering through but not combining with any of the constituents of the living particles taking part in the process, and its consideration suggests not only the rational treatment of the disease, but enables us to draw important inferences as to the precise way in which morbid changes may be modified or stopped by treatment.

In some of the cases published in my paper, it was shown that, although there was not a trace of chloride in the urine, and the blood contained less than its normal proportion, the *sputa were very rich in chloride of sodium.* In one case, the proportion amounted to upwards of 18 grains in 100 of the solid matter of the sputum. In a fatal case, much chloride was found in the products effused into the air-cells of the lung. In most exudations, and in growing tissues, there is a considerable amount of chloride of sodium. In acute inflammations generally, the proportion of chloride in the urine gradually diminishes until the disease is at its height, and the more extensive the inflammation, the more marked will be the diminution of the chloride in the urine. When resolution occurs, the chloride reappears, and gradually increases as convalescence advances, until it attains its normal standard. The amount of chloride in the urine is much influenced by the nature of the food, and by the quantity of fluid taken, as I remarked when treating of the chloride in healthy urine; but the results above described cannot be explained in this manner; for, although patients take less food when they are ill, and therefore less salt, the same results are observed if salt be given to them. Moreover, the disappearance is gradual, and the reappearance is marked by a change in the symptoms of the disease, although the food has remained the same during the whole period of the illness.

There can be little doubt that, in these cases, the chloride is gradually separated from the blood in unusual proportion at the point where the inflammatory changes are taking place; and that, instead of at once filtering through the organism as it does in health, it accumulates at this point until a certain stage of the morbid process is passed, when the bioplasts or cells, which have been growing and multiplying so fast, die and become disintegrated and dissolved; the products thus formed with the chloride of sodium being reabsorbed into the blood, are afterwards

altered and at length excreted by the ordinary channels. The precise office which the salt plays in these processes is not understood; but certainly, in all the specimens of inflammatory lymph that I have examined, I have always found this substance present in large quantity. In many cases of bronchitis, acute rheumatism, pleurisy, in some cases of skin disease, and in some other instances in which its absence would appear to be merely an accidental circumstance, no salt can be detected in the urine. We cannot, therefore, regard this diminished proportion or absence of chloride in the urine as a point of any value in the *diagnosis* of pneumonia, although it must be looked upon as a fact of great interest with reference to the morbid changes which are taking place at the time, and ought not to be left out of consideration when the rationale of treatment of acute inflammation is discussed.

The conclusions deduced from clinical observations and analyses of the urine, blood, sputum, and inflammatory products, in several cases of pneumonia, are as follows :—

1. That in pneumonia there is a total absence of chloride of sodium from the urine at or about the period of hepatisation of the lung.

2. That, soon after resolution of the inflammation, the chloride is again present in the urine, and often in considerable quantity.

3. That, at this period (resolution), the serum of the blood is found to contain a greater amount of chloride than in health.

4. That the presence of chloride of sodium in the urine may be taken as evidence of the existence of a greater quantity of the salt in the blood than is required for the wants of the system generally, or, at least, of an amount sufficient for that purpose; and that the absence of the salt from the urine indicates that the circulating fluid contains less than the normal quantity.

5. That the sputum in pneumonia contains a greater quantity of fixed chloride than healthy pulmonary mucus, if there be not much less than a normal amount in the blood, although there be complete absence of the salt from the urine. In all cases, however, there is found in the sputum a quantity many times greater than exists in an equal amount of blood at the same period of the disease. The absolute amount present is subject to variation at different periods of the disease, and in different cases.

6. That, in one case which was fatal, the proportion of chloride present in the sputum underwent a decrease, while the amount of solid matter, and especially the extractive matters, increased. At the same time, the sputum became acid; and in the matters expectorated within the last few hours of the patient's life, a large quantity of grape-sugar was found; but, in that obtained on the day previous to his death, none could be detected.

7. The absence of chloride of sodium from the urine during the

stage of hepatisation seems to depend upon a determination of this salt to the inflamed lung; and, when resolution occurs, this force of attraction ceases, and whatever salt has been retained in the lung is reabsorbed, and appears in the urine as usual.

I desire particularly to direct the reader's attention to the fact of these changes with regard to the excretion of the chloride in the urine, because it has a very important bearing upon the probable mode of action of many of our remedies in various pathological conditions.

Principles of Treatment—On the Effects of Diuretics and Sudorifics in certain Acute Inflammations.—The increased secretion of urine, the profuse sweating, often accompanied with increased action of the bowels, which mark the occurrence of resolution of the inflammation, that is, of the death of the bioplasts or masses of germinal matter which enter largely into the formation of the "inflammatory lymph," are undoubtedly encouraged by giving acetates, citrates, carbonates, and some other salts. Indeed, it is almost certain that, in many cases, critical discharges take place at an earlier period in consequence of the action of such remedies. If profuse sweating and diuresis can be brought about quickly, it is even a question if the disease may not sometimes be cut short. There can be no doubt that, by an increased action of the excreting organs, many substances which would have been absorbed by the growing bioplasts are eliminated, but it is probable that the salts given in these cases act favourably in another and not less important manner. Chloride of sodium seems absolutely necessary to the growth of the inflammatory products, while the salts given as medicines exert an unfavourable influence upon this process. These salts being in the blood already deprived of common salt, would probably be poured out at the seat of inflammation, and taking its place in the morbid products, would drive out the latter, and interfere with the further growth and multiplication of the bioplasts.

On enquiry it will often be found that some persons habitually take far too little salt with their food, and that, in consequence, the changes, which result in the formation and removal of excrementitious matters, are too limited. Salt not only favours tissue growth, but has much to do with the free and proper action of the organs of excretion, and probably with the free interchange of gases. Although a certain quantity of salt exists in most of the things we take as food, it is certain that more than this is required to keep our tissues in a healthy and active state. Everybody ought to take in addition about a teaspoonful of salt daily. The free use of salt has much to do with the health of most vertebrata, and this is one of the articles which ought to be freely used all over the world both by man and animals. Of all bad taxes I regard the tax on salt as a cruel and unprincipled tax, and one that ought never to be imposed. It is the interest of a government to make

salt as cheap as possible, in order that it may be freely taken. It is not only cruel but stupid to tax such a commodity as this, unless it be to the advantage of a state to increase the percentage of its weak and incapable subjects, and weaken and annoy all by making it difficult to obtain an article of diet which, as a mere commercial speculation, it would probably pay an employer of labour to provide them with for nothing.

In the treatment of such morbid conditions as pneumonia, when a greatly increased activity of the vital processes of growth and multiplication of living matter are going on at a very rapid rate in an organ necessary to life, we must not forget the very important principle of establishing increased action in one organ or part of the body with the effect of reducing exaggerated action in another situation where it cannot proceed for long without endangering the integrity of an important tissue or organ, and perhaps life itself. The new action established may almost be regarded as a form of counter-irritation; and probably operates in this way. By effecting increased action of an eliminating organ which is known to be related in function to that whose action is implicated, we diminish the rate of change in this latter, and many things which would be removed at this spot, are, as it were, diverted, and are removed from the body by the organ, the increased action of which has been induced by the treatment adopted. Thus in pneumonia the action of the skin, kidneys, and bowels, is to be stimulated in order to reduce the intensity of the action at the pulmonary surface. Through the influence of nerve action the blood flow is increased at the surfaces referred to, and temporary capillary congestion established, while the tension of the pulmonary vessels is relieved in at least a corresponding degree.

The favourable action of many salts in modifying pathological changes is probably due to their taking the place of the salts already there, and which favour the progress of the morbid change or are essential to it. The salt which replaces the first either exerts no action at all, or, more probably, actually interferes with the growth and multiplication of the bioplasts. I should explain the beneficial effects of iodide of potassium by supposing that it gradually drives out the chloride of sodium in the syphilitic growth, and takes its place. Being unfavourable to the processes of growth and multiplication of bioplasm the living particles cease to multiply and die, and the products of their death are first absorbed and then excreted by the emunctories.

The processes referred to are, no doubt, very slowly performed, and what is required is the continuous operation of the drug for a considerable period, and under circumstances favourable to combination, especially in a very diluted state. It is doubtful whether any advantage is gained by strong solutions. It is rather by frequent doses of the remedy in a very dilute state that we should expect benefit would result.

It is by the free percolation of weak solutions through the tissues that imperfectly soluble substances are gradually removed from the seat of their deposition, oxidised and otherwise chemically changed, and at last excreted from the body dissolved in water. It has of course been often suggested that in such a disease as pneumonia, when carbonic acid accumulates to a dangerous extent in the blood, advantage would follow the inhalation of pure oxygen or a mixture containing a higher percentage of that gas than common air. But not only is there an impossibility of the gas being absorbed by the blood, in consequence of the congestion of the capillary vessels specially concerned in that process, while in many the blood is probably actually stagnant; but the blood itself is in a condition unfavourable to the process, the red blood corpuscles and other constituents of the blood concerned in taking up oxygen being altered, and in a state capable of absorbing less, not more, than the normal quantity taken up in a given time.

It is the fashion now-a-days to condemn such remedies as acetate of ammonia and citrate of potash, but I cannot help thinking if those who express themselves thus confidently would themselves only take one or other remedy for a time, when they happen to be suffering from, say, an ordinary cold—they would change their opinion. The exceeding confidence with which many condemn this and praise that drug without ever having taken it or studied its action in others for a sufficient time and under sufficiently varying circumstances to enable them to judge as to its usefulness, is very remarkable and interesting as one of many curious examples of narrowness combined with the conviction of personal infallibility which we often meet with. Such-like ridiculous dogmatic assertions may enhance the repute of an individual, but they do not further the true interests of medicine nor are they of any advantage to the sick. Some are giving up in contempt methods of treatment which have been proved to be of unquestionable service, and substituting for them things which are puffed into notoriety and credited with properties which neither they nor any other substances in nature possess. I think our very serious attention should be given to the treatment of pneumonia and some other acute diseases as advised and carried out by some during recent years. Not only are stimulants not given in cases where there is marked tendency to death from distension and dangerous stretching of the right ventricle and failure of the heart's action, but aconite in frequent, and in some cases in what I should consider to be dangerous doses, is given. Although as strongly opposed to the use of alcohol in the healthy state as any one can be, I feel quite convinced that patients may be lost in consequence of alcohol being withheld at a critical moment. Possibly alcohol may be required only for a very short period, but in many cases there is a point in the disease when the heart begins to flag and the circulation in the capillaries

becomes very slow. Sometimes the blood accumulates in the right side of the heart, the muscular tissue of which may be paralysed by the stretching. The capillaries even of the surface become distended with a dark blood which hardly moves through the vessels. The tint of the surface of the body becomes dusky, the lips blue, and the face partly livid partly pale. If these changes go on to actual stagnation of the blood, the patient must die, but if a short time before stagnation of the blood occurs stimulants be given in decided quantities, the heart is stimulated to contract more vigorously, the blood is driven through the vessels, and the patient is saved. In such a case the brandy should be given in dessert or table spoonfuls, and not diluted with more than twice the quantity of water, because the contact with the mucous membrane of a tolerably strong solution stimulates the afferent nerves distributed to the mucous membrane of the stomach, and by reflex action the heart is excited to contract more vigorously, and from that time improvement is manifest, and the patient may soon become convalescent. If, on the other hand, no stimulant be given at this critical period of the case, the heart gets weaker and weaker, and the patient succumbs. If, however, the practitioner or the patient, or both, are determined that alcohol shall not on any account be given, I do hope that ammonia, and in very decided doses, will be substituted for it. Three or four times the quantity usually prescribed may be taken with advantage—of course properly diluted. The solution should not be stronger than ten grains of the carbonate of ammonia to one ounce of water, but this may be given once in an hour or oftener. The quantity of ammonia that may be taken with benefit in some maladies is enormous. On page 72 will be found an interesting statement on this matter.

Excess of Sulphates: Action of Liquor Potassæ.—The proportion of sulphates varies often, but not always, according to the amount of the urea formed. In diseases characterised by violent nervous and muscular action, we usually find an increased amount of sulphate in the urine. In *chorea*, the increase of the sulphates and urea is often very remarkable; but there are conditions in which the increase of the sulphates does not appear to be associated with the formation of urea to a correspondingly large amount. Dr. Parkes has shown, by some very careful experiments on four cases, that in rheumatic fever the sulphuric acid is greatly increased. In one case, 52½ grains of sulphuric acid and 5½ grains of unoxidised sulphur were excreted in twenty-four hours. The urea was not, however, increased in the same degree. This increase of sulphate is not observed in typhoid fever and scarlatina. It *does not*, therefore, depend merely on increase of temperature. Dr. Parkes suggests that in the blood, in acute rheumatism, there may exist a material richer in sulphur than albumen. Potash increases the tendency of this substance to undergo disintegration; and hence,

whenever liquor potassæ is given, the proportion of sulphates in the urine is augmented. ("The Influence of Liquor Potassæ on the Urine in Rheumatic Fever." Med. Chir. Review, vol. XIII, p. 248.) An increase in the quantity of sulphate in the urine, in cases of *rheumatic* fever, is noticed in some of Dr. Bence Jones' analyses. In one case, on the fifth day, the urine had a specific gravity of 1,026, and yielded 11·89 grains of sulphate of baryta.

In many cases of skin disease, I have found the relative proportion of the sulphates to be considerably augmented. This is well illustrated in the composition of the urine of a boy suffering from eczema.

It must not be forgotten that a great increase of the sulphates in the urine takes place if sulphates be taken as medicine. Sulphates of soda and magnesia are those which are most commonly given, and the proportion found in the urine is by this means frequently doubled or trebled, and the increase continues for some days after the sulphates are taken.

Sometimes the sulphates themselves, on the other hand, instead of sulphur being oxidised seem to be deoxidised in the organism with the setting free of very appreciable quantities of compounds rich in sulphur. It is not uncommon for patients who are taking waters containing sulphates, as well as those in which hydrosulphuric acid predominates, to discover that any silver they have about them has been completely blackened from the formation of a film of sulphur upon the surface. This setting free of sulphides may continue for a considerable period of time. I have known the process to continue over several weeks, but have not been able to get at any satisfactory explanation of the fact. If we could ascertain the causes of the change, and bring it on at will, it might be advantageous in the treatment of scabies, and possibly of many conditions depending upon the presence of animal or vegetable parasitic organisms. In taurine and cystine large quantities of sulphur exist, and it may be to some change in the former of these compounds which is constantly produced in the organism, that the chemical changes resulting in the formation of free hydric sulphide or hydrosulphuric acid or compounds which readily yield it are due.

Excess and Deficiency of Alkaline Phosphates.—I have adduced evidence which indicates that the greater part of the phosphoric acid eliminated is carried into the organism in the food. Dr. Ralfe has shown that "alkaline phosphates are retained in the system when the alkaline carbonates are withdrawn, and discharged when these are again supplied." ("Inquiry into the Pathology of Scurvy," by C. H. Ralfe, M.A., M. D. Lewis, 1877.) A certain proportion, however, of the phosphoric acid, there can be little doubt, is formed in the body by the oxidation of the phosphorus of albuminous textures. Contrary to what has been most positively affirmed, it is probable that the

amount formed in the nervous textures is exceedingly small. In diseases generally, the alterations which have been observed in the quantity of phosphate removed in the urine are to be attributed mainly to the altered diet of the patient. It is, however, but reasonable to suppose that, in some conditions of the system in which a more than usual disintegration of tissues rich in phosphorus takes place, more phosphoric acid would be produced in the organism than in health. This excess should be found in the urine in the form of alkaline phosphate, and it was said the amount corresponded to the activity of the changes taking place. Then it was assumed that by ascertaining the proportion, we should be able to form an estimate of the quantity of phosphorus oxidised—and therefore of nerve tissue disintegrated.

Those who labour to prove this, and further that all the changes in the body are the direct result of certain chemical decompositions, have not hesitated to appeal to the results of the observations referred to above in favour of their theory. Some years ago it was accepted as a settled point, that the quantity of phosphate in the urine varied according to the amount of nervous tissue disintegrated; and it was too hastily assumed that the quantity of work done by the brain varied in direct proportion to the activity of the chemical changes going on in the nervous tissue. But it has never been shown that the quantity of phosphate depends upon and varies according to the activity of the changes in question. The problem is much more intricate and more difficult of solution than at first appears.

The excretion of an unusual quantity of alkaline phosphate is not, as far as I have been able to ascertain, productive of any definite symptoms, nor does it, as far as I am aware, result in any derangement of the health. An extra amount simply filters through the organism and escapes partly in the urine, and is partly discharged from the intestinal surface.

When one considers the large amount of alkaline phosphates in wheat, in meat, and in other kinds of food habitually consumed, one wonders at remarks being made about the deficiency of phosphorus in the organism, and suggestions that this deficiency can be made up if phosphorus or some compound be taken as medicine or with the food. That phosphoric acid is useful in some disturbances of the digestive system I have no doubt, and that some phosphatic salts are of use in the treatment of certain disturbances of the health is likely, but that phosphatic salts act by furnishing phosphorus to the nervous system is most improbable.

There are no doubt circumstances under which a proportion of the alkaline phosphates present becomes decomposed, the phosphoric acid combining with calcium or magnesium to form earthy phosphates which may be held in solution in the blood and intertextural fluid, or may be

precipitated in an insoluble form in the tissues; or finding its way into the urine in a state of solution, may be precipitated from that fluid either before or after it has left the organism. In the former case the earthy salt may be deposited on the epithelial surface of the pelvis of the kidney, ureters, or bladder, causing grave disease of the mucous membrane, and leading to the formation of stone, or the establishment of disease of the mucous membrane—in the latter it forms a deposit in the urine partly amorphous, partly crystalline, well known to all who are familiar with the ordinary urinary deposits.

It has often been suggested in cases where an unusual quantity of phosphatic salts are being carried off by the urine, that phosphate should be prescribed, but it is hardly likely any advantage can result from the proceeding. There is no defect as regards the mere quantity of phosphate in the organism, but the increased excretion seems to be due to some derangement of the processes by which the phosphates are taken up by the tissues which should contain them, or to an unusual activity of the changes by which phosphates are removed and ultimately excreted from the body. We should endeavour therefore to put right any derangement of digestion or assimilation of the existence of which we could obtain some evidence or indication, rather than pour in at one part of the body salts of the same kind as those which are being rapidly carried off from another.

The earthy phosphates—phosphate of ammonia and magnesia, or, ammonio-magnesian phosphate, and phosphate of lime, or calcium phosphate, are referred to on page 73.

URINARY DEPOSITS.

THE subject of urinary deposits must always be of interest to the practitioner, and it is of considerable practical importance. In consequence of the expansion of other departments of medical enquiry, less attention has been given to urinary deposits of late years than formerly, but as no one can successfully treat many forms of urinary disease, unless he is familiar with the characters of urinary deposits and acquainted with the methods, chemical as well as microscopical, of identifying them and demonstrating their exact nature, the practitioner should take every opportunity of studying the character of the deposits commonly found in urine in various cases of derangement and of actual disease.

Considerable practice in the wards of the hospital and some patience are necessary for any one who would become familiar with the multitudinous forms of the substances which constitute urinary deposits. Far too little attention is now given by the student to practical work in this department. Looking occasionally at a few deposits mounted in Canada balsam is of little real service. Nothing short of examining a number of specimens of urine obtained in the wards will enable the practitioner to gain that confidence in his power of identification which he desires.

The presence of a deposit in the urine is of itself evidence that the secretion is not in its perfectly normal or healthy state, for healthy urine contains all its constituents dissolved, and the only thing that approaches deposit is a trace of mucus which forms a flocculent cloud which subsides to the lower part of the fluid after the urine has been allowed to stand for a time. The presence of some deposits in the urine may be taken as an indication either that the oxidising processes are not duly performed, or that the materials to be oxidised are in unusual amount, in consequence of the food taken being in excess of the amount the system requires.

Although, as a general rule, our treatment of a case is determined by various circumstances taken in conjunction with the results of a careful examination of the urine, there are a few urinary deposits just as as there are certain morbid constituents dissolved in the urine in certain cases, by which the nature of the disease may be conclusively determined. Care must be taken not to allow the judgment to be influenced only by the character of the urine or the urinary deposit, for serious

mistakes are sometimes made if the practitioner ventures to found a diagnosis exclusively upon one fact or upon a series of facts, instead of allowing his conclusion to be based upon everything that can be ascertained in connection with the case. Moreover, by concentrating his attention too exclusively upon one symptom or one special feature of disease, the student runs the risk of neglecting to take into account broad general facts of far greater consequence, and of thus making serious mistakes of both diagnosis and treatment. The experienced practitioner tries to grasp all the broad general features of a case, and in grave maladies he is careful to have well before his mind the tendency to death, before he allows his attention to be concentrated upon any one or two special matters which, although of some consequence, are probably of considerably less importance as regards the welfare of the patient than a thorough grasp of his pathological condition at the time, and of the changes which take place in his symptoms from day to day. For these and many other reasons that might be urged, it is important that while the great value of the careful microscopical and chemical characters of urinary deposits is fully recognised, the investigation of a case should not be limited to these methods, but the diagnosis grounded upon all the clinical facts of the case.

Urine Opalescent from Insoluble Matter being suspended in it.—Urine often appears opalescent in consequence of insoluble or very imperfectly soluble matter in a state of extremely minute division being evenly distributed through it. So very minute are the particles which cause the opalescence, that few of them, and sometimes none, subside after the urine has been allowed to stand even for a considerable time. Many substances may cause the appearance in question. Among the least common forms of opalescent urine, is that which depends upon an admixture of chyle, known as "chylous urine." The fluid is white and opaque, and looks like milk to which a considerable quantity of water had been added. Fatty matter in an extremely minute state of division is suspended uniformly through the fluid in these cases. It will neither rise to the surface nor subside to the bottom, if the urine be left to stand for many hours.

Opalescence may also be caused by the presence of multitudes of bacteria, which increase enormously as decomposition proceeds. Earthy phosphate also may be diffused through the urine, and cause it to be opalescent. Mucus from the urinary passages, perhaps, holding in suspension very minute crystals of oxalate of lime, is another cause of an opalescent appearance, but deposit which most frequently gives rise to an opalescent appearance of the urine, consists of urates which gradually pass into an insoluble form in a varying time after the urine has left the bladder. This deposit is instantly dissolved if a little warm

water be added to the urine, or if the latter be exposed to a gentle heat. The particles themselves are excessively minute, many of them so small as to be only just visible under the highest powers. There is no indication of crystalline forms in the largest of them.

CHYLOUS URINE.

"Chylous" urine will not be seen many times by any physician in this country, even though he be in large practice. Most of the cases observed, it will be found, originated in the tropics, where the condition is by no means uncommon. The urine, as I have already remarked, looks as if a little milk had been added to it. Indeed, such "chylous urine" is sometimes prepared for the purpose of deceiving us. The fact can, however, be at once determined by careful microscopical examination with a quarter of an inch object-glass, when the fat-globules of the milk at once come into view. In true chylous urine the matter in suspension which gives to the urine its whiteness and its opacity is fatty matter in an extremely minute state of division, in fact it is the so-called "molecular base" of the chyle which has found its way into the urine. Under the microscope the minute particles resemble those of urate of soda, but they are not dissolved when the urine is warmed, or when a little alkali is added. Chylous urine is so rarely seen in this country that the practitioner is very likely to regard the urine as a case in which ordinary urates of an unusually pale colour are held in suspension. Both urates and fatty matter in a molecular state as it exists in chylous urine, exhibit molecular movements, but the latter, though not altered by a moderate heat, are dissolved if the urine be agitated with ether. Blood is often found in chylous urine, and this gives to it a pinkish hue. Cases of chylous urine are comparatively common in Brazil, Cuba, the West Indies, the Mauritius, and India. The following interesting case occurred in the practice of my friend Mr. Cubitt, of Stroud, to whom I am indebted for the notes, and also for the specimens of urine which I analysed.—"Mrs. S., aged 50, native of Norfolk, in which county she had always resided, has been married twenty-nine years, and has had five children, the last of whom died in its second year. The youngest now living is 20. The catamenia ceased at 43. Till within the last four years, she has usually enjoyed good health, but at that time had a severe attack of influenza. She continued more or less out of health during the six or nine following months, and soon after this period her urine assumed a milky appearance, which character it has retained up to the present time (November, 1849), except at intervals of unfrequent occurrence and of short duration. The disorder would seem to have been gradually progressive, as the urine, which was at first only turbid and opalescent, has become by degrees more and more

opaque, so that when I saw it, the unassisted eye could not distinguish between it and milk; moreover, after the lapse of a few days, a rich kind of cream rises to the surface. It is almost entirely free from any urinous odour, and has a faint, sweetish smell, something resembling that of ripe apples. In the mean time, the general health has been more and more failing, and the digestive functions imperfectly performed; the patient has complained of loss of appetite, pain at the epigastrium after eating, slight headache with nausea, palpitations, and other dyspeptic symptoms. She has been losing flesh, suffering from pain in the back and loins without tenderness, from aching of the limbs, incapability of exertion, and other evidences of general debility; but still when the duration of the disease is taken into account, the general health may, upon the whole, be said to have suffered little. She states that, throughout the affection, fatigue, whether of mind or body, unusual exertion, excitement, late hours, distress, anxiety, immediately render the milky character of the urine more marked. She has been under the care of several medical men, as well as of some professed quacks (none of whom have ever examined the urine), without benefit; nevertheless, she has found that, for the time, brandy and isinglass, or compound spirits of lavender, have never failed to clear the urine, but without at all improving the general health. She seems to derive *temporary relief from all kinds of stimulants.* Occasionally and without any apparent cause, the urine resumes its ordinary appearance, but this is of rare occurrence, and its duration never exceeds two or three days. At no one time has she passed milky urine *during the day.* It is only the urine passed in the morning, after the night's sleep, which has ever presented a milky character. Occasionally, this urine settles down into a tremulous jelly, which takes the shape of the containing vessel, and more than once this spontaneous coagulation has taken place within the bladder itself; and in consequence of the impaction of small masses in the urethra, the patient has suffered from temporary retention of urine. She has tried various kinds of diet, but without any visible effect upon the urine. The quantity secreted appears normal, and there is no unusual frequency of micturition. The appetite has never been inordinate, or the thirst unnatural; the bowels are inclined to be costive. There is nothing remarkable about the state of the skin. She has suffered a good deal from pain in the back and loins, but there is no tenderness in this locality, and the uneasiness seems to depend upon exertion, and appears to be connected with general debility. There has never been any dropsy, and she has suffered from no cardiac or pulmonary symptoms, but such as may be accounted for by the dyspepsia; but I have not had an opportunity of examining the chest. She has never had severe headache, vertigo, vomiting, or other cerebral symptoms. Has never had rheumatism, fever, or any inflammatory attack,

has not been salivated, and has no reason to suppose she has suffered from exposure to cold. At the time when I saw her, the tongue was slightly furred, pulse 70, small and soft, respiration 20, and the skin cool; but there was a haggard appearance about the countenance, and a dark circle around the eyes, with slight bagging of the skin in this situation."

The first specimen of urine was passed in the morning, *Analysis* 1. It was perfectly fluid, and had all the appearance of fresh milk. It had neither a urinous smell nor taste. Upon the addition of an equal volume of ether it became perfectly clear: but when the ether was allowed to evaporate by the application of a gentle heat, the fatty matter could be again diffused, by agitation, through the urine, which regained its milky appearance, although it appeared rather more transparent than before the addition of the ether, and upon examination by the microscope, instead of the minute *granules* visible in the first instance, *numerous large and well-defined oil globules* were observed.

Urine. Specific gravity, 1013. Reaction, neutral. A little of the urine was evaporated to dryness. The dry residue was very greasy to the touch. It was treated with ether: and, upon evaporating the ethereal solution, a considerable quantity of hard and colourless fat was obtained.

ANALYSES	1		2
Water	947·4		978·8
Solid matter	52·6		21·2
Urea	7·73		6·95
Albumen	13·00		—
Uric acid	—		·15
Extractive matter with uric acid	11·66		7·31
Fat insoluble in hot and cold alcohol, but soluble in ether	9·20		
Fat insoluble in cold alcohol	2·70	13·9	·0
Fat soluble in cold alcohol	2·00		
Alkaline sulphates and chlorides	1·65		5·34
Alkaline Phosphates	4·66		1·45
Earthy Phosphates			·15

The second specimen (*Analysis* 2) was passed during the same day. Specific gravity, 1010. Reaction, very slightly acid. It was almost clear and contained a mere trace of deposit, consisting of a little epithelium, with a few cells larger than lymph corpuscles, and a few small cells, probably minute fungi. Not the slightest precipitate was produced by the application of heat, or upon the addition of nitric acid.

The presence of so large a proportion of fatty matter, perhaps, combined with the albumen (13·9 grains) in the first specimen, and its complete absence in the second, which was passed only a few hours afterwards, is very interesting, and bears upon the pathology of this

strange condition. The fatty matter was carefully examined for cholesterine but not a trace could be detected. The characters of this substance are described in "The Microscope in Medicine."

The proportion of the constituents in 100 grains of the solid matter of these two specimens of urine, is given in the following table. 1 is the chylous, 2 the clear specimen :—

ANALYSES	1	2
Solid matter	100·00	100·00
Urea	14·69	32·78
Albumen	24·71	—
Extractive matter, uric acid...	22·17	35·18
Fatty matter	26·43	—
Alkaline sulphates and chlorides	3·14	25·18
Phosphates	8·86	7·54

The slight deposit which formed after the chylous urine had been allowed to stand for some time in a conical glass vessel, consisted of a small quantity of vesical epithelium, and some small slightly granular circular cells resembling chyle or lymph corpuscles. No oil globules could be detected upon the surface of the urine or amongst the deposit, and the fatty matter, which was equally diffused throughout, was in a molecular or granular form. By examining the urine with the highest powers, only very minute granules could be detected. These exhibited molecular movements. Indeed, it may be said that the microscopical characters of this urine closely resembled those of chyle. (100 Urinary Deposits, pl. I, fig. 2.)

My analyses conclusively proved that while one specimen of urine contained the large proportion of nearly fourteen grains per 1000 of fatty matter, another taken only a few hours later contained a mere trace. This remarkable fact led me to make the remark "that the condition does not depend upon any permanent morbid change in the secreting structure of the kidney, and that the chylous character of the urine is intimately connected with the absorption of chyle. The debility and emaciation show that the fatty matter, albumen, and other nutritious substances are diverted from their proper course, and removed in the urine, instead of being appropriated to the nutrition of the system." ("Urine, Urinary Deposits and Calculi," published in March, 1861.) In a paper in the same year by Dr. Vandyke Carter, concerning a case of dilatation of the cutaneous lymphatics with discharge of a milky fluid, it was suggested that the admixture of chyle and lymph was due to a direct communication between the cutaneous lymphatic vessels of the scrotum and lower part of the body with the thoracic duct. In the cases adduced by Dr. Carter, chyle escaped from the cutaneous lymphatic vessels. There was evidently an accumu-

lation of chyle which, as the vessels became distended, was occasionally discharged from the cutaneous surface. Dr. Carter remarks :—" Had the chylous fluid, which in this case poured out on the cutaneous surface, been turned upon the urinary mucous tract, *we should have had all the phenomena of chylous urine.*"—" Med. Chir. Trans.," vol. XLV, 1862, p. 195. As respects another case, to which he refers in his paper, he says, " this (the escape of chyle in the urinary tract) must in reality have occurred." In all these cases there was accumulation in the lymphatics. In the first the chyle was occasionally discharged from the cutaneous surface, the urine being unaffected. The opening in the lymphatic vessel, from which the chyle escaped, was situated a few inches below Poupart's ligament, and sometimes a pint could be collected in a day. In the second case there was an external discharge of *chyle*, and the urine was frequently *chylous*. The third was a case of *chylous urine* without any external discharge of chyle. These cases proved the existence of a dilated condition of the lymphatic vessels. If the dilatation extend as high as the lower part of the thoracic duct, the chyle might pass from this tube into the lymphatics through communicating branches. The lymphatic tubes would soon be stretched so as to render the valves inoperative. Dr. Buchanan has reported a very interesting case in which a fluid like chyle was discharged from the surface of the thigh.—" Med. Chir. Trans.," 1862, vol. XLVI. The patient was a woman in humble circumstances, forty-six years of age, pale, but not emaciated. She was weak in consequence of an excessive discharge which could not be cured, from the inner and posterior aspect of the left thigh. The fluid which escaped resembled milk. It flowed from a semi-excoriated surface about the size of the palm of the hand. Over this space were numerous pearly vesicles, and from the excoriations resulting from the rupture of some of these there was a *constant stream* of milky fluid, more copious and more persistent when the patient was in the erect posture and moving about. In the after part of the day, so free was the flow that her " garments were drenched, even through the cloths which were applied to protect them." Five ounces of the fluid were collected in the course of an hour. The affected thigh was much swollen, its girth being nineteen inches, while the opposite limb only measured sixteen inches. The inguinal glands were not enlarged. Variation in the food produced no alteration either in the quantity or quality of the secretion. The patient had had several attacks of phlebitis in the affected limb which commenced after her second confinement. A few vesicles made their appearance about fifteen years ago. The number of these increased on a subsequent attack. She seems to have had many attacks of inflammation of the left inguinal region ushered in by shivering fits. Dr. Buchanan advised the patient to wear an elastic stocking, which relieved her very much,

although the discharge recurred whenever the pressure was removed. The discharge resembled chyle. Fibrin coagulated from it. Its specific gravity ranged between 1011 and 1015. Bodies like white blood corpuscles were detected upon microscopical examination, and the fluid contained minute particles which exhibited molecular movements and were soluble in ether.

These cases, and many more that might be referred to, establish the fact of free communication between the lacteals and lymphatics of the lower part of the abdomen and of the lower extremities. They naturally lead to the adoption of the conclusion that in cases of chylous urine a direct communication is somehow established between the lacteals and the lymphatic vessels of the urinary apparatus. Another link in the chain of evidence required to show the true nature of these remarkable cases was discovered by Dr. Timothy Lewis, who, in March 1870, detected small nematoid worms in the urine of a case of chyluria in Calcutta. Dr. W. J. Palmer and Dr. Charles found similar entozoa in the urine of other patients. In July 1872 similar nematoid worms were discovered by Dr. Lewis in the blood from the finger of a Hindoo, and were named by him Filaria Sanguinis hominis. Since this time the filaria has been detected many times both in the blood and in the urine of many cases of chyluria by Dr. Lewis, and his observations have been fully confirmed by a great number of observers. These parasites probably accumulate and cause dilatations in the lacteals, and ultimately lead to the establishment of free communications between the vessels in which they collect and the lymphatic channels in the neighbourhood.

Much further highly interesting information concerning the manner in which the filariæ get into the organism has since been obtained. Dr. Manson of Amoy proved that a special "Filaria Mosquito" takes up living embryonic filariæ with the patient's blood, and that in the body of the mosquito these undergo further change, and are transferred to the water of ponds. The embryo Filaria Dr. Manson shows undergoes great developmental changes in the body of the mosquito, and that "it finally quits this insect as a large and powerful animal equipped for an independent life." These creatures being taken with the water find their way into the stomach of man, and probably there undergo further change, and after passing into the intestinal canal some make their way into lacteal and lymphatic trunks, and most likely become parent filariæ. Many of the above facts have been confirmed by Dr. Lewis and by Sonsino in Egypt ("Medical Times and Gazette," May 13, 1883, p. 494; also September 22nd of the same year, p. 340). Dr. Manson's paper on "The Metamorphosis of Filaria Sanguinis hominis in the Mosquito" was communicated by Dr. Cobbold to the Linnean Society, and read March 6th, 1884. *See* Transactions, vol. II, part 10, April,

1884. For drawings of the Filaria Sanguinis hominis, *see* "The Microscope in Medicine," Fourth Edition, plates 77, 78, and 86.

A very important case of "Filarial hæmato-chyluria" was communicated to the Pathological Society in 1882 and published in the "Transactions" for that year by Dr. Stephen Mackenzie, in which great dilatation of the iliac lumbar and renal lymphatics was observed, with great changes in the glands, receptaculum chyli and thoracic duct, and calculi in the renal lymphatics of the left side.

Of the Treatment of Cases of Chylous Urine.—Various plans of treatment have been tried in cases of chylous urine, but without very satisfactory results. Astringents have proved useful in many instances; and in one of Dr. Bence Jones' cases, the pressure of a tight belt "relieved the pain, and rendered the urine slightly less chylous." Dr. Prout found that in some of his cases temporary relief resulted from the use of mineral acids and astringents, as alum and acetate of lead. Opium also arrested some of the symptoms for a while. Dr. Bence Jones has tried a variety of remedies, but the greatest advantage seems to have been derived from the use of astringents. Tannic acid, acetate of lead, and nitrate of silver, were employed. Matico afforded some relief, but the most valuable remedy in Dr. Bence Jones' hands was gallic acid. Its good effects were probably due to its astringent properties, and not to any specific action. The chylous character of the urine and the albumen disappeared two days after the commencement of the use of this drug; and in one case the patient seems to have been cured by its long continued use. (For the results of a daily examination of the urine for some weeks while the patient was on gallic acid, *see* "Phil. Trans.," 1850.) In Dr. Priestley's case, the gallic acid caused such nausea that it was considered expedient to give it up. The same remedy was tried by Dr. Goodwin of Norwich, in a case which came under his care. He says—"Gallic acid appeared to exert great influence in restraining the milky appearance of the urine. The patient took it for about nine months in 1855 and 1856; and I found his water perfectly normal in colour after six months' steady use of it in doses of half a drachm three times a-day. He then discontinued its use, and went to work. In four or five days the same milky appearance presented itself, and was again removed by taking the gallic acid. He could at any time render the urine nearly normal in appearance by taking this drng; but it was necessary to avoid hard work. He only complained of occasional dimness of sight and deafness; but it was not easy to make out to what cause these symptoms were due. He left off attending the hospital in September last, when my note is as follows:—Has not had any gallic acid for three weeks, and the urine is now slightly opaline in appearance. Specific gravity, 1010; the temperature of the air was about 50°. He passes seven pints and a half

daily on the average. It does not coagulate with heat or nitric acid, or both combined." Dr. Goodwin has not been able to ascertain anything of the further history of this case.

In Dr. Waters' case gallic acid was given in doses commencing at 30 grains a-day, gradually increased to 135 grains a-day, and then gradually reduced. The patient was under treatment less than nine weeks and got quite well. His weight increased from 8 stone 6 lbs., to 10 stone 6 lbs. Four months after his discharge from the hospital he continued in good health. There was no albumen or fatty matter in this patient's urine. The general debility in these cases will be relieved by iron, tonics, and carefully regulated diet. The patient suffering from chylous urine should rest much in the recumbent posture, and should avoid jolting and all movements likely to disturb the circulation.

DEPOSITS OF URATES.

Urates diffused through the urine which occasion an opalescent appearance consist of several different salts of uric acid mixed together. Urates of soda, lime, ammonia, and magnesia are the most important. In a few cases the deposit which looks like urate and is often mistaken for it, is really uric acid in a state of extremely minute division. By careful microscopical examination the little crystals can be demonstrated without difficulty, and if the deposit be left to stand for twenty-four hours, the small crystals will be found to have considerably increased in size, and can be easily identified.

Although much has been said and written on the subject of deposits of urates, we have still much to learn concerning the conditions which favour the deposition of this salt as well as its exact significance. The occasional precipitation of urates of soda and ammonia, with traces of urate of lime and magnesia occurs in the urine of almost every person from time to time. Very slight disturbance of the chemistry of the body seems to cause this sediment which persists for a few days and then ceases. Injudicious living, excess of nitrogenous food, over fatigue, the influence of cold, a tendency to gout, improper action of the skin, close rooms, stomach disturbance, are a few among the numerous circumstances to which the formation of this urinary deposit has been attributed, but the deposit has occurred often enough in the absence of every one of these supposed causes, and has been absent when these have been present, and in a marked degree. Nevertheless it must be admitted that these deposits ought not to be very frequently present in the water, and when they occur day after day means should be taken to assist their removal in a soluble form, and to prevent their formation. In an ordinary cold, in a bilious attack, during indigestion, the deposit is very generally

observed. The general conditions which determine the presence of an increased quantity of urates seem to be the same as those which cause excess of uric acid.

There may be a *deposit* of urates without *excess*, and there may be *excess* without any deposit whatever. Deposits of urates are very common in many cases of heart disease, emphysema, and chronic bronchitis. It is probable that the passive congestion of the liver and the slow circulation of blood through this organ has much to do with the formation. In cases where there is a gouty tendency, for weeks or months urates may be constantly present.

These deposits are almost invariably present in acute febrile conditions; and an enormous deposit of urates, sometimes red, sometimes pale, marks the occurrence of "resolution" of many acute inflammatory attacks. A "critical deposit of urates" is commonly seen in acute pneumonia, scarlatina, continued fever, rheumatic fever, &c. It need scarcely be said that no special treatment is required to prevent the formation of the deposit in such a case, but it is well to promote its solution, and to favour its elimination. In many cases of acute disease, I am in the habit of giving weak solutions of acetates or citrates. In pneumonia, I often give as much as 12 ounces of the liquor ammoniæ acetatis in the 24 hours. No doubt by this treatment many imperfectly oxidised products, and urates amongst the number, are eliminated. One of my patients who suffered from acid eructations, and what he called acidity of the stomach, not associated with any gouty symptoms, passed urine which always exhibited a deposit of urate.

An increased quantity of fluid, and a little bicarbonate of potash or soda, or liquor potassæ, will generally cause the disappearance of these deposits. When the liver is inactive, a small dose of calomel, blue pill, or gray powder, chloride of ammonium, or solution of acetate of ammonia, will set matters to rights. Some people make themselves very nervous about the appearance of this sediment. A little more exercise in the open air, moderation in diet, simple food, a little less wine than usual, no beer or porter, and a glass or two of Vichy or potash water with the dinner and the last thing at night, will generally have the desired effect. All sorts of remedies have been devised for the treatment of this condition. Benzoic acid and benzoate of ammonia, among other things, have been given with advantage. Sometimes a little more liquid will stop the deposition, alkalies of any kind in small quantity, with linseed tea or barley water, salts of the vegetable acids, a diet largely composed of fruit and vegetables, plenty of milk, are some of the means which are usually effective in stopping at any rate for a time the deposition of urates. In many cases it is necessary to see that the bowels are cleared out, and oftentimes the condition which gives rise to the deposit is relieved by remedies which, as I have remarked, act upon the liver.

But it is nevertheless certain that mercurial preparations which often afford great relief in these cases, effecting not only the removal of the deposit, but of a number of unpleasant symptoms and discomfort which have perhaps long troubled the patient, will actually occasion a deposit of urate, particularly if persisted in day after day for some time. In former days when mercurials used to be given systematically, urate deposits were constantly noticed, and I think there is no doubt that the means taken for their removal did sometimes cause their appearance and promote their persistence. Neither urate nor any other deposit ought to be found in healthy urine, but urate deposit often occurs when the departure from the healthy state is not perceptible, and there is no evidence that when it occurs only now and then any harm results. Its frequent occurrence should certainly be prevented, because the formation of urinary calculi might be favoured by the presence of this deposit; indeed, both uric acid and urates often form minute concretions which are in fact microscopic calculi, and which, being present in the pelvis of the kidney or in the bladder, may increase in size if the state of the urine referred to persist for any considerable time.

Often the urate remains suspended in the urine without forming a visible deposit, and produces a decided opalescence. If albumen be present in urine containing urates, the urine will not become clear by heat, or rather, the urine will at first clear, but soon become turbid again, in consequence of the precipitation of the albumen. With a little care, however, in applying heat, the upper stratum of urine in the test-tube may be made hot enough to coagulate the albumen, the middle stratum being *cleared* by the solution of the urate without the albumen being thrown down, while in the bottom of the tube the deposit remains unchanged. In performing this experiment, the test-tube should be held by the lower part.

The urine of a child suffering from scarlatina, with delirium and unconsciousness, contained an abundant deposit of urates. It was acid; specific gravity, 1025.

ANALYSIS.

Water	932·2	—
Solid matter...	67·8	100·
Organic matter	59·03	87·07
Fixed salts	8·77	12·93
Uric acid...	1·19	1·75

In a deposit, which was composed of rounded globules, with small sharp spicules projecting from them (uric acid), I found the following constituents: phosphate of lime, urate of soda, and other urates. A considerable quantity of these spherules existed in the urine of a man suffering from pneumonia, and they had the following chemical characters. There was distinct evidence of the presence of uric acid by the

murexide test. The deposit was soluble in boiling potash; and when, to the alkaline solution, excess of hydrochloric acid was added, well defined crystals of uric acid were formed. Upon exposure to red heat, an odour like that of burnt horn was exhaled; and, after decarbonisation, a moderate quantity of a white ash remained, which dissolved in acids with effervescence; and, from the acetic acid solution a precipitate was thrown down, upon the addition of oxalate of ammonia. I conclude, therefore, that urate of lime entered into the formation of these crystals. The quantity of crystals at my disposal was far too small to make a quantitative analysis.

In cases where the ordinary remedies fail, a number of others may be tried, which will suggest themselves to the practitioner, if he bears in mind the conditions under which this deposit occurs, and enquires carefully into the general habits of the patient. Many of the salts of vegetable acids do good in cases where urates are deposited day after day; and many fruits, such as apples, strawberries, oranges, lemons, grapes, &c., may be taken. The salts of these vegetable acids become converted into carbonates in the organism, and they may be given in cases in which alkalies derange the action of the stomach. Phosphate of soda is often prescribed, and benzoic acid has been strongly recommended by Mr. Ure; but it is of the greatest importance, when these deposits are constant, and especially when associated with rheumatic pains, to pay attention to the action of the skin and bowels. The vapour bath, the hot-air bath, and the Turkish bath, are of great service by promoting sweating. The vapour bath is sufficiently potent, and does not produce depression, which sometimes follows the use of the hot bath, especially if it be taken very frequently.

DEPOSITS OF URIC ACID.

The deposition of uric acid crystals, or of urates in an amorphous state, or as small spherules, or in all these forms, is not of itself an indication of a morbid condition. Slight change in the acidity of the urine will cause the deposit to form, and though no more may be present than in ordinary health, being in an insoluble form and constituting a deposit visible to the unaided eye, it usually attracts the patient's attention, and if it occurs often the fact will very probably be brought under the notice of the medical adviser, and the patient will feel anxious to be relieved. This deposition of the slightly soluble uric acid and urates is a fact of real consequence, and if allowed to continue for some time the result may be the formation of a stone. In the majority of cases there is no doubt the formation of a calculus is preventible. If the attention of the practitioner is directed to the state of the water at a sufficiently early period of the case, he will probably prescribe remedies which will

interfere with the formation of the deposit. Many patients suffer from this deposit for years without even noticing the fact, until perhaps one day they are surprised by passing a small stone, or by symptoms which are clearly due to its presence in the bladder.

Sometimes small uric acid concretions are produced in immense numbers. The urine being secreted in a state favourable to the precipitation of uric acid, the presence of a dumb-bell crystal of oxalate of lime, or a few blood corpuscles or particles of epithelium or epithelial *débris* in the uriniferous tube may serve as the nucleus of a calculus. Around this particle uric acid is precipitated and is deposited layer by layer until an actual concretion results. This may make its way to the bladder, where further deposition takes place until a stone of considerable size is formed. In one remarkable case under my care for some time, minute calculi of uric acid were formed in the kidney literally by the thousand. Hundreds as large as mignonette seeds could often be counted in a single specimen of urine.

The *quantity* of uric acid in the urine depends, to a certain extent, on the activity of the skin; and, as a general rule, when there is profuse cutaneous perspiration, the amount of uric acid in the urine will be found to diminish. If, on the other hand, the function of the skin be in any way impaired, or perspiration be impeded by cold, a considerable increase in the quantity of uric acid sometimes take place. Marcet found that the amount of uric acid diminished after severe perspiration; and Fourcroy noticed more uric acid in the urine of a man in winter than in summer. In this way may be explained the presence of the large quantity of uric acid in the urine of persons affected with acute dropsy, or dropsy after scarlatina, and it seems probable that the frequency with which these deposits are met with in the urine of persons affected with skin diseases (especially eczema and lepra) may be due simply to the impaired function of the skin. After increased muscular exertion, accompanied with imperfect respiratory action, uric acid occurs in abnormal proportion. It is present as a deposit in very many cases of chorea. It should, however, be borne in mind that considerable quantities of uric acid are often dissolved in the urine as a urate at the time it is passed. This may afterwards be precipitated, being separated from its combination with soda (urate of soda) by a process of acid fermentation.

The various forms which uric acid assumes in urine may often be traced, by intermediate stages, from one into the other; but the conditions which determine the changes have not yet been satisfactorily explained. Doubtless the length of time occupied in the formation of the crystal, and the extractive matters present have much influence in determining its form; for not unfrequently one crystal is observed to acquire entirely different characters if it be allowed to remain for a

longer period immersed in the urine. Some of the commonest forms met with are represented in 100 Urinary Deposits, plates V, VI, VII, figs. 68 to 90. The dumb-bell form of crystals is occasionally met with in deposits: but it may often be readily obtained by the addition of acid to urine. These crystals must not be mistaken for dumb-bells of oxalate of lime, from which they may be distinguished by their large size and darker colour, and by their being readily soluble in alkalies. Pure uric acid often crystallises in micaceous plates. Uric acid deposited in urine can generally be distinguished by its colour from other crystalline deposits, although two or three instances have come under my notice in which the crystals were found to be perfectly colourless.

In the plates of "Urine, Urinary Deposits and Calculi," as many as thirty-six different forms of uric acid are represented, but were the number greatly increased the practitioner who made frequent examinations of the urine would, from time to time, meet with crystals not exactly resembling any of my figures. I think, however, that anyone familiar with the representations here given, and with the most common forms as actually seen in the microscope, would be able to recognise without difficulty any forms of uric acid which he is likely to meet with.

Uric acid is sometimes deposited very rapidly, when it forms a thin glistening film, in which no indication of crystalline form can be detected. A film of this kind was brought to me some time since by Dr. Chambers. After the lapse of a day or two, however, well-marked crystals made their appearance. Some of these films are composed of layers of small crystals, closely matted together. After the lapse of a short time, the larger crystals grow, while the smaller ones disappear; so that at length a number of large well-defined crystals are produced. A deposit of uric acid sometimes resembles amorphous urate, and even under very high powers of the microscope nothing but minute granules can be detected, even for some hours after the urine has been passed. This deposit is not soluble in boiling water, and in the course of from 24 to 48 hours the granules will be found to have increased considerably in size, while many exhibit well-defined crystalline forms.

Uric acid exists in the blood, in combination with a base, as an alkaline or earthy urate, which is comparatively soluble. The soluble urate may be decomposed; 1, when it arrives in the uriniferous tubes; 2, subsequently, when the urine reaches the bladder; or, 3, the acid may not be set free until some time after the urine has been passed.

In the first case, the acid may accumulate and block up the uriniferous tubes, or perhaps form a small concretion. I have shown that oxalate of lime usually forms the nucleus of uric acid calculi which are so common. In the second case, if a small concretion of any kind, as, for example, a few epithelial cells or a dumb-bell crystal of oxalate of lime exist in the bladder, uric acid may be deposited around it, and a uric

acid calculus become rapidly formed. The acid crystallises sometimes very soon after the urine has been voided, sometimes not for some days afterwards. I have before alluded to the importance of not regarding the *deposition* of uric acid crystals as in all cases depending upon *excess* of the acid in the urine. There may be actually less uric acid than is present in health, although it may be deposited entirely in an insoluble form, and being bulky, a very small amount in weight appears as a considerable deposit to the unaided eye.

Uric acid is more commonly met with in summer than in cold weather. In chronic diseases of the respiratory organs we often meet with uric acid and urates in the urine. It is common in emphysema of the lungs and in chronic bronchitis. In pneumonia and rheumatic fever it is often found. It is seldom absent from the urine in chorea, and very often exists in various forms of skin disease and in cases of acute inflammation of the kidney. Some children are very liable to suffer from these deposits, and their appearance is accompanied by frequent desire to pass urine. Uric acid and urates will be found in some children's urine for weeks at a time. Generally there is disturbed health, and there are indications for the employment of small doses of gray powder or calomel, which treatment often cures the patient in two or three days.

The presence of uric acid in the water is not unfrequently associated with pain in the centre of the back, often considered to be "rheumatic" in its nature, but probably more often due to a vitiated state of blood acting upon the nerves distributed to the lumbar muscles, or upon the centres through which these pass to their peripheral distribution. A dose of alkali will often relieve this pain in the course of a few hours.

A gouty tendency is often accompanied by eczema, lasting perhaps for many years, and in such conditions uric acid deposits are common. One patient who suffered in this way could not be persuaded to give up wine and beer, although it is certain both the eczema and the urinary deposit were aggravated thereby, and almost as certain that the patient might have been cured if he had given up these beverages. Those who will indulge in good living in spite of these continual warnings and disturbances of the health, must adopt the principle of free and frequent purgatives or be content to suffer from serious disease of liver or kidneys, or both as age advances.

When uric acid gravel is passed in considerable quantity its passage down the ureter sometimes causes pain like that of calculus. A young woman only 22 suffered from attacks of gravel every three weeks for two or three years. There was also irritability of the bladder and frequent micturition at night. Such cases are almost invariably cured by alkalies, purgatives, and a carefully regulated diet, but the treatment has to be continued for three months or longer. A lady of 55 who had had

frequent attacks during ten years, with bearing down pain and terrible irritability of the bladder, interfering with sleep and preventing her from taking exercise, was greatly relieved by taking iron and henbane for some time. Not only was the irritability of the bladder relieved, but the stream became larger, and the organ emptied itself more thoroughly—once in two or three hours instead of every half hour; and in fact this patient was on the high road to recovery four or five months after the commencement of the treatment. In this case alkalies, carried to any great extent, would have done harm instead of good. I have seen several instances of irritable bladder with secretion of quantities of muco-pus which have resulted from the persistent use of alkalies by the patients themselves.

The most severe sensation of scalding as the urine passes along the urethra with or without pain, or a feeling of soreness at the tip of the penis is sometimes associated with the secretion of highly acid urine with an abundant deposit of urates or uric acid, or both, and rich in urea. Such cases are cured in a very short time by diluents, especially linseed tea, with a dose of citrate of potash or the effervescing citrate of magnesia every two or three hours, and continued for a few days. I generally also give a pill containing half a grain of gray powder or calomel at bed time for two or three nights running. Patients who suffer in this way should live carefully, taking little or no meat and no stimulants—at any rate while the symptoms continue.

In the case of a man of 41 years of age, uric acid (gravel) had been constantly present in the urine for fifteen years, during five of which he had passed from time to time numerous small calculi of uric acid. This patient's liver was often inactive, but upon the whole he had good health. When 64 he had a very bad attack of shingles. He quite recovered his health at 66, and no longer passed gravel or calculi. This patient's mother had suffered from gravel, and a brother had died of acute rheumatism. It is curious in how many cases uric acid is passed for several years, and perhaps numerous uric acid stones formed over a considerable period, when an attack of fever or some other illness occurs, and the "constitution" seems to undergo a change. The general health is altered. Numerous slight ailments disappear and never recur, and the patient is compensated for much wretchedness, caused by bad health and constant discomfort, and perhaps frequent attacks of severe pain in early life, by a glorious old age of sustained health and strength, lasting possibly far beyond the ordinary period of life.

In one case in which the urine contained large excess of urea as well as almost constant deposit of uric acid, I found that from the age of 20 to 41 the uric acid had been constantly present in the urine in the form of crystals. The man was engaged in out-door work. His

uncle had had stone in the bladder, and his father had suffered much from sciatica.

Uric acid is not generally present in diabetic urine, but it is sometimes noticed, and in considerable quantity. In a child aged 8, who was in a diabetic condition, an abundant deposit of uric acid occurred and lasted for a considerable time. This deposit seemed to be consequent upon a course of mineral acids. Some authorities have affirmed that diabetic urine never contains uric acid, but such a statement is certainly erroneous. In this country at least it is no uncommon thing to find uric acid in the urine of diabetics.

Occasionally we meet with patients who appear generally in good health, but who complain of getting thin, although they live well, in many instances perhaps too well, and suffer from an almost constant deposition of uric acid. It is very difficult to explain this symptom in every case in which it occurs; but I feel sure that many of these persons constantly overtax their digestive organs, and are in the habit of consuming far more than their systems require. They think that the only way to gain flesh is to eat a large quantity of food; and, in consequence of too much work being thrown upon their digestive organs, especially the liver, assimilation is not properly carried on, and a quantity of material is formed which is unfitted for the wants of the organism, and much of this is perhaps got rid of in the state of urea, uric acid, and urates, and the processes concerned in the production of these compounds may overtax the power of certain organs. By cutting off a certain part of the supply, their anxiety as to the gravel is soon relieved, and at the same time, to their surprise, they gain strength and increase in weight.

The value of benzoic acid and benzoate of ammonia in the treatment of the gouty state has long been known, and for more than thirty years I have been in the habit of prescribing it in cases of uric acid and urate deposit, in various conditions which seem to be due to a gouty disposition or tendency, and in many forms of hepatic derangement. This method of treatment was employed for many years by Dr. Todd, and I think before him by Mr. Ure, one of the Surgeons of St. Mary's Hospital. Benzoic acid acts upon glycocine in the liver to form hippuric acid, and it is probably to this chemical action that the benefit resulting from its use should be attributed. The reader will gain important information on this matter, as well as concerning the probable action of many chemical remedies in gout and allied affections, from Professor Latham's work "On the Formation of Uric Acid in Animals: its relation to Gout and Gravel." Cambridge: Deighton Bell. 1884.

I have seen instances of uric acid deposits occurring in adults, over which ordinary remedies appeared to exert little influence. The urine of a patient suffering from emphysema of the lungs always contained a

large quantity; and it appeared while she was taking considerable doses of alkalies, and also when she was put upon mineral acids.

The occasional deposition of uric acid crystals from the urine requires no medical treatment, or at most a dose of bicarbonate of potash after meals or the last thing at night. In some cases in which these deposits are frequent, and in people of a gouty tendency, small doses of hydrochloric acid with pepsin before meals, and twenty grains of bicarbonate of potash in half a tumbler of water after meals, is a plan which answers admirably, and often cures the patient after other methods have completely failed.

Of all the remedies employed for carrying off uric acid from the system liquor potassæ is, in my opinion, the most efficacious. The objections sometimes urged against the use of liquor potassæ are not established by the facts of experience, unless it is persisted in for too long a time, or given in cases when its use is contra-indicated. Where an unusual proportion of uric acid is formed, as much as a drachm of liquor potassæ has been taken daily for many months without any ill effects, though, as a general rule, I should not advise the drug to be given in more than half the proportion, or for more than a fortnight at a time without an interval during which it is withheld altogether. A gentleman of 60, who had been passing small uric acid concretions from the kidney, sometimes to the number of 100 or more in a single week, was ordered to take liquor potassæ. After a time, the stones ceased to appear. But, without the knowledge of his medical adviser, this gentleman continued to take liquor potassæ daily for upwards of twelve months in quantities of from twenty to sixty drops daily. The acid reaction of the urine continued during the whole time. Such a case conclusively proves what a large amount of alkali may be taken for a considerable time without detriment—indeed with great advantage to the patient. This patient was muscularly weak, but he found that he felt better and stronger when taking liquor potassæ than he had done for many years before, while his lumbar pain ceased to trouble him, and the calculi only made their appearance very occasionally. However, as I have already remarked, it is desirable not to give liquor potassæ for longer than a fortnight at a time. After an interval of a week or two, the remedy may be resumed for a like period. In prescribing acids and alkalies, and indeed all other remedies, the practitioner should feel sure that the patient understands how long he is to continue the drug. It is very important we should know how far the frequent administration of potent remedies may be pushed with advantage, and without being detrimental to the patient. Unfortunately information of this kind is for the most part in the heads of practitioners, and so far little exact knowledge on the matter has found its way into treatises on medicine and therapeutics. We are instructed as to the doses in which a drug

should be prescribed, but it is seldom we meet with exact directions which we can apply to the management of a given case. Much is still left to the experience, judgment, and medical sagacity of the individual practitioner. Unfortunately, it is almost impossible to record in a form that would be practically helpful the results of individual observation and experience by the bedside, and indeed when attempts are made to do this, except in the most broad and general way, it is not possible to avoid prolixity and detail which would be tedious to read, and would practically be of little assistance even to the few who took the trouble to wade through what was written. This is no doubt why, as students and practitioners often complain, many practical questions of the simplest and broadest character remain almost unanswered, not only in our text-books, but in our books of reference, encyclopædias, and dictionaries. Nay still there remains much uncertainty concerning broad principles upon which the treatment of well-known and common forms of disease should be conducted. We still have to appeal to the judgment of those who have had greater experience than ourselves, or to trust to our own. The actual practice of medicine, the treatment of actual cases of illness, changes so much from decade to decade, that it is not to be wondered at that our so-called "principles" are often called in question, and are regarded as prejudices and fads of advisers full of confidence in themselves, more positive than thoughtful—"principles" founded upon egotistic imagination, upon dictum, upon fashion, rather than upon fact and observation. Nevertheless, there are principles by which we may be guided, and which rest upon a very firm and solid basis of fact.

XANTHINE.

Uric or Xanthic Oxide ($C_{10}H_4N_4O$) is a substance closely resembling uric acid in many of its characters. It is very rarely met with in urine. It was described first by Marcet, and has since been detected in the blood, and also in the spleen, muscles, liver and brain. It is rarely met with in the crystalline form, but Bence Jones reports the case of a boy, aged 9½ years, suffering from a feverish attack, in whose urine xanthine crystallised in lozenge-shaped crystals, which were first mistaken for uric acid. ("Journal of the Chemical Society," 1862.) The crystals were dissolved when the urine was boiled, and were found to be soluble in water, nitric and hydrochloric acids, and in all alkalies. Douglas Maclagan also reports a case in which xanthine occurred in a urinary deposit. The synthesis of xanthine has been effected by Gautier, from hydrocyanic acid, and no doubt ere long uric acid will be obtained from xanthine. Xanthine is probably a common constituent of urine, but exists in very small quantity. According to Dr. John Davy it is the

constituent of the urine of spiders and scorpions. A rare form of calculus is entirely composed of it. Dr. G. Durr, after bathing in natural sulphuretted waters, found xanthine in his urine, and also in the urine of a patient who had had strong sulphur ointment rubbed into his skin, but not after taking milk of sulphur into his stomach.

DEPOSITS OF OXALATE OF LIME.

Oxalate of lime was first shown to be a common urinary deposit by Dr. Golding Bird. It is seldom deposited in quantity sufficient to be recognised by the unaided eye, or to be tested chemically. Oxalate of lime crystallises in well-defined octahedra—easily seen even if very minute under a quarter of an inch object-glass.

There is still much difference of opinion among practitioners as to the clinical importance of oxalate of lime. There can be no doubt that, in many instances, the crystals form after the urine has left the bladder. The conclusions of Dr. Owen Rees, and the experiments of Dr. Aldridge indicate that the oxalic acid is produced by decomposition of the urates after the urine has been secreted. Oxalate is often found in the urine of gouty cases, and it is certainly very commonly detected among urate deposits. Although there are many abnormal conditions of the system in which both oxalates and urates are very common, both deposits may be present, and indeed very commonly are present in the urine of healthy persons. Hence it is obvious that such deposits do not necessarily establish the existence of any particular diathesis. What is termed the "*oxalic diathesis*," seems to have derived its name from the fact that oxalate of lime is present in the urine; but this is not the most important part of the case, and the practitioner cannot make a greater mistake than to direct his attention to the urinary deposit alone, or to consider this as a special indication for treatment. In the same case, at one period we may find uric acid and urates; after a time, these mixed with oxalates; and, lastly, oxalate alone, and there will probably be found in connection with the symptoms, clinical facts of far greater consequence, especially as regards the question of treatment, than the presence of oxalate of lime in the patient's urine.

Wöhler and Frerichs injected uric acid into the blood of a dog, and found oxalate of lime in the urine. Oxalate of lime passes through the alimentary canal unchanged; but oxalic acid is in part excreted in the urine, while part is decomposed in the system. Bucheim and Piotrowsky have shown that small repeated doses of oxalic acid (fifteen grains every hour for six hours) are not poisonous. I should, however, strongly dissuade anyone from repeating such an experiment. Not more than 12 per cent. of the oxalic acid taken by the mouth appears in the urine. I have detected oxalate of lime in the urine of several persons who have

attempted to poison themselves with oxalic acid. In "100 Urinary Deposits," pl. VII, fig. 90, are some very marked six-sided crystals of oxalate of lime, obtained from the urine of a patient who had taken a large quantity of oxalic acid. They were insoluble in water, and were not dissolved by potash or acetic acid. The refraction of the crystals corresponded with that of oxalate.

Oxalate of lime is, however, not *always* formed *after* the urine has been passed, indeed it is often present while the urine remains in the bladder. Besides being found in octahedra in the urinary organs, or after the urine has left the bladder, oxalate of lime crystallises in a different form altogether. It crystallises in mucus in the form of spherules or "dumb-bells," and these as I have shown are often deposited in the tubes of the kidney during life. The crystal must therefore have been formed at the time of the separation of the urine from the blood, if indeed the salt did not exist in solution in the blood itself. The spherical and dumb-bell crystals I have proved often constitute the nucleus of uric acid and other calculi, and around it the other constituents are deposited in successive layers. It appears, then, that oxalate of lime may be excreted in the urine when oxalic acid or oxalates are taken in the food. It may be formed in the organism itself. It may be produced by the decomposition of uric acid and urates after the urine has left the bladder, and it may be deposited in the uriniferous tubes.

It must be borne in mind that oxalate of lime is often discovered in almost opposite conditions. Thus it is sometimes present in poor broken-down subjects, and it is found in the urine of well-to-do country gentlemen. It will appear when we live too well and take too little exercise, and will be found when we subject ourselves to very low diet. It is common in chronic pulmonary affections, as bronchitis, and it is often observed in old cases of emphysema. It is common enough in dyspeptics, and is usually met with in cases of jaundice. In various forms of general debility, in cases of over-fatigue, and in men who have overworked their minds, it is perhaps the commonest of urinary deposits. Lastly, as I have already remarked, it is often found, and sometimes in very large quantity, in the urine of men who appear to be in all other respects in perfect health.

Anything which improves the general health and promotes oxidation will diminish the tendency to the deposition of this substance. Cold bathing, exercise, attention to diet, and the mineral acids, bitter tonics, and iron, are usually prescribed with advantage. I feel that by many writers too much has been made of the indications for treatment afforded by urinary deposits. Many cases of what has been called the "oxalic acid diathesis," because the urine contains octahedra of oxalate of lime, may in truth be treated by the practitioner just as successfully

without taking into consideration the presence of the oxalate as by laying stress upon this fact. The patient will probably, in either case, be treated with tonic infusions and dilute acids (nitric, hydrochloric, or phosphoric), with a gentle purgative (mercurial in some cases), now and then. Pepsine may also be given. The diet should be simple, and small quantities of whisky or brandy in Seltzer or Vichy water may, in some cases, do good. Some patients must have change of air, and a sea voyage is often the best, as it is the cheapest, way of obtaining rest and fresh air, and change of scene.

Although the octahedra of oxalate of lime afford no special indication for treatment, the *dumb-bells*, on the other hand, unquestionably do so; for these bodies may form the nuclei of renal calculi. These dumb-bells of oxalate of lime have in fact a special significance, and, as I have pointed out, ought to be regarded as minute calculi. Deposited in the uriniferous tubes, they increase in size by the deposition of more oxalate on the surface, and often collect together to form small oval bodies around which, and between the individual dumb-bells, more oxalate is deposited. Thus is formed the nucleus of what may eventually become a calculus of considerable size. In cases, therefore, in which they are found, it is well to promote their expulsion, and endeavour to prevent the formation of more.

Dumb-bell and oval crystals of oxalate of lime are represented in "100 Urinary Deposits," pls. VII, VIII, figs. 95, 96, 97, 98, 111. These dumb-bells ought to be expelled from the uriniferous tubes as soon as possible after they are formed. Diluents usually effect this purpose. Two pints or more of linseed tea or barley water, flavoured with lemon juice; or mere water, or soda, potash, Vichy, or German Seltzer water may be given instead. These dumb-bell crystals sometimes give rise to the same symptoms in mitigated form as actual renal calculi. Lumbar pain on one side lasting for years, with occasional retraction of the corresponding testicle, and pus in the water, are not unfrequently met with in cases in which dumb-bells are very often found in the urine. In the case of a man of 65, irritable bladder with the formation of minute renal calculi, was succeeded after ten years by the frequent appearance of oxalate of lime and uric acid in the urine.

Much has been said and written concerning the pathological importance and clinical significance of deposits of octahedra of oxalate of lime, and many theories have been propounded, some of which are scarcely warranted by the facts of the case. The following points may, however, I think, be considered proved:—

1. That oxalate of lime crystals have been found in the urine of persons who are in excellent health, and whose constitution is sound, and at every period of life, even before birth.

2. That there are certain persons who are far more subject to these

deposits than the majority, and that in these oxalate-producing individuals the quantity found varies much from day to day, and is greatly influenced by diet, exercise, and a number of different circumstances within the range of the healthy state.

3. That in many forms of functional and organic disease, as has been mentioned, deposits of oxalate are often formed in considerable quantity.

The patient who habitually forms considerable quantities of oxalate of lime, and suffers from the malaise or gouty symptoms which not unfrequently accompany this deposit, should be recommended change of air. When it is feasible, a good long sea voyage, say to New Zealand, is often of the greatest service. In this way, the health is restored, and the general condition of the system is often completely changed. A "bilious" person is sometimes cured for life. Residence in the South of Europe for a winter or two has often the effect of re-establishing the health in middle life, after derangement and many slight ailments have troubled the patient for years. But where this expensive but pleasant advice cannot be followed, we must needs do our utmost to relieve the patient in the condition under which he is obliged to live, though unfavourable for getting rid of the deposit. Change from a diet rich in animal food to one consisting principally of vegetable food, fruit, milk, and farinaceous puddings, and an occasional small dose of mercury, twice a week, will sometimes effect a wonderful change in two or three months, so that the patient himself will be as astonished as pleased at the alteration in his health. Not only does he feel better, but he is able to do more, and his temper has improved for the better, to the advantage of all his friends as well as of himself. He is no longer despondent or irritable, and far from feeling the greatest difficulty in controlling his irritability, he discovers to his satisfaction that he has no distressing ill-temper to control. A little really hard work in the cases of many who never use their muscles will sometimes effect a cure. At first the patient will feel worse, but as his muscles get into order, the improvement in his health will be obvious enough. Carpentering, gardening, or other work where a little labour, but not severe effort much taxing the strength, is required; games of various kinds, when so great a luxury of labour can be indulged in, cricket, rowing, in moderation, or lawn tennis, or tricycling, if not carried to an extreme, will be found beneficial. I have no doubt that few of our modern exercises are more advantageous to men of middle age than tricycling, which with due care may be indulged in almost to advanced life. The practitioner must, however, be careful in recommending the tricycle. Before he does so, he must satisfy himself that his patient has no disease of the kidneys or liver, and that the heart and lungs are in good order. It is in the case of well-to-do men under 40, that the

"labour cure" for oxalate of lime deposits, biliousness, constipation, and other slight ailments, is so effective.

There is, then, in my opinion, no doubt that the general view entertained by the practitioners of the last generation that frequent deposit of oxalate of lime was associated with a general condition of the system sometimes called bilious, sometimes nervous or irritable, is correct, and it is certain that many of these cases, particularly when there is decided lowness and depression of spirits, are relieved by those medicines which relieve a congested state of the capillaries and retarded circulation in the liver, stomach, and intestinal canal. Small doses of calomel or gray powder every other day, or oftener, for a week, will often relieve patients who have "tried everything," and have even subjected themselves to a long course of waters, and a diet and mode of life which is more like a mild form of penal servitude than is a regimen which a sensible person having a knowledge of the structure and functions of the tissues and organs of his body would be inclined to voluntarily submit himself. Even half a grain of calomel, or gray powder, will often relieve a state of system which has caused its owner the greatest discomfort, if not actual misery, it may be, for many weeks.

CYSTINE.

Cystine ($C_6H_6NS_2O_4$) occurs occasionally as a crystalline sediment in urine, and also enters into the composition of a rare form of calculus, which has been termed the cystine calculus. Cystine was formerly spoken of under the name of cystic oxide, and the same term was applied to the calculus.

From the glistening of the crystals a very small quantity of cystine makes a great show when diffused through a considerable bulk of urine. Indeed what would be described as an abundant deposit, may not amount to half a grain in a thousand grains of urine.

Cystine forms a whitish deposit, which is found, upon microscopical examination, to consist of characteristic *six-sided plates*, "100 Urinary Deposits," pl. VII, figs. 92, 93, 94, which may be distinguished from uric acid crystals of the same form by the solvent action of ammonia upon the deposit. Upon the spontaneous evaporation of this ammoniacal solution, the cystine is again deposited unchanged in its hexagonal crystals. Uric acid would have been converted into urate of ammonia, which, on evaporation, would have remained as an amorphous residue. Ammonia, it appears, merely dissolves the cystine, and does not enter into combination with it. Cystine is insoluble in boiling water, in strong acetic acid, and also in very weak hydrochloric acid; but it is readily dissolved by oxalic, and by the strong mineral acids. The most remark-

able property of this substance is, that it contains as much as 26 per cent. of sulphur—a character in which it resembles taurine. Potash, like ammonia, readily dissolves cystine. The presence of sulphur in cystine may be proved by heating the substance in an alkaline solution of oxide of lead, when a black precipitate of sulphuret of lead occurs. This test cannot be regarded as characteristic of cystine, because all animal matters containing sulphur exhibit a similar reaction. Urine containing cystine is said to smell very much like sweet briar. Undoubtedly it has a sweet smell, but I cannot say that to me the smell has any resemblance to sweet briar.

Dr. Golding Bird observed that calculi composed of this substance undergo a change of colour by long keeping. From pale yellow or fawn coloured, they assumed a greenish-gray, and sometimes a fine greenish-blue tint. Crystals of cystine may be obtained from a calculus by dissolving a portion in a solution of potash, and adding excess of acetic acid to the alkaline solution, when the cystine will be deposited in its well-marked six-sided plates. Virchow and Clöetta have proved that cystine is sometimes found in the liver, while taurine as well as cystine have been detected in the urine.

The proportion of cystine in urine is really very small, seldom amounting to more than two or three grains in 1000 of urine, although it occupies a considerable bulk; so that the opinion commonly entertained with reference to cystine being a compound in which the sulphur is removed from the organism in an unoxidised state, in consequence of the oxidising processes being in a low condition, will not explain its formation, for in a case I carefully examined, it was found that a much larger quantity of sulphur passed off as sulphuric acid than in a state of combination in the form of cystine. Cystine has been met with in several different conditions of the system, but in most of the recorded cases the patients have been in a low weak state of health. Little is known with reference to the origin of this substance. It has been supposed to result from hepatic derangement, and Scherer and Virchow have detected cystine in the liver in disease. It is curious that cystine deposits occur in families, and even appear to be hereditary. Dr. Golding Bird speaks of an instance of its occurrence in three successive generations. Of the conditions of system which give rise to the elimination of this substance by the kidneys, little is at present known. In the majority of cases in which it has been found, the general health and nutrition of the patient have been bad. It is one of the most persistent of urinary deposits. After it has once appeared it may be produced, and in considerable quantity, over a period of twenty years or more, or its production may only cease with life. It is among the least common of urinary deposits, and usually its presence is not associated with any symptoms more serious or definite than malaise, a

feeling of weakness, fatigue, or exhaustion, with depressed or very low spirits.

One of the most remarkable cases of cystine deposit which I ever saw came under my notice many years ago, and has been under observation for fifteen years or more. During part of this time I saw the patient very frequently, and made many examinations of the urine, of the deposit, and of the calculi, which he passed in considerable numbers. This case and the following were reported in the "Lancet" of August 30th, 1884.

The patient (E. H. O.) was a fairly healthy-looking man, of 30, 5 ft. 5½ in. in height, weighing 9 st. 6 lbs., who was by trade a packer, an occupation involving pretty hard work and long hours. For four years before he came to me he had suffered more or less from lumbar pain and discomfort about the thighs, especially on exertion, and he often felt weak and low. He sometimes had to walk with a stick, and had had to give up work now and then for a week or two at a time. About two years after the first commencement of the symptoms he suffered from a fixed pain in the left groin, and soon afterwards several stones were passed, sometimes to the number of twelve or more at once. One of the calculi, however, was so large that it remained in the bladder, and Mr. Coulson had to crush it.

I put the patient on carbonate of ammonia, and told him to increase the dose gradually until it amounted to about fifty grains a day. He found the remedy agree with him so well that he soon exceeded this quantity, and for twelve months he took as much as fifty-five grains daily on the average, on some days consuming much more, on others considerably less, than this amount. In this time he did not pass as many calculi as before he had passed in a single month, and his weight increased to 9 st. 11 lbs. In the next year he took about thirty-five grains of carbonate of ammonia per diem, and in the following only an average of about twenty grains a day. This patient's family history was not very satisfactory. His mother died at the age of 52 of phthisis, and two sisters died under the age of 25 of the same disease. He did not look a strong man, and the muscles of his arms and legs were below the average size and prominence. When a young man he used to take violent exercise, and rowed in races. The quantity of urine passed was generally about the average, and never exceeded three pints. Every specimen that passed during a period extending over at least five years, he feels sure contained cystine. Afterwards the cystine was very frequently detected in considerable quantity. The crystals could be seen in the urine immediately after it was passed as small sparkling grains. The ammonia not only diminished the formation of the cystine, but the patient found that while he was taking it his bowels acted freely, and he never required an aperient, although previously he had been

much troubled by obstinate constipation. When the ammonia was not taken he says he did not feel as well as when he was taking it. He found no inconvenience from taking these large doses of carbonate of ammonia, and soon became so accustomed to the taste that he did not object to it in the least. I have seen this patient at intervals during the last few years, and although cystine in small quantities was generally present in the urine, it gave him no inconvenience, and no calculi seem to have been formed for the last three or four years. In this case, then, cystine has been found in large or small quantity during a period of at least eighteen years, and for the first five or six years of this time hundreds of cystine calculi were passed, the largest being about three-eighths of an inch in diameter, the smallest not larger than the head of a very small pin. The cystine crystals formed a visible whitish deposit, which varied much in quantity, even from day to day, but sometimes formed a considerable sediment.

Another case was that of a gentleman about 50, who had suffered from abundant cystine deposit for two years before I saw him, and had passed seven or eight renal calculi, some of them beautifully crystalline, and entirely composed of cystine. This patient took fifty grains of carbonate of ammonia dissolved in two ounces of distilled water three times a day after a meal for upwards of two years without any inconvenience, and during this time he had not even once required an aperient. If he gave up the ammonia he did not feel "up to the mark." As the amount of ammonia seemed very large in proportion to the water in which it was dissolved, I had twenty-five grains of Howard's volcanic carbonate of ammonia dissolved in an ounce of distilled water, and found that, although it tasted very strongly, it was not caustic. On inquiry, Mr. D—— informed me it was only gradually that he reached this degree of concentration, but that he experienced no difficulty in taking it. He took it immediately after a meal—"on an empty stomach it produced nausea." For three years, with scarcely an intermission, 1050 grains of carbonate of ammonia were taken per week. The cystine deposit ceased during the last year of taking the medicine, and three years have now passed without its recurrence. I think, therefore, we may regard this case as really "cured" by the large doses of carbonate of ammonia.

It is to be feared that the tendency in the present day is rather to prescribe new remedies which are being continually introduced, than to select old ones such as are known to have valuable properties, and which have been proved by long experience to be really beneficial in certain pathological conditions. Far from condemning the new because they are new, like all who know the extreme value of such things as salicylate of soda and bromide of potassium, I am most anxious to acknowledge my gratitude to those who devote themselves to the study

and the discovery of the healing properties of every substance that can possibly be of use in treatment. But, while I am desirous not to say anything that could suggest to the reader that I am condemning the new things, I would impress upon the rising generation of practitioners the importance of being careful not to neglect the old. One cannot but desire that a drug like ammonia, so valuable in many forms of disease and departures from the healthy state, should not be forgotten or laid aside.*

The cases I have adduced are sufficient to show that ammonia may be given in much larger doses than are generally prescribed, and that it need not be diluted to the degree generally supposed to be necessary. We used to be taught that five grains of carbonate of ammonia should be dissolved in at least an ounce of water, but as one of my patients took as much as twenty-five grains per ounce, and continued this three times a day for three years, we may feel satisfied that a solution of from ten to fifteen grains per ounce may be taken without difficulty, and I have prescribed this as often as once an hour in cases where the heart's action was very feeble and a decided stimulant was evidently necessary.

The public have discovered the value of sal volatile in cases of cold-catching and many minor ailments, but ammonia, like many other substances of real value in the treatment of many departures from the healthy state, has lately been somewhat neglected, and is, like some other valuable remedies, in danger of being forgotten amid the multitude of new preparations which are thrust upon our notice; and it is therefore desirable that attention should be directed to its usefulness as well as to the value of many other drugs which have been of real service to past generations of patients.

DEPOSITS OF EARTHY PHOSPHATES.

The earthy phosphates soluble in acids, but insoluble in water and alkaline solutions, which are most commonly met with as deposits in urine, are the ordinary *triple* or *ammoniaco-magnesian phosphate*, or the

* In our endeavours to help those who have acquired the vicious habit of consuming too much alcohol, ammonia is of great use, but it ought to be given in doses far larger than those in which it is usually prescribed. One of my patients assured me that he found ammonia very beneficial, that it relieved him of the feeling of tiredness from which he frequently suffered, and enabled him to perform hard work without getting exhausted. Not only have I found great benefit result from giving ammonia in considerable doses in many low forms of illness, but I have experienced its good effects by taking it myself. It acts very differently from any form of alcohol, although its effect upon the patient as judged from his own sensations appears to be somewhat similar. Though no feeling of hilarity seems to be induced by it, the lowness and depression of spirits and the tired feeling affecting the muscles, or rather the nerves and nerve centres by which they are supplied, are often removed in the course of half an hour or less by a dose of ammonia.

phosphate of ammonia and magnesia; and *phosphate of lime.* The triple phosphate crystallises in two or three different forms ("100 Urinary Deposits," pl. V, figs. 56, 57, 58, 64, 66; pl. VII, fig. 91). When clear, and unmixed with other deposits, the crystals form beautiful microscopic objects. The most common form is that of the triangular prism, with obliquely truncated ends; but these are sometimes complicated by the bevelling of the terminal edges and angles. Not unfrequently the crystal is found much reduced in length, and the truncated extremities become so closely approximated as to give the appearance of a square, the opposite angles of which are connected by straight lines; and thus a crystal very closely resembling that of an octahedron of oxalate of lime is produced. The urine which contains phosphatic deposits is generally neutral or alkaline, but crystals of triple phosphate are now and then found in *acid urine.*

If ammonia be added to fresh urine, or to a solution of phosphate of soda and sulphate of magnesia, ammoniaco-magnesian phosphate is precipitated in the form of beautiful stellate crystals ("100 Urinary Deposits," pl. V, fig. 58), and phosphate of lime is thrown down in the form of a fine granular amorphous precipitate. Ammoniaco-magnesian phosphate is slightly soluble in pure water, particularly if it contain carbonic acid. It is said to be insoluble in solutions of ammoniacal salts, but this statement is not I think accurate. Phosphate of lime occurs in urine in a crystalline form, as well as in amorphous granules. It is usually associated with the triple salt,—always, if deposited from alkaline urine. In cases of disease of the bladder, in which the urea becomes very rapidly decomposed into carbonate of ammonia, much amorphous phosphate of lime and many crystals of triple phosphate are precipitated. Crystals of phosphate of lime are represented in "100 Urinary Deposits," pl. V, figs. 59, 60.

Phosphate of lime is soluble in albumen; indeed, it is by reason of its solubility in this substance that the phosphate of lime formed by the action of phosphoric acid on the egg-shell becomes applied to the formation of the osseous system of the embryo chick. Mucus also is a solvent of this salt, and from the mucus of the gall-bladder a considerable quantity is deposited as decomposition proceeds.

The conditions under which an excess of alkaline phosphates occurs, have been already considered in p. 42. The remarks made upon the question of "*excess*" of a constituent and its precipitation as a visible deposit, must be borne in mind. In the great majority of cases in which there is a deposit of earthy phosphates, there is no "*excess*" at all, and the deposition depends upon the urine being neutral or less acid than usual, or upon the decomposition of the urea, and consequently, the formation of carbonate of ammonia after the urine has left the bladder. It is common enough to find triple phosphate in the urine in

cases of dyspepsia, perhaps from the secretion of too large a quantity of highly acid gastric juice or from the formation of other acids.

A good deal has been said and written concerning the significance of a deposit of earthy phosphates in the urine, and I have even heard it suggested that the deposit showed not only that large quantities of the salts passed from the system, but that it was necessary to supply their place and thus compensate for the removal of phosphate from the organism. I remember a case in which phosphates were prescribed for the patient who was suffering from typhoid, on the ground that large quantities were being excreted in the urine, and that therefore more should be given by the mouth, as if this excreting of phosphate was really a very important clinical fact in connection with fever. The physician was in truth troubling himself very needlessly about the phosphate, while he was neglecting to treat the low febrile state which was of the utmost consequence. If we refine too much concerning the smaller and less important attendant phenomena of many forms of disease, we shall be apt to regard too lightly or to pass over the broad clinical facts of the case. While carefully directing our attention to the removal of comparatively unimportant symptoms, we may neglect to suggest remedial measures for the pathological changes which are jeopardising, and may shortly destroy the patient's life. The fact is, these earthy phosphates, consisting of phosphates of lime and magnesia and ammoniaco-magnesian phosphate, are always present in healthy urine in a state of solution, and if the fluid becomes alkaline, or if an alkali be added to the urine, the earthy phosphates are thrown down as an insoluble deposit which is sometimes crystalline, but generally contains a certain quantity of amorphous phosphate of lime. In some cases, however, it has been shown that these earthy phosphates are actually excreted in more than the average quantity, when it may be advisable to give medicines containing these salts, or food in which they exist in considerable proportion. It must however be borne in mind that bread and milk and meat and fish of various kinds contain considerable quantities of phosphates, and it is I think impossible to assent to the general proposition that the presence of these salts in excessive quantity is pathognomic of any definite condition or morbid state which can be relieved or even modified by giving them in quantity by the mouth. Their presence in excess is to be regarded as a fact which may accompany a number of conditions without having any causative relation to any one in particular.

The principal objection to be urged against the frequent presence of these deposits is their tendency to form soft concretions in the urine, or to collect upon the surface of the mucous membrane. This depends upon the urine becoming alkaline, as explained on p. 16. In many cases there is no doubt that by attention to diet and by giving mineral

acids frequently during the day in moderate doses, the deposition may be reduced or entirely prevented. Tincture of iron with free acid and a grain or two of quinine three or four times daily, often has a beneficial effect; but a purgative treatment is also requisite in most cases. The obstinate persistence of phosphatic deposit should be attended to, the practitioner directing his mind to the consideration of the state of digestion and to the general condition of the patient, instead of concentrating his attention on the fact of the phosphate deposit only, and endeavouring to counteract the discharge or to make up for the loss.

In various cases of disease, arising from more or less complete paralysis of the nerves, owing to changes occurring in the nervous centre itself, or at the distribution of the nerves in the mucous membrane, the action of the bladder may become impaired and it may fail to expel its contents completely. The urine thus retained sometimes undergoes change, and the mucous membrane suffers in consequence. It has been supposed that the formation and excretion of large quantities of earthy phosphate was somehow due to degenerative changes in nerve matter, but this is probably not the source of the phosphates in these cases. In general there is not really an excess, but the urine being alkaline the earthy phosphate it contains is thrown down in an insoluble form. Earthy phosphate is precipitated, and the condition thus induced gradually increases, unless proper preventive measures be adopted. There are cases in which phosphates are deposited upon every part of the urinary mucous membrane,—bladder, ureters, and the pelvis of the kidneys, apparently depending upon changes which result originally from some affection of the nerves. Although the formation of epithelium and all the essential phenomena of nutrition and secretion may take place, independently of nervous action, it is quite certain that the regularity of these changes, the even flow of nutrient pabulum, and the regulation of the proper proportion distributed, are determined by the nerves. Hence it follows, that if the nerves, distributed to a structure, be destroyed, or their action impaired, directly or indirectly, the tissue soon suffers, its structure becomes altered, and its function is imperfectly performed or suspended. Such changes in the epithelium precede and favour the deposition of the phosphates upon the surface.

Some of the cases of disease of the bladder with phosphatic deposit, perhaps the great majority, are due to local change. The condition known as chronic inflammation, affecting one part of the mucous membrane, is very prone to spread. It may extend from urethra to bladder, and even into the ureters and pelvis. A rough almost ulcerated state of the mucous membrane may also spread in the opposite direction; beginning in the kidneys, it may pass downwards to the bladder. In all cases, the urine in contact with any portion of such altered surface would be decomposed and its earthy phosphates precipitated. These,

with the epithelium and mucus of the part, would form irregular projections with intervening depressions, in which more urine would be decomposed; and so the process might proceed, unless the nutritive changes taking place below the surface return to their normal condition, when the matter deposited would soon be thrown off, the even growth of new healthy epithelium would proceed below, and the surface would again assume its smooth healthy character. For this reason, in such cases, it is of the first importance to pay attention to the general health, for it is obvious that if the blood be in an unhealthy condition, the action and nutrition of the nerve-centres will suffer. Until this is corrected the normal state of the mucous membrane cannot be restored.

Disease of the mucous membrane, and impaired action of its muscular coat, may also result from lesions of the central part of the nervous system, and some of these cases are among the most distressing which the physician is called upon to treat. The affection may begin in the nerve cells of the posterior roots and those of the cord itself. These gradually undergo change, and many cease to act, or the nerves arising from them may be pressed upon or degenerate in structure at some distance from their point of origin. Over such chronic structural changes, when firmly established, we can exert little influence by remedial agents.

On the other hand, I have seen cases in which earthy phosphates have been constantly present in every specimen of urine passed during several years—without any disorganization of mucous membrane of the bladder, ureters, or pelvis, and without the formation of stones or any form of concretion. In these cases the reaction of the urine was decidedly, but not very strongly, alkaline. The phosphates were in an amorphous state, but after standing for several hours crystals of phosphate of lime were deposited ("100 Urinary Deposits," 1884, pl. V, fig. 60). In the case of some of these patients the formation of phosphatic calculi undoubtedly occurs, but in others it is quite certain the condition is due to functional disturbance of the digestive process only—the patient being for the most part weak and thin, and in what may be called a low state of health; various plans of treatment have been devised and tried, but occasionally the condition persists in spite of every attempt to alleviate it by ordinary remedies. In these cases, living in the open air in a good climate must be recommended, with complete change for a time in the usual routine of life. A sea voyage usually does good; the appetite improves, and the patient may gain many pounds in weight. But return to sedentary work in a town is too often followed by a return of the low state of health and the feebly alkaline phosphatic urine. Very likely the patient will suffer from some degree of headache and stomach derangement. It is very remarkable

to observe the change which takes place in many of these cases as age advances. Up to 30 or 35 the patient suffers almost constantly from some dyspeptic symptoms, and no matter what he eats, digestion, which is slow, is always accompanied by discomfort or actual pain. Not uncommonly the patient will tell you he is utterly miserable, and perhaps his sufferings are so great that he will assure you he does not care to live. About the age of 40 he perhaps begins to improve—is able to eat a pretty good meal now and then, and only gets upset occasionally. Although seldom feeling strong or vigorous, or contented and happy, life seems to be endurable. By the age of 50 probably all is changed. The patient enjoys good health, and is conscious of sensations which are quite new to him. His spirits are so good that he can scarcely believe he ever suffered from depression. His working power is greater than it ever was—he sleeps well, and, most wonderful of all, he can eat anything without discomfort and in quantities which astonish him, and the despairing dyspeptic of early and middle life becomes cheerful and happy, and looks hopefully forward to a vigorous old age, and good health and strength to the end.

It has been assumed by some, that when phosphates were passing away the brain would suffer in nutrition, to prevent which phosphorus should be given. That so-called brain food is either required or can be supplied is an amusing fancy, but nothing more. Phosphorus used to be ordered some years ago in leucocythemia, upon the fanciful and quite unjustifiable hypothesis that deficiency of phosphorus in the blood interfered with the development of the red blood-corpuscles. The only very decided effect I have seen resulting from the giving of phosphorus in any cases was, I regret to say, unfortunate. In one or two of my own patients there were pain and disturbance about the mouth and teeth, and in one, decided threatening of necrosis of the bone of the lower jaw.

When the phosphatic condition of the urine is only occasional, small doses of dilute acids in a bitter infusion before meals, or the tincture of the perchloride of iron, will generally cause the urine to become healthy by improving the action of the stomach. Pepsin ("On Slight Ailments," 2nd ed., p. 86) may also be given with advantage in some of these cases. Benzoic acid and benzoate of ammonia in doses of from ten to thirty grains three or four times a day, between meals, for a month at a time, have also been prescribed, and sulphate of zinc, and extract of nux vomica, are favourite remedies. If the intestinal canal be loaded, and the patient has been living too well, as is not unfrequently the case, a little blue pill and compound colocynth pill will cure him.

Alkalies, as Dr. Owen Rees was the first to show, undoubtedly do good in some of these cases of phosphatic urine, probably by their action in promoting the normal chemical changes in the blood rather

than by direct action upon the kidney or any part of the genito-urinary mucous membrane. Dr. Rees' explanation has been already referred to, p. 16.

When the phosphate in the urine has persisted for some time, and is accompanied with any symptoms referable to probable affection of the cord, especially if the bladder be irritable, and there be nervous twitching of the muscles, with tingling or numbness of the skin in any part of the lower half of the body, or diminished control over the voluntary movements, acids and tonics, with small doses of opium, should be given. The practitioner will meet with many cases where disease of the cord has been diagnosed, which nevertheless get quite well as soon as the general health is improved. Before treating such cases we must find out how the patient lives, and ascertain whether he has been troubled with mental anxiety, excitement, over-mental work, &c. The patient must not be led to suspect that he is suffering from any serious organic disease, for not unfrequently people are terribly nervous, and too prone to dwell upon every ache or pain they may have, and they are foolish enough to refer to medical books, with the view of ascertaining the nature of their ailments. The diagnosis in these cases should be very guarded, unless the symptoms clearly and positively indicate the real nature of the disease.

A patient for some time under my care, whose urine almost invariably yielded an abundant cloud of phosphates of lime and magnesia, on the application of heat, complained of a strange feeling of dread of some impending disaster. Whenever he heard of cases of fever or other disease in his neighbourhood, he had the greatest difficulty to reason himself out of the conviction that he was about to have an attack. Although he admitted while talking to me that the probabilities were the other way, as soon as he got home and was alone, the opposite conclusion took possession of his mind, and he suffered terribly from low spirits and a vague indefinable fear or dread of something or other. When this patient's digestion and general health improved, the curious state of mental depression gradually disappeared, and he almost forgot that he had suffered from the symptoms which distressed him so much at the time.

OF BLOOD-CORPUSCLES IN THE URINE. HÆMATURIA.

The significance of blood in the urine must engage the consideration of every practitioner in medicine and surgery. The presence of blood may mean that a little has escaped from the vessels of some part of the urinary mucous membrane, of no more consequence than a very slight nose-bleeding. On the other hand, a little blood in the urine may be the first evidence of the presence of stone, or of a very serious organic change which will almost certainly result in death.

As in cases of hæmoptysis, the practitioner cannot be too careful about committing himself to a definite opinion until he has well thought over all the facts of the case. Without care, and especially in cases where the patient, or his friends, may be inclined, as is said "to insist" upon having the "candid" opinion of the practitioner at once, is there danger of asserting that a case of slight bleeding, which turns out to be serious, is nothing, or, of affirming that one which is of no consequence at all is the commencement of a terrible and necessarily fatal disorder. In many cases where blood is present in the urine, it is even more difficult to come to any positive conclusion on first seeing the patient, than it is in cases of hæmoptysis, hæmatemesis, or bleeding from the bowels, to decide whether the bleeding is serious or only of trivial consequence.

It is of the first importance to insist upon rest in any case of hæmaturia—especially so in cases where the patient has passed the age of 45 or 50. Even when you are pretty sure that the blood comes from the urethra, in a young and apparently healthy man, it is nevertheless most desirable to act upon the cautious side, for by making the patient rest at once, you may save him from a somewhat severe illness, or from the occurrence of pathological changes which may result in stricture, abscess, or some other serious and troublesome lesion. Even where bleeding occurs from an inflamed surface of mucous membrane, where there is continued irritation and movement of the parts, the discharge is often followed by the pouring out of lymph, which results in thickening and formation of fibroid tissue. This change is especially damaging in the case of the mucous membrane of the ureters, bladder, or urethra. In cases of hæmorrhage we cannot be too strong in insisting upon rest for a few days or a week, or until we feel pretty certain that all danger of a repetition of the discharge of blood has ceased.

Blood Corpuscles usually form a red or brownish-red granular deposit, which sinks to the bottom of the vessel; but a few corpuscles are usually diffused through the urine. If the urine be perfectly neutral, or slightly alkaline in its reaction, the colour of the blood will be bright red; but in those instances in which the reaction is decidedly acid, it will be found of a brown colour, imparting to the supernatant fluid a "smoky" hue. When the urine has a decidedly "*smoky appearance*," it will often be found that the blood is derived from the kidney. If, however, the urine is decidedly alkaline, the blood will retain its florid red colour. In the majority of cases in which the mixture of blood and urine is bright red, it is probable that it has escaped from the mucous membrane of the bladder, or from the prostate or urethra. If blood globules remain long in urine, they become much altered in form, the outline appearing irregular and ragged, and the surface granular. Sometimes, however, they appear swollen and very much enlarged. These changes are no doubt due to physical actions. The characters of blood

corpuscles are represented in "100 Urinary Deposits," pl. VIII, fig. 100. As a single grain of blood contains three hundred million blood corpuscles or more, it must be obvious that only one drop diffused through a pint or more of urine would yield corpuscles enough to be discovered by microscopic examination if time were allowed for the sediment to subside.

If blood remains for some time stagnant in the uriniferous tubes, or in the capillary vessels, before it passes into the urine, crystals of hæmatoidin are often found. From five days to two weeks probably elapse before the crystals in question result. Blood in the urine may be derived from any part of the genito-urinary mucous membrane. In the female, it often escapes from the vessels of the uterus or vagina. At the time of the menstrual discharge a good deal of blood is of course found in the urine. For some days afterwards, a few blood corpuscles and disintegrated blood corpuscles may often be detected. In some cases it would appear that small quantities of blood get entangled in the mucus and amongst the papillæ of the mucous membrane of the os and cervix, or in folds or depressions of the mucous membrane, for in some cases we find blood corpuscles in the water for many days after the catamenial discharge has ceased. Some of these cases are put down as renal calculus, while in others the blood corpuscles are regarded as evidence of the existence of ulceration of the os uteri. From the urine of some females, who nevertheless enjoy excellent health, blood corpuscles are hardly ever absent, and are almost always to be detected if a considerable quantity of the urine be allowed to stand for some time, and the slight deposit which subsides is submitted to microscopic examination.

Blood may come from the kidney, in consequence of recent inflammation or old-standing disease, causing distension and rupture of the vessels of the Malpighian body, or its escape may depend upon that peculiar condition of system in which there is a tendency to capillary hæmorrhage in all parts of the body, a condition which is now known as Hæmophilia (αἷμα, blood, φιλία, love, friendship, fondness, "predisposition for"). In one case in which there was occasional bleeding from the gums, the urine contained blood during a period of nine months. In this case there was no loss in weight during the five years the patient was under observation.

When blood corpuscles are found entangled in casts, we may feel sure that they have escaped from capillary vessels in the cortical or secreting portion of the kidney, in most cases from the vessels of the Malpighian body. The blood is sometimes poured into the upper part of the uriniferous tube, while the cast is found in the lower; but more generally the blood escapes into the part of the tube where the cast is formed. The cast, however, is not composed of fibrin. If urine con-

taining blood is acid, it has a dark smoky appearance. This change in colour, which is more marked when a small quantity of blood is very gradually mixed with a large amount of acid urine, is due to the action of the acid of the urine upon the hæmoglobin.

Hæmorrhage from the kidney also occurs in the course of many forms of chronic disease. In such instances it is a favourable sign if the albumen is not to be detected after we have failed upon microscopical examination to find blood corpuscles. If the albumen, however, continues to be passed, in the absence of any blood corpuscles, we may feel sure that it has not been solely derived from the serum which escaped with the corpuscles through the ruptured capillary vessels. Its presence must be attributed to chronic renal disease. It is important to be able to determine whether there is more albumen than may be accounted for by the presence of the blood—whether the case is one of hæmorrhage only, or of hæmorrhage complicated with acute or chronic kidney disease.

When the kidney is injured by mechanical violence, hæmorrhage occurs, and sometimes a violent shake appears sufficient to cause the rupture of some of the small vessels of the kidney, and the escape of a considerable quantity of blood in the urine. A gentleman of my acquaintance fell against a step, and his side and back came violently in contact with the edge. Much blood soon made its appearance in his water, and for several days the hæmorrhage was severe. After the lapse of a fortnight the urine still contained an abundant brownish deposit, in which a few altered blood corpuscles with numerous crystals of hæmatoidin were found. The blood effused in some of the tubes had probably remained in them a sufficient time for the crystals to be formed from the blood-colouring matter. I have seen similar crystals in sputum some time after hæmoptysis; also in the fluid outside hydatids of the liver, which sometimes escapes with the sputum; and oftentimes in clots in the brain two or three weeks after rupture of the vessel.

Hæmorrhage from the kidney is not uncommon in cases of continued fever. Sometimes it occurs in the course of pneumonia; and I have seen it in several cases of acute rheumatism. In all these conditions the vessels of the kidneys and internal organs generally are highly congested.

Hæmorrhage from the kidney and bladder always occurs sooner or later in the course of cancer of these organs. The diagnosis in the early period of the case is often very difficult, as there may be no pain and a complete absence of any definite symptoms. The persistence of the hæmorrhage, however, its occasional increase in amount, the gradual emaciation of the patient, especially if he be upwards of fifty, will lead the practitioner to suspect the real nature of the malady, and not un-

frequently the detection of cancer cells in the urine proves beyond doubt the serious nature of the case. Fungus of the kidney or bladder is almost invariably accompanied by hæmorrhage, which is sometimes very violent, and soon exhausts the patient; and this violent bleeding may be the first intimation to the patient of the existence of anything wrong. Hæmorrhage from the prostate may be due to a very serious affection, and it is oftentimes one of the first symptoms of structural disease of that organ. Occasionally the veins of the gland become dilated and varicose, and at length rupture. The attack may last a few weeks, and then pass off, or it may continue in spite of all treatment, until the patient's strength becomes exhausted.

I have known hæmorrhage of a very decided character from the bladder, from the prostate, and from the urethra, occasioned by mere jolting over a rough road. Hæmorrhage of this kind is sometimes very troublesome, and continues for so many days that we begin to fear it depends upon actual disease. We must therefore press upon the patient the extreme importance of rest until the bleeding ceases. Citrate of potash and purgatives seem to be of use in many cases, and should be prescribed before gallic acid is given. The position of the calculus can sometimes be fixed by the discovery of epithelium from the pelvis of the kidney or from the ureter mixed with the blood or entangled in the meshes of small blood clots.

Hæmorrhage from calculus in the bladder is often very considerable, and occasionally persists uninterruptedly for days or weeks; but more commonly it lasts only for a few days, and recurs after an interval. The patient should of course be carefully sounded.

Hæmaturia may depend upon a calculus being impacted in the kidney, in which case it may continue for a day or two, and then cease entirely for some time. In many cases it recurs constantly after unusual exertion or jolting. I have seen a case in which violent pain down the ureter, with retraction of the corresponding testicle, persisted for years during boyhood after exertion.

Simple hæmorrhage, not dependent upon organic disease, sometimes takes place from the mucous membrane of the bladder, as well as from other mucous membranes, as those of the nose, throat, air-tubes, stomach, intestines, &c.; but it must never be forgotten that slight hæmorrhage is often the very first symptom of very serious changes, and the practitioner should therefore in a doubtful case always give a very guarded opinion, and see and examine the patient a few times before he commits himself to a diagnosis.

When blood is found in the water pretty frequently after the age of 60, the observer should be very careful not to commit himself to an opinion until he has examined many specimens of water at intervals of a week or two, as the blood may be due to the commencement of

malignant disease. Every now and then a few cancer cells may be found if carefully searched for.

Small quantities of blood are sometimes passed day after day by apparently healthy persons just as micturition ceases. It seems as if the effort to expel the last drop of urine had caused the rupture of a few capillaries about the membranous part of the urethra or neck of the bladder. The hæmorrhage usually ceases after a time if the patient rests. Usually no special treatment is necessary, but it may be desirable to give a saline purge. In some of the cases which have fallen under my notice the bleeding was certainly caused by undue sexual indulgence. Occasionally a few blood corpuscles are found in the urine, although not a trace of albumen can be detected in it. Sometimes the blood remains for some time in some part of the urinary passages before it escapes, and the serum and all the soluble constituents are absorbed, the red blood corpuscles in certain cases not being so much altered as is usual.

Blood Clots assume various forms, and if they have been retained for many days in the bladder undergo great changes in colour and form, so that there may be considerable difficulty in identifying them. They have been mistaken for portions of mucous membrane, entozoa, and other things. Clots of extraordinary forms are often passed by patients suffering from renal calculus. Sometimes these clots are of very curious shapes, and occasionally upon the surface will be found a depression evidently from the stone over which the blood had coagulated. By careful microscopical examination, without disturbing the clot, small crystals may sometimes be seen, which have been detached from the surface of the stone. Epithelium, which may sometimes be identified without difficulty, is often entangled in the blood clot. The ova of entozoa are also occasionally found. By careful examination of the blood clot, in short, we may often gain very important information which is of the greatest assistance to us in forming a conclusion as to the nature of the case.

Hæmorrhage caused by Entozoa in the Kidney.—The presence of entozoa in the kidney is occasionally the cause of the escape of large quantities of blood from the renal vessels. In some of these cases there is bleeding to an alarming extent. The patient becomes blanched and very feeble, and his case is diagnosed as soft cancer of the kidney or bladder, until the urinary deposit is carefully examined, and then ova or fragments of the envelope of the ovum of Bilharzia are discovered (Bilharzia Hæmotobia, "100 Urinary Deposits," pl. VIII, fig. 112). This entozoon occurs in Egypt, the Mauritius, and many parts of the East. Dr. John Harley has discovered the ova of this entozoon in the urine of several persons from the Cape, where the disease was contracted. Dr. Harley considered that the ova came from a particular

species of Bilharzia, which he named Capensis. *See* "The Transactions of the Medico-Chirurgical Society, 1864," and following year. Strongylus is another entozoon which gives rise to much hæmorrhage in the very rare cases in which it occurs.

Intestinal worms are sometimes passed into the vessel containing the urine, and the patient not unfrequently affirms that they come from the bladder. Various species of acari are frequently met with in urine. It need hardly be said they were not formed in the urinary organs. Insects and their larvæ are from time to time brought to us in specimens of urine. Patients will positively assert that larvæ of the common flesh-fly have been passed through the urethra. I have on many occasions had specimens of the common maggot and cheese maggot forwarded to me, with the positive assurance that they have been voided by the patient. The presence of the tracheæ in every part of the body proves the creature to be an insect, and it need scarcely be said that an air-breathing insect could not have been developed in any part of the urinary organs. These insect larvæ will pass through the entire tract of the intestinal canal in a living state. *See* "The Microscope in its Application to Practical Medicine," and references to papers by Dr. Brinton and Mr. Blood.

Treatment of Hæmaturia.—In acute febrile conditions, as has been already remarked, the kidneys are apt to become congested, and sometimes considerable quantities of blood may be lost. The symptom generally passes off after a few days, but in one case of acute rheumatism it persisted for three weeks, producing an anæmic condition; cupping over the loins and several remedies were tried, but did not seem to produce any immediate effect upon the hæmorrhage, which however gradually subsided as the patient improved in health. Turpentine in this as well as in some other forms of hæmorrhage seems to do good. Acetate of lead in doses of three or four grains every three hours, for five or six doses, often checks hæmorrhage. This remedy was much employed by Dr. Golding Bird. It is of course very important not to continue giving lead for any length of time, and it should be borne in mind that some persons are more susceptible to its influence than others. If the blue line should appear near the free edge of the gums, the lead must be stopped, and its elimination promoted by purgatives and sudorifics.

Gallic acid is one of the most powerful remedies in hæmorrhage from the kidneys or bladder. It may be given in much larger doses than is usually recommended. The reputation of this remedy would, I think, soon be greater than it is if those who try it would give it in sufficiently large doses, and persevere in its use for several days, before replacing it by other astringents. As gallic acid probably acts according to the strength of its solution which bathes the bleeding tissue, it is

necessary to ensure the introduction of a certain quantity into the blood by the frequent administration of successive doses. We must remember that gallic acid soon passes away from the blood, being carried off in the urine. It is therefore only by administering frequent doses that we can hope to compensate for this continual draining away of the remedy, and we must give it in quantity and often enough to more than compensate for what is removed with excrementitious matters.

In chronic bleeding from the surface of the mucous membrane of the pelvis of kidneys, ureters, bladder, and urethra, and from villous growths, as well as in the very obstinate hæmorrhage from large fungous tumours of the kidney and bladder, I have found gallic acid most valuable in a large number of cases, and for some years past I have been led to depend upon it more and more. In that spongy condition of the prostate where the veins are large and the capillaries of the surface considerably dilated, and forming here and there little pouches like aneurismal dilatations, hæmorrhage is often not only very obstinate, but from time to time blood escapes in such excessive quantity as to blanch and weaken the patient. The remedy should be given in frequent doses day and night until the bleeding is very decidedly reduced in degree, when it may be ordered once in six hours, or less frequently, being again increased in frequency if the patient ceases to improve or the hæmorrhage again increases in severity.

Gallic acid seldom disagrees in any way. Some patients complain of its taste, but it is generally well borne by the stomach. It does not cause constipation, and even when the crystals are swallowed in a state of suspension in water or mucilage no inconvenience results, and the stomach is not disturbed by their presence. The glycerine of gallic acid is, however, the most pleasant form in which to prescribe the remedy. This contains one part of gallic acid in four. Forty minims will contain ten grains, and may be given in distilled water, peppermint, orange, or other water. But it is most essential that the patient should persist in taking the doses regularly for several days. Gallic acid is absorbed by the blood and much of it passes away in the urine, and it is probable that it acts directly on the tissues from which the bleeding is taking place, and therefore a certain strength of solution is necessary to get the good effects, and this can only be obtained by its persistent introduction into the stomach and so into the blood at short intervals of time. I have given gallic acid in ten-grain doses every two hours without intermission for three weeks, no objection having been made on the patient's part. Whether much larger doses would be absorbed I doubt, but I am not aware to what extent the remedy may be pushed, nor do I know in what respect very large doses would be deleterious. I have generally found that the desired effect has resulted after ten-grain doses had been kept up for three or four days, and in cases where the

bleeding did not actually cease, it was certainly well under control. In several of those painful cases of hæmorrhage from fungous growth the bleeding was much lessened and the fatal result I think postponed; in some of my cases I should say that death was due rather to exhaustion and weakening of the general health than to hæmorrhage. I therefore commend this remedy in the cases of hæmorrhage to which I have referred, and I prescribe it with confidence. Its use may be steadily continued until its beneficial action is clearly established.

Ergot of rye, alum, matico, and other styptics may be tried in obstinate cases.

The Liquid Extract (*Extractium Ergotæ liquidum*) is the best preparation of ergot. Fifteen or twenty minims may be given every two hours or more frequently for two or three days at a time, but I cannot say to what extent the use of this drug may be pushed with safety, or the symptoms which indicate that the patient is taking larger doses of the remedy or more frequently than is desirable.

Hamamelis bark (*Hamamelis virginica*, the American Witch Hazel) contains principles which are not only astringent but soothing and perhaps sedative. It has been much prescribed in diarrhœa, dysentery, and irritable states of the intestinal canal; but it also acts on the mucous membrane of the urinary organs. In bleeding from any part of the urinary tract and hæmorrhage from the vagina, from five to twenty minims of the tincture may be given in an ounce of water every two or three hours, but I am not aware to what extent the remedy may be pushed in serious cases, or what symptoms result if much larger doses than those mentioned above are given.

As an injection for the vagina or bladder, one part of the tincture may be diluted with from twenty to forty parts of tepid distilled water.

In some very severe cases of hæmaturia depending on renal disease advantage has resulted from the administration of the tincture of perchloride of iron. In this as in many other forms of disease more relief may be afforded by improving the state of the blood than by giving remedies supposed to affect directly the particular action at fault. I have seen patients suffering from chronic renal disease, completely blanched by renal hæmorrhage, who have improved immediately after they had been put upon iron and quinine, a more generous diet, and the digestive power had been increased by the administration of hydrochloric acid and pepsin.

Hæmorrhage from the kidney which results from a blow, fall, or other injury, often ceases if the patient remains perfectly quiet for a few days. It is doubtful if recovery can take place after very decided laceration of the kidney, but it is probable that in many instances some of the delicate capillaries may be ruptured without the secreting structure being actually torn through.

In that obstinate and distressing form of hæmorrhage which takes place from the prostate, the patient should remain in the recumbent posture with the pelvis raised on a pillow to favour the gravitation of blood from the gland, and he should be kept as quiet as possible. Iron, gallic acid, turpentine, or other styptics ought to be tried, but I am sorry to say they often fail to afford as much relief as is desired. Sometimes small pieces of ice placed in the rectum diminish the hæmorrhage. In such cases, if we are sure of the absence of stone, and there is no other positive indication for its use, it is desirable to avoid introducing the catheter, for the operation frequently increases the hæmorrhage and adds to the distress the patient already suffers. In cases in which the blood has coagulated within the bladder, and especially if the hæmorrhage continues, the practice of introducing an instrument to break up the clot, and the injection of iced water, has been recommended. Dr. Prout injected into the bladder a solution of alum (20 to 40 grains in a pint of water), and says that by this proceeding he succeeded in stopping violent vesical hæmorrhage which had resisted other methods.

In hæmorrhage depending upon cancer of the kidney or bladder the treatment is necessarily only palliative. Gallic acid, opium, and complete rest sometimes afford great temporary relief. If in such a case the hæmorrhage is dangerous from its excessive amount, ice should be applied to the pubis, and styptics may be injected into the bladder.

If the blood present in the urine has escaped from the kidney in consequence of acute congestion or inflammation, as may generally be determined by the sudden accession of the symptoms, the small quantity of the urine, the presence of casts, a considerable quantity of albumen, associated with puffiness about the face, and perhaps lumbar pain—the case must be treated by rest, purgation, and sweating, and, in bad cases, the patient should be cupped over the loins. If the escape of the blood from the kidney is due to a low state of health, or to a condition of system allied to that which gives rise to purpura or to hæmaphilia, the treatment must be directed to improving the general health and the action of the stomach; tonics, the tincture of perchloride of iron, or gallic acid, may be given; quinine, dilute acids, and pepsin, also do good. If hæmaturia occurs in the course of a case of scurvy, the scurvy, not the hæmaturia, must, so to say, be treated; lemon or lime juice, fresh vegetables and plenty of milk, as usually given in this disease, will be of essential service.

In cases where the hæmorrhage depends upon renal calculus, rest in the recumbent posture must be enjoined. *See* the treatment of renal calculus.

As regards the treatment of cases of hæmorrhage caused by the pre-

sence of entozoa there is little to be said. Some of the styptics already referred to, particularly gallic acid and ergot, may be given in cases where the hæmorrhage is considerable; but as a general rule the bleeding gets less after a time, and if the general health be sustained by nutrient substances and preparations of iron prescribed, the loss of blood is soon made up, and the patient may completely regain his health in a few months. Demulcent substances, such as linseed tea and barley water, flavoured with a little lemon juice and sugar, seem to soothe the irritated mucous membrane. Persons who live in districts infested with entozoa should be most careful to avoid drinking any water which has not been previously boiled for at least ten minutes. It is probable that the immature parasites or ova gain admission into the system with the water, or even in the bodies of small animals which live in the water.

REDDISH-BROWN DEPOSIT LIKE BLOOD—INTERMITTENT HÆMATINURIA.

The variation in colour of different specimens of urine passed within a few days by the same person is very remarkable, and seems to be due to varying conditions, internal and external, allied to those which determine great changes in the urea, uric acid, and other organic constituents of the urine. The alteration in colour is mainly occasioned by chemical changes in the colouring matter of the red blood-corpuscles. The ratio of disintegration and solution of these varies greatly at different times, and the character and intensity of the colour produced is liable to great alterations. The deep colour of the urine, irrespective of the presence of bile, in diseases of the liver has been often remarked by physicians practising in India; and my friend Dr. Payne made some interesting observations on this point, which will be found in the "Indian Annals of Medical Science" (Calcutta, Sept. 4, 1858). In order to detect the colouring matter, Dr. Payne boils the urine, and then adds a drop of nitric acid. Various shades of colour are produced, but at last the mixture becomes of a ruby red. The colouring matter of the blood-corpuscles may be present in urine without any corpuscles. In many cases the serum is highly coloured, and the dissolved colouring matter is excreted by the kidneys. Blood may escape from the vessels into the tubes of the kidney, the corpuscles may gradually become disintegrated, and the colouring matter be dissolved. Sometimes the colouring matter forms an abundant granular deposit containing also urates or uric acid, or large collections of granules and minute dark red angular particles, derived from the red blood-corpuscles, may exist. That bile acids and their salts were powerful solvents of blood-corpuscles was long ago proved by Hühnefeld, Plattner, and Simon; and it has been shown by Kühne that, by the action of the colourless

biliary acids or their salts upon the blood-corpuscles, bile-colouring matter is produced. The bile acids themselves are not converted into the colouring matter, as Frerichs held, for they pass through the system unchanged. In certain cases where these processes are deranged it is very probable that the blood-corpuscles are disintegrated in abnormal quantity, and rapidly converted into pigment, which escapes in the urine. The complicated mutual reactions which would ensue when varying proportions of biliary acids, hæmatine, and oxygen, are presented to each other in the living blood would fully account for the different characters and tints which the colouring matters in urine assume in various instances. Professor Vogel alludes to a case in which the colour of the urine became very dark after the inhalation of arseniuretted hydrogen. Some experiments were made upon a dog, and it was found that the dark colour was due to the disintegration of the blood-corpuscles. Albumen was present, but no blood-corpuscles could be detected. A similar disintegration of blood-corpuscles seems to take place in typhoid fever, and in several other diseases. It is not uncommon to find distinct crystals of hæmatoidin amongst the brown colouring matter. These were no doubt formed in the upper part of the uriniferous tubes, where the colouring matter had remained quiescent for some time.

Black Pigment.—Dr. Marcet, Med. Chir. Trans., 1822, describes a black pigment which was present in the urine of a child. After the addition of an acid, some black flocculi were deposited. The colouring matter was dissolved by alkali, and Prout called it melanic acid. Professor Dulk gives a case in which a black deposit was separated from the urine by filtration. Other examples are recorded by Dr. Hughes. In three of these cases creasote had been taken internally, and in two, tar had been applied externally. In one case a dense black precipitate was thrown down by heat and nitric acid, which was examined by Dr. Odling, who found that by exposure it became converted into indigo blue. He draws attention to the close alliance between indigo and the creasote series of compounds, and suggests that, in the above cases, it was derived from the tar or creasote. (Guy's Hospital Reports, 3rd ser., vols. II and III.) Dr. Stevenson refers to a case of melanuria in vol. XIII of the third series of the Guy's Hospital Reports, 1867. The urine, which was black, and in thin layers brownish-black, like a mixture of Indian ink and water, was passed by a woman whose thigh had been amputated by Mr. Bryant. The stump had been dressed with a solution of carbolic acid. In most of the cases of black urine which have been reported, pitch, tar, or other substance containing carbolic acid had been taken, or applied externally. In this case, Dr. Stevenson proved that the colour did not depend upon any compounds allied to albumen or hæmatine, and indigo blue was carefully sought for, but none could

be detected. The colouring matter was freely soluble in potash. After the urine had been boiled with hydrochloric acid for some time, it acquired the property of reducing oxide of copper, and Dr. Stevenson therefore infers the presence of a substance capable of yielding sugar. This was probably a colouring matter allied to that formed by the action of concentrated acids on the extractive matters.

Sometimes the urine is made black by remedies prescribed by the physician. If large doses of gallic acid be given, and the urine passed be tested with a solution of a salt of iron, a black colour like ink results. Sometimes patients taking gallic acid pass urine of a dark colour, and it has been noticed that if iron is administered at the same time the urine is occasionally perfectly black. My friend Dr. George May, of Reading, sent me a specimen of urine passed by a patient who was taking lactate of iron and gallic acid. The urine was almost as dark as ordinary writing ink.

It not unfrequently happens that the urine contains a red-brown and bulky deposit much resembling blood in its general appearance, but of a browner and more dull colour. Upon microscopical examination not a blood-corpuscle is to be found, and the deposit is seen to consist entirely of brown granular matter. The older observers invariably called this deposit blood, from its colour. No blood-corpuscles are present, but no doubt the deposit is derived from the red blood-corpuscles, by some disintegrative process. These cases are quite distinct from those in which the colouring matter of the red blood-corpuscles is dissolved and excreted in a soluble form, as occurs in the course of exhaustive fevers, &c.

The cases to which I have now to direct attention are those in which the colouring matter found in unusual quantity exists in great part in an insoluble form. In many of them there is a reddish-brown bulky deposit, which varies in amount, and is only occasionally present. As I have remarked, no blood is present, and in the majority of the cases not a blood-corpuscle can be found after the most careful search through many specimens of the deposit, examined by the twelfth of an inch objective. Albumen may be present in considerable quantity, or the merest trace may be detected. Albumen may be found in the urine before the characteristic colour appears. It usually is present in considerable quantity while the hæmatinuria lasts, and persists for some time after the attack has passed off. The cases in which this brown blood-like deposit occurs, which is completely free from blood-corpuscles, are spoken of as *intermittent hæmaturia, or hæmatinuria, or hæmoglobinuria.* The brown granular colouring matter is derived from the blood-corpuscles by disintegration, but precisely where the disintegrative process takes place, and the exact conditions under which it is effected, are questions still surrounded by much uncertainty. The deposit only

occurs now and then, sometimes not oftener than once in six months, but in some cases once in two or three weeks. Between the attacks the patient seems to be quite well, and his urine perfectly clear. It may be altogether free from albumen, or this substance may be always present in small quantity.

The cases in which this deposit occurs are characterized by a train of very remarkable and definite symptoms. The disease may last for many years, or the patient may suffer from one or two attacks, and then get quite well. The symptoms by which the attack of hæmatinuria is ushered in, the general look of the patient, the temporary relief always following the use of large doses of quinine or cinchona, or both, favour the opinion formed by many who have studied the disease that it is nearly related to intermittent febrile conditions, though the real nature of the malady cannot be said to have been ascertained up to the present time. From ten to twenty grains of quinine may be given twice or three times daily. In one very bad case of this affection Sir William Gull prescribed with great benefit quinine and every kind of bark in the Pharmacopœia. The patient's strength must be sustained by a nourishing easily-digestible diet, and when the paroxysm is coming on, and during its occurrence, it is often necessary to give stimulants. Ammonia seems to relieve the malaise and depression in some cases.

The attack usually begins with a feeling of chilliness and malaise, sometimes heightened to a distinct rigor. Not only is there severe lumbar pain, but pain down the back; coldness of the hands and feet, pallor and blueness of fingers and toes, and not unfrequently of the face and lips. Indeed the look of the skin of the extremities reminds one of the appearance and coldness in the collapse stage of cholera, so very marked is it. The tongue is often furred, and the digestion much deranged, but there is seldom more than slight fever, and in many cases the temperature is not above the normal. These symptoms are often associated with nausea, a complete distaste for food, intense weakness, and a longing to go to bed and get warm; and this longing should at once be gratified. In fact the phenomena which usher in an attack of intermittent hæmatinuria are essentially the same as those which many have frequently experienced, only in a very slight degree, when an ordinary cold or a bilious attack is about to come on, and precisely accord with those which characterize decided agues and various intermittent febrile affections.

In intermittent hæmatinuria exposure to cold when the circulation is weak has, I think, much to do with the initiatory symptoms. As regards the pallor, lividity, and slightly yellow colour of the skin, it must be remarked that it is very common to meet with these changes in people who are generally considered, and consider themselves, to be in good health. One, two, or more fingers of one or both hands become very cold and

pallid, the capillary circulation being very much lowered, or completely checked for the time. This state may last for minutes only, or for hours. The circulation may be restored by a little gentle friction, or the blood may not be caused to return to the surface by any efforts that may be made for the purpose of effecting this object. The state of the vessels of the cold skin is of course due to contraction of the minute arteries, induced by some change of a reflex character in the nerve centres which govern them.

It is not improbable that the general symptoms referred to which characterize the commencement of the attack are due to changes in the blood, and probably correspond to the period of the disintegration of the blood-corpuscles, and the accumulation in the blood of the resulting products. In attacks of intermittent fever, and in all those less marked affections which are however distinctly aguish in their character, do we not notice disturbance of the circulation in the liver and spleen? In these, as well as in most minor maladies belonging to the class, accumulation of blood in the liver and spleen, and slowed circulation of venous blood through these organs, as well as through the veins of the viscera generally, may almost be said to be the one constant broad phenomenon. It seems then probable that in an attack of intermittent hæmatinuria the first phenomenon is accumulation of blood in the liver and spleen, where considerable disintegration of red blood-corpuscles takes place; possibly also to some extent in the vessels of the system generally, but mainly in the vessels of these organs where the circulation is very slow, and where disintegrative changes normally occur. The products of the breaking down of the red corpuscles being slowly driven into the general circulation, set up those disturbances of the nerves and vessels of the surface which cause the feeling of chilliness and the rigors when they occur, and usher in the actual attack. Soon, however, the kidneys begin to act, and the noxious products which have been accumulating in the blood are by degrees eliminated; not without serious derangement of the vascular and secreting apparatus of the kidney itself, but with great relief to all the symptoms which accompanied the paroxysm. The patient, weak and ailing, gradually regains his usual state, which, however, is anything but perfect health.

Intermittent hæmatinuria rarely occurs in women, but is occasionally met with in children. Those who principally suffer are men from 25 to 50. The affection often lasts for a year or two, and then gradually passes off, but it may persist during a long life. The inter-paroxysmal periods vary greatly in length, and in favourable cases the paroxysms occur after longer intervals of time, and at length cease. (*See* a paper by me in No. 2 of the "Practitioner," p. 73, July, 1868.) The urine in this condition is usually of high specific gravity, frequently 1025 to 1035 The high specific gravity generally depends upon the quantity

of urea present. Urates are often detected, and uric acid is not uncommon. The reddish-brown deposit is very characteristic, but to the unaided eye it is not unlike the deposit which is found in cases of some forms of cancer of the bladder. These deposits can with certainty be distinguished from one another by microscopical examination. Not unfrequently a few red blood-corpuscles are to be detected in the deposit, but generally not one is to be found. As the deposit becomes more scanty, the water falls in specific gravity, and the albumen which at first was in very considerable quantity either becomes reduced to a mere trace or completely disappears, and perfectly healthy urine is secreted until the next paroxysm occurs. In the interval the patient seems to be in fair health. The subjects of this malady are seldom robust or very strong, and most are thin and pale, and generally troubled with stomach derangement from time to time, or they habitually suffer. In the cases under observation which have ended fatally the condition has been complicated with some other pathological change, and in many of the cases which have been recorded concurrent affections of a different order altogether have been present. In one case under my care for years there was certainly structural disease of the cord, probably of the nature of what has been termed insular sclerosis. In another there was cancer of the kidney, but I believe the hæmatinuria commenced long before the cancer developed, and probably was not in any way connected with the disease that destroyed life. The condition is often associated with actual gout or with a gouty state of system.

One of the most striking cases of hæmatinuria I ever saw was that of an intimate friend of my own. The condition extended over a period of more than ten years, during which time the remarkable red-brown deposit, without a single ordinary blood-corpuscle, with considerable quantities of albumen, was hardly ever absent for more than a month or so at a time. The supervention of an attack was always marked by chilliness, pallor of the surface, and not unfrequently very severe rigors. The patient felt weak and exhausted, but intellectual action was never even disturbed. The tongue was always much coated when an attack came on, and the digestion was weak and deranged. When the paroxysm began the patient was obliged to go to bed. He felt sure the malady was made worse by cold; and a warm climate, warm rooms, and warm weather always brought relief. When he was pretty well he suffered much from change from warm to cold weather, and was obliged to live in a room artificially heated. Gallic acid, iron, and every form of styptic was tried in the most careful manner, but I think the only remedy which my friend was quite certain benefited him was quinine and preparations of bark. That these were useful he was convinced, and he had frequent recourse to them, and often in very large doses, all through his prolonged illness. Stimulants helped him

during the paroxysms, but I do not think he was any better when he took wine than when he entirely abstained. The patient became exceedingly thin and weak, and at last died exhausted and worn out. Unfortunately no examination was made.

Occasionally the sporules of fungi which very closely resemble blood-corpuscles in size and also in their general appearance are found in urine. ("Archives of Medicine," vol. II, p. 49.) Upon very careful examination, however, with a high power, a little eminence, which is the first commencement of the formation of a new sporule from the parent, may frequently be observed projecting from them. Not unfrequently two sporules may be seen together, one having grown from the other. Some time since I received a specimen of urine from a friend which contained numerous bodies of this kind; and the resemblance to blood-corpuscles was so great that, had I examined the specimen carelessly, I should certainly have considered them to be of this nature. By using a power of seven hundred diameters, however, the true nature of the bodies was distinctly made out. In some of these cases albumen, due to the existence of kidney disease, may be found in small quantity. This would complicate the case, and increase the chance of our being led to form a wrong conclusion. When doubt exists, the deposit should be set aside for a few days, exposed to the air in a warm place, and if the bodies be spores they will germinate, and all doubt as to their nature will be set at rest.

DEPOSITS OF EPITHELIUM.

The practitioner should be well acquainted with the characters of the epithelium derived from different parts of the urinary system, not only because it is liable to undergo change in disease, but also on account of the evidence sometimes afforded by the presence of particular kinds of epithelium of the exact seat of morbid change. Cells from the uriniferous tubes, from the pelvis of the kidneys, and from the ureters, entangled in fibrin or in a blood clot, for example, will sometimes assist us in coming to a conclusion as to the exact position of a stone.

The seat of small ulcers may sometimes be determined by the same method of observation. Epithelial cells from the bladder are discharged in considerable numbers in cases of stone, and also in cases where abrasions of the mucous membrane exist; and when an irregular growth of the mucous membrane has taken place, or a tumour has been developed in connection with the epithelium of the surface, or even in the submucous tissue, the alteration in the character of the cells of the part will excite suspicion in the mind of the observer as to the changes

which are going on. While if an epithelial growth has been actually formed, fragments of it may be from time to time detached, and from the microscopical characters of these an exact diagnosis may sometimes be made.

The rate of formation of epithelium varies greatly from time to time, and the character of the cells alters much. Sometimes, possibly from prolonged inactivity, the formed material accumulates to an unusual extent upon the surface of the cell, and its proportion to the bioplasm becomes very considerable. In other cases owing to accelerated growth of the bioplasm which occurs in all cases of inflammation and fever, even in the slightest degree of febrile disturbance, the relation is changed in the other direction. The bioplasm grows fast, and may even take up the formed matter already existing, while any new formed material produced is soft, and being quickly formed soon breaks down, so that it is hardly apparent. The masses of bioplasm grow, and divide, and sub-divide, and this multiplication goes on until the surface of the mucous membrane seems to be covered with a layer of soft substance more like mucus or pus than its normal epithelial covering. If a portion of this be submitted to microscopical examination it will be found to consist almost entirely of small particles of bioplasm—in fact of pus-corpuscles which have been derived from the bioplasm (nucleus) of the cells of epithelium of the mucous membrane.

The *chronic* changes of epithelial surfaces are no less important than those which have just been referred to, and which may be fairly termed acute. Just as chronic alterations occur in the structure of the derma and epidermis, so we have to notice changes in the tissues which lie beneath the epithelium, and the epithelium itself, of mucous membranes, and of glands. Changes occur which are probably akin to those in what is known as gouty psoriasis and other surface affections, where perhaps for months or years irregular growth of epithelium and subjacent tissue proceeds, and, by what for want of more knowledge of the real phenomenon we call "depraved nutrition," the structure of the tissues gradually becomes completely changed. But, and it is a very remarkable circumstance, after years of abnormal growth and nutrition, and impaired or suspended action, the normal condition may be restored, and the tissue may regain its perfectly healthy state, and retain it henceforth through life. A man may have to contend with gout in many forms for years, perhaps for a quarter of his life, and then get completely rid of the tendency. Now what is true of gout is also true of a number of other affections which belong to the same general category of morbid actions. It is exceedingly important for the physician to bear well in mind the fact that many chronic maladies of a most obstinate and intractable character do get well, but that considerable time is required for the change to be fully completed. How

absurd, therefore, is the system of ordering in such cases a few bottles of medicine. We have been driven to this ridiculous practice partly by the ignorant who still half believe in the value of touches, and spells, and charms, partly by absurd affectation of the possession of some universal anti-morbific power on the part of some very confident medical advisers who would have it supposed that they possessed some means of cure not at the command of the rest of us, and of powers of prescribing wonderful and exceptional, if not in a sense actually miraculous. Patients with chronic maladies, and especially those affecting cutaneous or mucous surfaces, must have patience with the physician, and must, if they are to get well, submit to a definite course of treatment, resting upon well ascertained principles, but requiring, perhaps, considerable time and steady perseverance. Instead of this, we find patients ready to pay anything for a mere promise of quick cure, however impossible this may be, resorting first to one nostrum and then to another, flying from one infallible healer to another, from quackery to reason and from reason back again to quackery, until their patience or their purse is exhausted, and they pass into the condition of therapeutic unbelief and despair, as unreasonable and as unfounded as was the conviction that they would be cured in a few days by swallowing so many doses of some wonderful compound.

Of the value of iodide of potassium, iodide of iron, bichloride of mercury, arsenic, glycerine, cod liver oil, in proper doses kept up for a sufficient time, in very chronic forms of disease of the skin and mucous membranes, there can be no question. Who can doubt that alkalies and purgatives do good in many forms of gout and rheumatism, or that congestion of the vessels of the liver and kidneys is relieved by taking alkaline and other waters, or that many disturbances of health affecting he organs of circulation, respiration, digestion, and the whole excretory system, to say nothing of those derangements of the sympathetic nerves and ganglia which cause such distress, are not sometimes completely cured by thorough change in the habits and in the mode of living? How many cases do we not meet of well-to-do people who have been wretched for twenty years or more from leading a sedentary life in London, and eating and drinking too well, who get completely cured by living in a good part of the country twenty or thirty miles from town, where they can be much out of doors, eat less than half as much as they formerly consumed, and drink water, milk, and tea or coffee only. Such facts, and the conclusions which naturally flow from their consideration, indicate surely enough how important it is to try to persuade persons who are suffering from various chronic ailments to give themselves a chance of getting well, by placing the weak part for some time under conditions, external and internal, which will favour or will determine its return to the normal state. In no department have such

considerations a more practical significance than in the management of chronic changes in the mucous membrane, and in the epithelial surface of the urinary organs.

Many of the maladies in question which may have been pronounced incurable are but chronic changes which have not gone too far to be checked, and although there are tissue-changes and infiltrations of lymph in the interstices of the tissue to such an extent as to interfere with or prevent its action, it is probable that in the course of weeks or months the normal state may return. One cannot but be struck at the character and extent of the morbid changes which have occurred in many scrofulous and syphilitic affections, possibly even involving the demolition of parts of important tissues and organs, and which nevertheless not only cease but are soon followed by a reparative process, rendering the tissue or organ, perhaps not what it once was, but causing its restoration to a condition which is not only not incompatible with work, but in which the active parts resume their activity and continue to discharge their functions during the ordinary period of life, if only they are carefully protected from overwork and kept from being unduly strained. Of late years we have so energetically studied the advanced morbid changes of tissues and organs, that the mind has been led to dwell perhaps too much upon the degenerated, the unchangeable, and the irreparable, and to take a too despairing view of morbid alterations in general. Every now and then we see an example of return to health, or to a condition approaching it, in cases of long-standing disease which have been despaired of in consequence of very distinct evidence of structural change, which, however, had been too hastily regarded as being completely beyond any reparative or reconstructive operation.

Many troublesome affections of the epithelium of the skin and mucous membranes may be cured, if only the patient can be persuaded to persist in the proper treatment for a sufficient length of time. Witness the effects of a long-continued course of mercury, of iodide of potassium, or of iodide of iron. In many cases the course of the nutritive process has not only to be changed, but changed for a considerable time. An alteration of the kind required must in many cases necessarily be very slow, although the disturbances and derangements may have been effected very quickly. Improvement must first take place in the young particles which are growing and multiplying at some distance below the surface, and no very obvious alteration can be effected upon the surface itself until these young cells have passed through their several phases of development and have reached maturity.

The beneficial action of local applications must likewise in many instances require considerable time for its full development, for the substance applied can only act by the influence it exerts upon the young cells. and it can only reach these by passing through the

minute channels between the old cells on the surface. In its passage it may lose much of its strength, and the frequent repetition of the local application daily, or many times daily, may be necessary before the desired effect can possibly be produced. But not a few of our remedies which influence epithelial growth act through the blood, either indirectly through the intervention of the nerves distributed to the capillaries, or directly by passing from the blood with the nutrient fluid which traverses the capillary wall, and which comes into contact with the cells themselves.

Epithelium of the Kidney.—The epithelium of the kidney differs somewhat in its characters in different parts of the tube, and also at different ages. That in the convoluted or secreting portion of the tube is described as being polygonal; it projects into the tube to the extent of one-third of its calibre. The epithelium in the straight portion of the tube is flatter, and approaches to the tesselated variety. Although the convoluted portion of the tube is much wider than the straight portion, *the diameter of the channel is much wider in the latter position than in the former*, in consequence of the much greater thickness of the epithelium in the secreting portion of the tube. Epithelium from the convoluted portion of the uriniferous tube is represented in "100 Urinary Deposits," pl. II, fig. 27. In healthy human kidneys the outline of the secreting cells is not to be seen so distinctly as it is usually figured in anatomical works, or indeed in my own figures. The round body, usually termed the nucleus, is very clear and well defined, and this seems to be surrounded by a quantity of soft granular matter which varies in amount under different circumstances. Although sometimes there appears to be a cell wall, no such structure really exists, and the apparent line is not due to the existence of a membrane, but is caused by the action of water and various agents upon the external surface of the soft granular matter, of which the bulk of the so-called cell consists. In many cases of disease, the round central bodies or nuclei are all that can be made out; and sometimes these are found in great number in the urine. The round "cells" (bioplasts or masses of germinal matter) present in the urine, in cases of acute nephritis, are generally the so-called "nuclei," which have grown in size and have increased in number in consequence of the very free supply of nutrient material. By the action of acetic acid, "nucleoli" will be rendered evident in the "nuclei." It would seem as if the granular matter external to the rounded granular body (nucleus) became altered in character under certain circumstances. The spherical masses of germinal or living matter, or bioplasts, the so-called "nuclei," are embedded in a granular material, which they have produced, and by which they are separated from each other by nearly equal distances, as represented in the upper part of fig. 27, pl. II, "100 Urinary Deposits."

If, instead of using the terms *nucleus*, *cell-wall* and *cell-contents*, we call the central mass *germinal or living matter* or *bioplasm*, and the outer granular matter *formed material*, the changes actually observed can be described without any difficulty or confusion. The formed material is rendered transparent by acetic acid, as represented to the left of the figure in "100 Urinary Deposits," and during life it is slowly converted into soluble substances by the action of the oxygen dissolved in the water discharged from the Malpighian capillaries. The secreting epithelium probably acts in this way:—the bioplasm or germinal matter takes up certain constituents from the blood, and thus new bioplasm is formed; but the mass does not increase in size because, at the same time that matters are taken up from the blood, a portion of the bioplasm already formed undergoes conversion into formed material; nor in a normal state does the formed material accumulate, because that which is already formed becomes disintegrated by the action of water and oxygen, and is resolved into urinary constituents which escape in solution in the water.

The renal epithelium, as above remarked, readily undergoes great change. In health the outermost part of the soft granular material is perhaps a little firmer in consistence than that which is more central. In some chronic diseases all may become hard and firm, so that the bioplasm (nucleus) in the centre of the cell cannot be easily dislodged from its position. More commonly, however, the outer part breaks down, and the masses of bioplasm being set free, grow and multiply, and pass into the urine in great number. *See* "100 Urinary Deposits." The epithelium in the straight portion of the tube is much flatter than that in the convoluted part, and probably serves the office of a protective covering. It is doubtful if it takes part in secretion, but there is some reason for thinking with Virchow that at least in certain cases albumen escapes from the blood into this portion of the uriniferous tube.

The epithelial cells from the ureter are columnar and spindle-shaped. In form and in general appearance they so closely resemble the cells in some scirrhus tumours that they have been mistaken for them. The observer must take the greatest care to avoid such an error, and thus suggest the existence of cancerous disease of the kidney in perfectly healthy people.

The epithelium of the bladder varies much in different parts of the organ. In the fundus, there is much columnar epithelium mixed with large oval cells; whereas, in that part termed the trigone, large and slightly flattened cells, with a very distinct nucleus and nucleolus, are most abundant. Columnar epithelium appears to line the mucous follicles, while the scaly is found on the surface of the mucous membrane between them. Many of the large oval cells of bladder epithelium lie upon the summit of columnar cells, and their under surface exhibits

corresponding depressions. Various forms of bladder epithelium are represented in "100 Urinary Deposits," pl. II, figs. 25, 30, 32; and the manner in which the young cells of vesical epithelium multiply is represented under a power of 700 diameters (fig. 30). The young cells are composed of a perfectly soft granular material, and like other young cells possess no limitary membrane or cell-wall whatever. The formation of pus from the bioplasm of epithelial cells may be well studied in inflammation of the bladder and urethra. The large cells of bladder epithelium grow very fast in cases of epithelial cancer affecting this organ, probably on account of the increased flow of blood to the mucous membrane established by the increased demand for nutriment excited by the rapid growth of the cancer.

The epithelial cells of the urethra are, for the most part, of the columnar form; but mixed with this there is also a good deal of scaly epithelium. Towards the orifice, the epithelium is almost entirely of the scaly variety. The young bioplasts on the deep surface of the epithelium very readily grow and multiply unduly, and thus pus-corpuscles result. Oftentimes this process goes on also in the small glandular follicles of the mucous membrane. The epithelium of the *glans* is of the scaly variety, and mixed with it is a quantity of soft white matter, seen under the microscope to consist of granules and numerous globules of earthy phosphate. This is the secretion from the modified sebaceous glands in the mucous membrane of the corona, the so-called *Smegma Preputii*, which accumulates in some cases to an enormous extent. In a specimen, which was removed by operation by my friend Mr. Bird, now of Melbourne, I found epithelial cells with many well-formed crystals of cholesterine.

The smegma preputii mixed with epithelial cells from the surface of the glans, fatty matter and earthy phosphates which have been deposited in it, sometimes forms hard flaky masses which have been mistaken for fragments of a phosphatic calculus. Not unfrequently the accumulation of this secretion excites inflammation of the prepuce and glans, causing severe pain and making the patient really ill. We are often consulted about a form of herpes which is prone to occur upon the mucous membrane in this situation. In some persons of a gouty tendency this affection is often very troublesome. It generally yields to the local application of Goulard water or even pure water, with a mild mercurial purge and citrate of soda or some other saline internally.

Vaginal Epithelium.—The large cells of scaly epithelium so commonly met with in the urine of females, and derived from the *vagina*, are represented in "100 Urinary Deposits," pl. II, figs. 24, 32. They, however, vary much in size and form, and are sometimes very irregular in shape with uneven ragged edges. It is very common to meet with cells of vaginal epithelium the bioplasm or germinal matter of which is

much increased in size and is undergoing division and subdivision into pus-corpuscles. The quantity of epithelium which is discharged from the surface of the mucous membrane of the vagina is sometimes very remarkable, and it is not surprising that its abundant formation and detachment from time to time should cause symptoms which disturb the patient and are sometimes accompanied by pain and distress, or at least discomfort, which rivets the attention, and excites in the patient's mind fears of pathological horrors, about which, through the mistaken kindness perhaps of a learned female friend, she has been led to form some very vague and exaggerated notions. Injections of tepid water, tonics, and mild purgatives often set everything to rights in a week or two, and if you can persuade the patient that a vaginal examination is not immediately necessary, you may often ease her without resorting to that in many cases needless and objectionable method of investigation.

Casts of the Uterus and Vagina.—A considerable thickness of the epithelial layer of the vagina, and according to some observers also that of the uterus, is sometimes shed in the form of a membranous cast or mould. I have seen such epithelial casts or moulds from the rectum, œsophagus, and from the stomach. They may be compared with the layers of cuticle which are detached from different parts of the cutaneous surface after scarlatina. It is only the superficial portion of the epithelial layer which is detached in these cases.

Leucorrhœa.—In this condition very many imperfect cells of vaginal epithelium are formed upon the surface of the mucous membrane, as well as pus-corpuscles. Many pus-corpuscles originate in the cells of vaginal epithelium, even after the epithelial cells have assumed their distinctive form, but many of the younger cells of vaginal epithelium, and those in the numerous follicles of the mucous membrane, themselves divide and subdivide, giving rise at length to multitudes of the spherical granular cells we know as "pus-corpuscles," which multiply very rapidly if freely supplied with nutrient matter. The manner in which pus is formed from the bioplasm or germinal matter of vaginal epithelium will be at once understood by reference to figs. 106, 107, pl. VIII, "100 Urinary Deposits."

Although it is not my province to discuss the nature and treatment of leucorrhœa, it may be well to state that many cases seem to depend upon an impoverished state of blood, without any special disease or derangement of a purely local character. These cases get quite well if attention be paid to the general health. Of all remedies the tincture of perchloride of iron is one of the most useful, and when there is any irritability of the mucous membrane, tincture of henbane, opium, or hop, or the extract of Indian hemp, will be found useful. The advantage of the local application of Goulard water with sedatives, and the frequent injection of cold or tepid water, and the beneficial effects of the cold or

tepid hip bath, in this condition, are so well known to practitioners, that it is almost needless to refer to them.

CANCER.

A careful examination of a urinary deposit sometimes affords the first evidence of the existence of a morbid growth from the mucous membrane of the bladder, or from the prostate, or from the kidney itself, a terrible form of disease which it is to be feared will end fatally. The morbid change may have been going on for many months, or for even a year or longer, without any pain or even discomfort having been experienced by the patient, and the reddish-brown deposit in his water, sometimes in considerable quantity, sometimes hardly visible, may be the first thing that attracts his attention, and that suggests the desirability of consulting a physician.

In cases of cancer of the bladder it is not uncommon to meet with well-defined cancer cells in the urine. Some years ago, Sir William Fergusson requested me to examine for him a small portion of jelly-like matter, which had been passed by a patient suffering from disease of the bladder. Of the exact nature of this matter there had been some difference of opinion. Upon treating a fragment of it with a little glycerine and water, and subjecting it to examination with a power of two hundred diameters, I had no difficulty in making out loops of capillary vessels covered with a thick layer of cancer cells. The specimen presented the usual appearances which distinguish a cancerous tumour rapidly growing into a hollow viscus, and was evidently one of the tongue-like or villous processes, broken off from the mass. There could, therefore, be no further doubt as to the exact nature of the case. The diagnosis was confirmed by subsequent examination of the parts after the patient's death. I have seen several cases of cancer of the bladder in which the disease was detected for the first time by the microscopical examination of the urine. In most of these there was an abundant deposit of a dark brown colour, much resembling blood in appearance when it occurs in acid urine. This brown deposit was found to consist principally of a vast number of cancer "cells," varying greatly in form and size, most of them being very large. Many were of considerable length, and contained "cells" in two or three different places. These so-called "cells" consist, in fact, of a soft material corresponding to the wall of a normal epithelial cell, in which masses of bioplasm are embedded in considerable number. A very good specimen of cancer cells from the bladder is represented in "100 Urinary Deposits," pl. VIII, figs. 103 and 107. The cancer cells multiply in the same way as epithelium, but faster and much more irregularly, instead of succeeding one another in an orderly manner, layer after layer.

The presence of cancer cells in the urine, it need scarcely be said, is irrefragable evidence of cancer of the bladder. This disease must be fatal sooner or later, and we can never give much hope of a favourable termination.

From time to time, however, specimens of urine are sent for examination, containing numerous well-defined spindle-shaped cells, which, from their general resemblance to the cells of scirrhus, have been supposed to indicate the existence of this terrible malady in connection with the kidney or bladder. But it must be borne in mind that cells from the ureter, bladder, or urethra, in health, may be mistaken for cells from a cancerous growth. Certain forms of cancer cells then which have been detached from a cancerous growth may be mistaken for epithelium or the last for cancer cells, and the greatest care should be taken by the practitioner not to come too hastily to a conclusion on this matter. Moreover as cancer is incurable, and as the disease often runs a prolonged course, not unfrequently extending over three years or more before it destroys life, there is no excuse for any hasty expression of opinion. To err on either side is a most grave matter, and it is of the greatest consequence that time should be allowed to pass before a decided opinion is given on a question of such tremendous consequence to the patient. I have known epithelial cells from the bladder and also from the ureter mistaken for cancer cells, and I have had the unpleasant duty of proving that a collection of what was supposed to be epithelial cells was really a fragment detached from a rapidly growing tumour in the pelvis of one kidney in a case in which death soon resulted from the almost sudden occurrence of violent hæmorrhage.

Villous growths from the mucous membrane of the bladder are unhappily common enough. They vary considerably in their microscopical characters, in the rate at which they grow, and the time as well as the manner in which they destroy life, and as to the degree of pain or discomfort caused by their presence. While it occasionally happens that the increase of these tumours ceases for a time, it is extremely doubtful whether they ever wholly disappear. Certainly the number of cases in which they steadily increase until death takes place, is so large in proportion to the instances where a favourable change occurs, that we can seldom venture to express a very hopeful opinion.

The bleeding from the surface of the highly vascular tumour is, as I have before remarked, very frequently the first intimation of its existence afforded to the patient or to the practitioner. The hæmorrhage is sometimes so copious as to quickly blanch the patient and exhaust his strength, while the accumulation of blood in the bladder and the means adopted for its removal, the pressure of the growth on surrounding parts, the stretching and irritation of nerves, and possibly the interference with the excreting process and the absorption of urine

by some parts of the surface of the growth, lower the patient's health and add to his distress and suffering. These cases are among the most unsatisfactory we are called upon to treat. But though we cannot cure we may undoubtedly do much to relieve the patient. Attention to his diet, and particularly to the quantity of liquid allowed during the twenty-four hours, is as important as the judicious administration of sedative remedies by the mouth, by hypodermic injection, or in the form of suppositories. The physician may indeed be of the greatest service to those who have to suffer from this terrible malady, and may be the means of preventing much pain which the patient would otherwise have to endure.

In general it will be found that there is far less suffering in those cases of vesical cancer in which a large quantity of the cellular growth is connected with the mucous membrane, than when the muscular tissue is implicated in the disease. I have known cases of the former in which there was scarcely any suffering, the patients dying in from one to two to three years after the cells were first found in the urine, from the gradual exhaustion caused by the hæmorrhage which sometimes takes place daily and never entirely ceases. In treating these cases, we must endeavour to keep the urine in as healthy a condition as possible, for if it be very acid or alkaline the patient's suffering will be increased.

A considerable mass of soft cancer is sometimes formed in the kidney. The morbid growth may exist for months, and attain a considerable size before it gives rise to any signs or symptoms whatever. Sometimes the patient complains of uneasiness apparently situated deeply in the back, and this may be mistaken for muscular or nervous pain. The tumour may, however, invade every part of the kidney, destroying entirely the renal structure, and form a mass twice the size of the organ before any definite diagnosis can be made. In the case of a man over fifty years of age that came under my notice some years ago, the first symptom to attract attention was violent hæmorrhage which could not be checked, and was fatal in the course of two days. A large fungus growth was found which had bled very freely into the pelvis of the kidney in which it was situated.

Cancer of the Uterus may exist and continue to increase for many months before any portions of the growth find their way into the urine. It is but seldom that this disease is first discovered by microscopical examination of the urine, the indications of its existence being generally sufficiently marked for its discovery by broader methods of observation long before the growth has sufficiently advanced to produce free portions which may be detached from time to time and find their way into the water. Cancer cells from a case of cancer of the womb, and which were found in the urine, are represented in "100 Urinary Deposits," pl. VIII, fig. 105. The treatment of these sad cases almost resolves

itself into palliative measures, such as relieving pain and restraining hæmorrhage, and it is rarely that one can feel convinced that any means adopted by us have the effect of retarding the growth much less of promoting its absorption. The practitioner must never fail to bear in mind, however, that mistakes have been made in diagnosis even by the best of physicians, and occasionally an example of what seemed to be undoubted cancer has happily turned out to be a comparatively harmless fibroid growth, which after a time ceased to increase, and then gradually dispersed. It is possible that the remedies employed may have had something to do with the favourable result. Iodide of potassium, and iodides of iron, mercury, and other metals, undoubtedly exert a favourable influence on many morbid growths, and we should prescribe them particularly in the early stage of any case of tumour, although the practitioner may have good reason for fearing that the growth will turn out to be of a cancerous nature. The so-called "cancer-curers" not unfrequently get hold of patients who are suffering from harmless tumours which have been too hastily assumed to be cancer, and if the patient gets better the case is talked of as a cure of undoubted cancer, by some new and wonderful system practised by the "curer" only, and of course by him kept particularly secret.

The hæmorrhage from many of the growths which project from the surface of the mucous membrane of the bladder is often serious, and even when it occurs only to a moderate extent, by frequent repetition the patient's strength is exhausted, and he becomes less able to bear the depressing effects of the disease. The observations on the subject of hæmorrhage (*see* p. 86, *et seq.*) apply to these cases, and of all the remedies I have used, gallic acid seems to be the most potent in the majority of cases, though, like every other remedy, it fails sometimes. Of the value of astringent injections into the bladder there can be no doubt, but these must be resorted to only after due consideration, for if a considerable quantity of blood in the bladder is coagulated by some astringents, it may be more difficult to remove than if it had been allowed to coagulate spontaneously, and thus the patient's suffering may be considerably increased by injudicious interference. On the other hand a slow but constant general oozing from the capillaries on the surface of a growth may sometimes be completely checked by the judicious use of weak injections; a 1 per cent. solution of Liq. Ferri Perchlor. often answers well. Hamamelis in the proportion of fifteen drops of the tincture to an ounce of water has also been used with advantage. Alum, sulphate of zinc, and other substances have been recommended with the same object. For the relief of pain sedatives must be employed. I always begin by prescribing suppositories of extract of henbane and extract of conium, and use opium when the above fail in their effects, beginning with a small dose and increasing very gradually

as the exigencies of the case seem to require. The practitioner will find it advantageous to vary the sedative and its form from time to time, only resorting to hypodermic injections when other means have failed. This, at least, is my practice, for I sometimes find that patients as soon as they experience the beneficial action of morphia introduced hypodermically, are far too anxious to have the injection repeated. Thus larger doses are soon resorted to than is desirable at a comparatively early period of the case, and the patient soon becomes absolutely dependent upon the drug for anything approaching to ease, and although the pain may be relieved, he may experience much distress from the effects of the narcotic, whereas if the dose had been increased more slowly, the action would have been more satisfactory, and the total benefit resulting would have been greater. The general condition of the patient must not be neglected, for there can be no doubt that suffering in this and many other maladies is much greater if the patient is weak and ailing than will be the case if we can manage to keep him in pretty good health. If the digestion is weak we must try to improve the action of the stomach by giving pepsine and other remedies.

DEPOSITS OF PUS.

Pus-corpuscles may be formed upon the surface of the mucous membrane in any part of the urinary tract, in the convoluted or straight portion of the uriniferous tubes, in the pelvis of the kidney, in the ureter, bladder, and urethra, and in any of the glands opening into these passages or cavities. Pus in the urine may depend upon the discharge of a collection of pus in any of the adjacent parts, or upon the opening of an abscess into these tubes or cavities, or into channels communicating with them. No pus is present in the urine of perfect health, but a small quantity is often found in the urine of men who have passed the age of forty, and its presence is not a matter of any consequence. A few pus-corpuscles may be formed in the urethra, in the neck of the bladder, or upon any part of the surface of the mucous membrane of that organ, without the occurrence of any derangement in function. It is only when pus-formation becomes very active that any inconvenience is experienced or damage results. An occasional pus-corpuscle on a mucous membrane does no harm, and although a considerable quantity of pus is formed, the mucous membrane may quite recover its healthy action and return to its normal state.

The mucus-like or mucilaginous deposit often seen in the urine in cases of inflammation of the mucous membrane of the bladder, consists of pus which had been formed in quantity upon its surface, and by the follicles, especially about the neck of the bladder, acted upon by carbonate of ammonia, set free by the decomposition of urea. If some pure

pus be taken, and a little liquor ammoniæ, or carbonate of ammonia, or liquor potassæ, be added to it, the opaque cream-like appearance is lost, and the mass becomes nearly transparent and gelatinous, so viscid that it will not drop from one tube into another, but as soon as a little is permitted to pass the whole is poured forth *en masse*. It is very remarkable for how long a time the genito-urinary mucous membrane may be not only deranged, but so completely altered from its normal state as to become an extensive pus-forming surface without any serious consequences resulting. I have seen several cases where chronic inflammation of the bladder commenced before the age of forty. The patient nevertheless enjoyed fair health, and was able to take as much exercise as was desirable up to or beyond the age of seventy. During these years pus was never absent from the water, and very frequently formed a deposit equal to a fifth or a sixth of the bulk of the total quantity of urine passed in the twenty-four hours. This shows that a grave pathological change may be effected in an extensive tract of mucous membrane resulting in the removal from its surface, and from the mucous glands in connection with it, of, perhaps, from twenty to fifty times the amount of ordinary secretion without any serious changes being brought about in the blood or in any other organs of the body. It seems that the very considerably increased action of the mucous surface is in some cases so provided for and compensated or balanced that no serious derangement of physiological action in other parts of the body takes place.

We know that a very large quantity of pus may be formed upon the surface of the bronchial mucous membrane with comparatively little constitutional disturbance occurring. If the changes resulting in pus-formation go on very gradually, it is remarkable to what extent the alteration in the quantity and quality of the secretion may proceed without immediate danger to life, and sometimes it almost seems as if the continuance of morbid actions which have been slowly established were almost as necessary to the well-being of the organism as the removal of ordinary excrementitious matters in the perfectly healthy state. In many cases the sudden stoppage of such an abnormal process does harm, and may occasion serious illness or even death.

The quantity of pus formed upon a mucous surface is sometimes extraordinary, and may amount in bulk to many ounces in the course of twenty-four hours, and this active process may continue for weeks or even months at a time. I have known a quantity of pus equal to from one-tenth to one-sixth of the bulk of the water passed almost daily for a period of twenty years without any serious symptoms being occasioned, and without the ordinary duties of life being interfered with. That in many instances it weakens the patient and exhausts the strength is quite certain, but it does so only in a very moderate degree, and after the

patient has suffered for months from this depressing process, we may be astonished at the vigour which still remains, and if the strength has been well sustained during the illness, the patient often loses little in muscular and nerve power during the early period of even severe forms of the distressing malady. Patients may live for twenty years or longer, although considerable quantities of pus are formed in the bladder during the whole time, or upon the mucous membrane of the large bronchial tubes.

This process of very free pus-formation may occur quite independently of mucous membranes, or of an epithelial surface, for it may begin in the substance of an organ, and a considerable portion of the structure may be destroyed until a cavity of considerable size results, in which pus-formation proceeds at a rapid rate, and from which the accumulated pus is from time to time discharged. As I showed long ago, pus-formation may start from the bioplasm of any tissue or organ of the body, though that of epithelium and of connective tissue when subjected to increased nutrition takes upon itself the change more readily than any other kind of bioplasm.

The formation of many ounces of pus in the course of twenty-four hours, extending over a period of several months, is well illustrated in cases of pyelitis, in which the secreting structure of one kidney is gradually destroyed, and the affected organ becomes converted into a large cyst with firm fibrous vascular walls, upon the inner surface of which pus-corpuscles grow at a great rate and multiply enormously, filling the cyst to distension, when in consequence of the pressure a gush of pus takes place down the ureter into the bladder, the process being repeated at short intervals during a period of perhaps many months before anything like contraction of the cyst and improvement in the patient's state can be said to begin. Such a case was for some months under my care not long since in the Hospital. Coincident with the destruction of the left kidney in this girl's case, was the gradual increase in size of the right one, which in fact did the work of two, urine being secreted in the normal quantity and of the normal density. For the development of new urine-secreting tubes, as undoubtedly occurs in such a case, time is required. It is important while this change is proceeding not to throw more work upon the organ than is absolutely necessary for the requirements of the system. Rest and a careful regulation of the diet, as to quantity as well as quality, are very essential points in the treatment. In some cases where a quantity of pus far less than this is formed, serious constitutional disturbance is produced, but in some forms of pyelitis, when an enormous amount of pus is poured into the ureter from a large pus-forming cavity, the general health and strength are but little impaired. When the disease occurs in young women, recovery usually takes place in a year or two. A domestic

servant who was under my care for this disease actually performed her duties as housemaid for a twelvemonth while pus was passing daily in very large quantity. She also ultimately recovered.

When the large pus-forming cyst, the walls of which are freely supplied with blood, has been formed, the pus does not seem to grow at the expense of any surrounding tissue, but it receives its nutrient matter entirely from the blood distributed to the surface on which it grows, just as epithelium does in the case of mucous membrane.

Pus, sometimes in large quantity, in the urine may have found its way into the secretion from an abscess situated in parts even at a considerable distance from any of the urinary organs, and we not unfrequently meet with cases in which pus gets into the water after taking a long and circuitous course. Abscesses about the pelvic organs and in the abdominal walls, abscesses connected with the vertebral column and lower ribs, occasionally discharge into the bladder, but one would hardly imagine that a communication would under any circumstances be established between the gall and urinary bladders. I have, however, had such a case under my care. Pus in considerable quantity was passed for some years in the water, and no one who saw the patient could decide as to its source. At length several small gall-stones made their appearance in the urine, and at last, after many years of suffering and extreme emaciation, the patient got quite well. Jaundice existed during part of the time, but I believe no bile was ever detected in the water. The stones were ordinary gall-stones, and consisted almost entirely of cholesterine, which readily dissolved in spirit, and was recrystallised.

Many of the cases in which pus is found in the water in considerable quantity require very careful consideration, and the practitioner should not attempt to decide as to their nature until all the many points in the history have been well thought over, and several careful examinations of the urine have been made at intervals of time. The mere fact, however, of a considerable quantity of pus in the water must not be regarded as evidence that an abscess has discharged into some part of the urinary tract. As already remarked, it is more probable that the pus has been formed upon the surface of the mucous membrane of some part of the urinary organs.

There is a chronic state of ulceration of the ureters and pelvis of the kidney and bladder, in which pus is formed in considerable quantity, leading to the most distressing symptoms. Pus may depend upon the existence of old stricture. Abscesses form in the kidney as in other organs; and, after the abscess has burst, pus makes its way into the urine. The inflammation of the mucous membrane of the kidney often extends upwards from the bladder.

The presence of a calculus in the kidney, in the ureter, or in the bladder, may set up inflammation which may go on to the formation of

pus. A very small calculus will sometimes excite great irritation in the kidney, so that pus, blood, and much mucus, in which microscopic calculi are sometimes embedded, are voided in the urine.

Pus may be derived from a sloughing process going on in the kidney. Sometimes a portion of the organ sloughs off entire in these cases. My friend, Mr. Newham, of Bury St. Edmunds, sent me some time since a piece of kidney which had sloughed off, and had passed with much pus into the urine. Pus may also depend upon the presence of cancer in the kidney or upon tubercle developed in the same situation. Pus may come from an acute affection of the uriniferous tubes, and the corpuscles will be found free in the urine, and entangled in considerable number in casts. These cases are often very rapidly fatal. Pus formed upon the mucous membrane of the vagina as takes place in leucorrhœa has been already considered.

In women, a large quantity of pus may be formed in burrowing abscesses amongst the pelvic viscera, and make its way into the bladder, ureters, or vagina. These cases of *pelvic cellulitis* are not uncommon. I have seen patients reduced to an extreme state of emaciation from the long-continued drain, nevertheless completely recover, although there were openings, both into the rectum and upper part of the vagina, so that sometimes pus passed by the bowel, and sometimes it was found in the urine.

But let us consider exactly how the four or six ounces of pus which escape, say, from the altered kidney in a state of pyelitis during each period of twenty-four hours are produced. How do the pus-corpuscles increase by millions and multiply thus rapidly? I have shown how on many occasions pus may arise in the first instance by the more rapid growth of the bioplasm, not only of epithelium or connective tissue, but from that of any texture in the body. I do not propose to discuss how the pus-forming process was first established in such a case, but simply to consider how the constant production of new pus-corpuscles is carried on. Are the new pus-corpuscles formed in plasma or blastema exuded from the blood by the aggregation of particles precipitated in this originally transparent fluid, or do they come from pus-corpuscles already produced? This question may be very briefly disposed of. The first supposition involves several hypotheses. There is the hypothesis of the precipitation of the particles in the blastema; there is the hypothesis of their aggregation in forms resembling pus-corpuscles; the hypothesis that the particles become endowed with certain vital properties either before or after their aggregation, and then the further question whether the molecules of the chemical compounds, or the elementary atoms of which they are composed, receive vital powers. No one pretends ever to have seen the constituent particles of a pus-corpuscle precipitated from a blastema, or their aggregation to form a pus-corpuscle, and no explanation of the

manner in which the peculiar properties, powers, or endowments of pus are communicated to the precipitated particles has yet been given. On the other hand, new pus-corpuscles may be seen to grow from older ones. Not only may small spherical projections be seen upon the surface of pus-corpuscles after the death of the greater part of the matter of an individual pus-corpuscle, but I have seen these in process of formation during the living state, so that we may lay it down as certain that the living matter or bioplasm of each pus-corpuscle has been derived from and is in fact but an extension of the bioplasm of epithelium or tissue in the manner I have fully described (*see* "Bioplasm," "Protoplasm," and "The Microscope in Medicine"). The first pus-corpuscles originate either from small detached portions of pus-corpuscles (germs), from another person, or they arise from the normal living matter or bioplasm already in existence. Moreover, I have shown that at least in some instances, whatever may be the cause of the pus-formation, the essential nature of the pathological change is the same. It consists of increased nutrition of the living matter of the young anatomical elements or cells of a tissue. This normal bioplasm grows, divides, and subdivides, and from one mass multitudes of spherical masses (pus-corpuscles) may very soon result. Whatever may have been the origin of living matter in the first creation, we may feel quite certain that in every case of which we have knowledge or experience living matter is but the offset, in fact a portion of living matter already in existence. Living matter is not now formed anew from lifeless matter, but any lifeless matter to become living must first come into very intimate contact with matter which already lives.

As to the growth of pus, there is no doubt that lifeless nutrient pabulum passes into the substance of a pus-corpuscle and becomes a part of the living particles of which the pus-corpuscle is composed. A portion of the living matter moves away from the general mass, and at length becomes detached and free. These pus-corpuscles live and grow and multiply in a medium which contains the substances fitted for their nutrition. But the pus-corpuscle does not go on growing infinitely. Before it reaches the largest size which it may attain it begins to subdivide into smaller portions, and the manner in which this occurs is the following. As pus grows comparatively fast, the process may be seen actually going on. So also it can be seen in mucus and in young epithelial cells, but in many tissues it occurs so slowly that the actual movements of the living matter cannot be demonstrated, although the appearances seen after death prove that the essential changes are the same. Indeed there is no doubt that all living matter increases and multiplies in the same manner. It may be called division, subdivision, germination, reproduction, repetition, multiplication, evolution, but there are to be noticed in all cases these simple phenomena :—

1. The passage of inanimate pabulum into the living matter, which in consequence *grows*.

2. The moving away of certain portions of this living matter from the general mass and their subsequent separation.

The smallest particle separated being supplied with nutrient matter grows and gives rise to new particles in the same manner. These vital changes occur in the same order in the case of the simplest living beings in existence, as in the elementary parts of the highest tissues of the highest organisms.

In the pus-corpuscle we may actually see portions of the living matter in the act of moving away from the general mass, and can see them at length detached and separated, nay, we can kill them while movement is going on, and preserve the particles, in the act of extension, from the parent mass; but we cannot see the inanimate pabulum passing into the substance of the living matter, though we are justified in concluding that it does so pass, because an alkaline solution of carmine, which from its red colour is easily detected, undoubtedly does so, and in less than a second of time. The vital movements go on for two or three days in pus-corpuscles from the bladder, if the urine happens to be of low specific gravity.

From the figures often given of pus, the reader would be led to infer that all or nearly all the corpuscles are of the same size. Such an inference does not accord with the facts. Pus-corpuscles, white and red blood-corpuscles, and many other cells, vary greatly in size. For example, in any specimen of pus, there are many corpuscles varying in diameter from the $\frac{1}{10000}$ to the $\frac{1}{3000}$ of an inch. Can any one doubt that the smallest of these particles is living, and might have grown into an ordinary pus-corpuscle? And who shall say how small a particle of a living pus-corpuscle may be capable of growing and producing millions if supplied with pabulum? To propagate pus from patient to patient it is not necessary that the very largest pus-corpuscles be transferred. Many of the smaller particles are so light that they may be wafted in the air for a considerable distance. Falling upon a surface favourable for their growth, they grow and multiply. There are facts concerning the origin and transmission of the poison of some contagious diseases which can be readily accounted for upon this view. We know that some living particles will retain their vitality under adverse conditions which would destroy others, and it is only reasonable to assume that certain forms of pus might retain their vital activity more vigorously, and for longer periods, after their removal from the surface upon which they were produced than others. In this way the more virulent action of some forms of contagious living matter might receive explanation.

Chronic Catarrhal Inflammation of the Mucous Membrane. Catarrh of the Bladder.—In the condition known as catarrh of the

bladder, the changes characteristic of catarrhal inflammation are well marked. The first step in the pathological phenomena probably occurs in the young cells of bladder epithelium, near to the capillary vessels of the mucous membrane, but it is probable that prior to this some alterations take place in the immediate vicinity of the vessels, consequent upon changes in the blood. It is to be observed, first, that in many, but certainly not in all cases, the state of the blood is the starting point of the disease, as it is in many of the so-called idiopathic fevers and inflammations, which are, nevertheless, characterised by local changes. But, secondly, it is certain that local injury alone may excite vesical irritation and inflammation, for the disease is not unfrequently caused by catheterism. While, thirdly, the commonest cause to which catarrh of the bladder is correctly attributed is gonorrhœa. The urethral inflammation extends backwards into the neck of the bladder, and in some cases the greater part of the surface of the mucous membrane becomes involved. Some of the cases attributed to gonorrhœa are not of this nature, but are, nevertheless, due to extension of urethral inflammation backwards towards the neck of the bladder.

Catarrhal inflammation of the bladder often proceeds from cold. When some persons "catch cold" the catarrh affects the mucous membrane of the bladder instead of that of the nose, which is the usual seat of disturbance. Catarrhal inflammation of the bladder from cold may be very severe and accompanied with much pain and distress. The pain is sometimes confined to the neck of the bladder, but very often it is described as spreading over the whole of the lower part of the abdomen. The urethra is not unfrequently the seat of "scalding" and of exquisite pain while urine traverses it, when urine ceases to pass, and before the bladder expels it. In many cases movement causes agony, and some patients are quite unable to hold their water when they are seized with the slightest cough. When the bladder affection is associated with bronchitis, which is not unfrequently the case, the patient's misery is greatly intensified by the dribbling of the water every time he coughs. We may greatly relieve his mind by assuring him that the trouble is only temporary, and that he will regain as much control over the escape of his water from the bladder as he ever had. Some of the most severe and sudden attacks of acute catarrhal inflammation of the bladder, though there is much pus in the water, progress most favourably, and the patient gets relief within a few days, and is as well as ever in a fortnight.

Serious catarrhal inflammation of the bladder is sometimes excited by a middle-aged gentleman imprudently sitting for some time upon a cold or, worse than this, a cold and damp seat. Such is indeed a common cause of the malady after the patient has had one attack. He should therefore be very careful not to expose himself to the risk.

Much has been said concerning the influence of bacteria in exciting catarrhal inflammation of the bladder, and it has been laid down, as if it were a matter of extreme importance, that a catheter before it is introduced should be carefully anointed with some reputed germicidal preparation. It is indeed strange that those who speak so very confidently about the introduction of bacteria should not have taken the trouble to ascertain whether these organisms were not already present on the surface of the mucous membrane. As a fact, millions are to be found on every part of the urinary as well as upon every other mucous membrane, all the old epithelial cells about to be cast off being pervaded with them in every part. It is therefore ridiculous to insist upon minute precautions being taken to prevent the introduction of the organisms on a catheter. They are already present in countless multitudes, ready to increase and multiply whenever the conditions become favourable. But in condemning a proposition which is erroneous, I know I shall be charged with giving encouragement to dirty and slovenly habits. However, it is obvious that people can be clean though they may have found bacteria everywhere and in everything they eat and drink and touch, and are quite convinced that these organisms flourished long before man appeared, that it is absolutely impossible to exterminate them, and foolish to suggest it.

In those who frequently suffer from catarrhal inflammation of the bladder the mucous surface is probably unusually sensitive, and prone to frequent derangement, so that undue exposure to cold is very likely to bring on increased action of the bioplasm of the mucous membrane and of the follicles, which soon results in the formation of pus. I have known many cases where the mucous membrane of the urethra, after being disturbed in process of epithelial formation by gonorrhœa, never perfectly regained the normal state, and was the seat of chronic pus-formation through life. In such cases the epithelial surface becomes modified, and in many situations pus-formation seems to take the place of epithelium production. It is very likely that many of those who have suffered very much from the action of gonorrhœal pus have acquired an unusually susceptible condition of urinary mucous membrane, and are afterwards prone to suffer from slight disturbing causes; while it is certain that the degree of sensitiveness to morbid influences differs much in different individuals, and that some have a power of resisting disturbing causes which would seriously damage others. A parallel fact is noticed with regard to other mucous surfaces, notably the mucous membrane of the nose, pharynx, and bronchial tubes. A change in the temperature and moisture of the atmosphere which will make some persons quite uncomfortable and perhaps ill, and cause capillary congestion and the secretion of a large quantity of mucus, will not even be noticed by others. One can never go out on a damp

evening without the mucous membrane covering the vocal chords being affected and the voice rendered husky ; another does not suffer in the slightest degree, and his voice never becomes hoarse, and perhaps he never once suffered from sore throat during a long life.

A gleety discharge from the urethra, following gonorrhœa, or arising from other causes, often ends in inflammation which extends backwards into the bladder and becomes of the most chronic and obstinate character. I have known inflammation which followed gonorrhœa and gleet last for more than thirty years, beginning about the age of forty, the patient not even dying from the bladder disease but from another affection altogether. In one case the quantity of pus formed was seldom less than one-sixth of the volume of the urine passed, and yet this patient was able to retain his water fairly well. Though he suffered now and then from violent attacks of hæmaturia, he recovered well, and the greater part of the time could travel long distances without inconvenience. Tincture of perchloride of iron always relieved him when his sufferings were unusually severe or the pus greatly increased in quantity. He continued to take this medicine, sometimes with belladonna or henbane, from time to time during the whole period of his illness.

As regards catarrh of the bladder originating in gonorrhœa we have two distinct pathological processes to consider. The gonorrhœa is no doubt a specific inflammation excited by a special form of contagious pus, but this is accompanied by ordinary inflammation and pus-formation, which persists after the specific pus-formation has ceased. The pus from gonorrhœa will excite its own peculiar specific inflammation, but the pus which is still found on the urethral and vesical mucous membrane long after all specific action has ceased will not excite gonorrhœal inflammation if transferred to a mucous surface. Whether the contagious property could be produced anew, as occurs in the case of the development of virulent contagious particles in cases of peritonitis, is a question which is open to consideration, but is far too extensive to be discussed here. There is, however, no doubt that specific properties may be lost—that pus-corpuscles having peculiar specific powers may produce descendants which have the properties of ordinary pus-corpuscles only.

When perspiration is suppressed the bladder sometimes becomes irritable. I have observed, in the case of patients who suffered from winter cough, that an attack often occurred when perspiration had been suppressed for some time, and it is well known that free perspiration is almost always followed by relief. Obstinate constipation is often associated with catarrh of the bladder, and the latter is relieved when the former is overcome.

In many forms of gouty affection the bladder is more or less impli-

cated. In a man of 65 there was gouty pain in the calf of one leg, associated with much oxalate of lime, pus, and urates in the urine, and a very irritable state of the bladder. There is no doubt whatever that the gouty state predisposes to catarrhal affection of the bladder, but it must be borne in mind that the local trouble in such cases is not the only thing to be dealt with. The bladder will not get well until the gouty condition is relieved. It is in some of these cases that frequent doses of alkali and diluents act so beneficially and with such rapidity. Even though the water be highly alkaline from the presence of large quantities of carbonate of ammonia, alkalies must be given, and in the course of a few days or a week the practitioner will be surprised to find that the reaction of the urine has changed. Sometimes the alkaline treatment actually restores the acid reaction.

Suggestions as regards Diet and Medical Treatment.—In cases of obstinate catarrh of the bladder, and the same remarks hold good with regard to catarrhal affections of the bronchial tubes, stomach, and other mucous tracts, the patient should avoid the use of cold fluids. Large draughts of cold water do harm, and though there is no doubt that dilution of the fluids of the body and free secretion are beneficial, the liquids should be taken in small quantities at a time, and tepid or actually warm. At the meals warm water instead of cold or iced water is to be recommended. Many persons fancy they cannot drink warm water without suffering from nausea, but most will consent to take with their meals warm lemonade made with fresh lemons and a little sugar. Some prefer weak tea, and to this there is no objection if it does not disagree with the stomach, for in spite of much authoritative condemnation of the most popular of all beverages, the vast majority of people find they can drink tea in moderation, not only without discomfort, but with pleasurable sensations and satisfying effects.

The mode of living exerts the greatest influence on the course of vesical catarrh, and indeed all forms of disease of the coats of the bladder. To avoid free distension and strain of the muscular walls must obviously enter into consideration, but of scarcely less importance than this is the character of the urine which is secreted. If the urine be decomposed from lying too long in the bladder, and ammoniacal, great pain and discomfort result, to say nothing of continually increasing damage to the mucous membrane itself. On the other hand, if the urine be highly acid, of considerable density, and loaded with urea, it will irritate the highly sensitive mucous membrane and increase the patient's suffering, while if the fluid be highly diluted and only feebly acid, it may remain in the bladder for a long time without causing any feelings of distress—nay, we may bring the urine into such a condition that it will actually exert a soothing effect upon the mucous membrane, and promote the healing of superficial ulcers should there be any upon

its surface. As the character of the urine mainly depends, at least in the case of those who are confined to the couch, upon the diet, the physician must be very careful to give exact directions concerning the character and quantity of the food to be taken. Little nitrogenous food is required, and no more than is absolutely necessary ought to be allowed. The amount of nitrogen in a purely vegetable diet would be quite enough, but in laying down rules for a patient's guidance, we are often obliged, if we are to get his confidence at all, to avoid going directly counter to his prejudices as regards food. We may allow him milk, beef-tea, and an egg. A little well-cooked fish or meat may be permitted, or he will perhaps accuse us of endeavouring to destroy him by starvation, and appeal to another adviser who will please him better, humour his appetite, and perhaps thereby help to prolong his illness. In advising the unfortunate sufferers from the morbid condition under consideration as to diet, I would remark generally that the nearer we can get the patient towards submitting to the dietary of the infant for a few weeks the better, and if we can only persuade him to restrict himself to milk, beef-tea, broth, milk puddings, sago, rice, tapioca, with cooked apples, French plums, or grapes, for even a week, there will be such alleviation of the symptoms that he will be encouraged in his self-denial to proceed on the same lines for a longer time.

To insist upon a purely milk diet is needless, and may be injudicious. No one who has himself tried milk for breakfast, milk for dinner, milk for supper, and milk between times, will be too hasty to inflict such a punishment upon others if it can be avoided without risk to the patient's well-being; and in the cases we are considering there is no good reason for enforcing arbitrary regulations which probably few doctors would submit to were they themselves patients. Moreover, you will find that most of your bladder patients have, as they will tell you, enjoyed life and good living, not a few having daily indulged in culinary perfection as regards the evening repast for many years.

The general mode of life when in health must also be taken into account when we are advising a patient what to take and how to live during a painful chronic illness. If for years one of the chief pleasures of life has been that of looking forward to the dinner, and the three hours consumed in the performance of its mysterious but unphysiological rites, it would be cruel to inflict, without apology and without allowing time for preparation, a mode of living which the patient could only think of with disgust, but to which, nevertheless, he may be gently brought by a little kindness and the avoiding of hard and fast rules and arbitrary and possibly somewhat unreasonable directions on the part of the doctor.

Many cases of chronic inflammation of the bladder with pus in the water have been subjected to all kinds of treatment, many of

them very judicious and likely to relieve, but not one plan has been persisted in for a sufficient time for any benefit to result. A patient is ordered, perhaps, uva ursi for a week, then, being no better, it is changed to buchu or pareira; next acids are tried with or without some tonic infusion; then alkalies, and so on; while in the mean time the patient has lost his appetite, and has gradually got weak, and perhaps suffered from night sweats. As the disease continues unabated he begins to lose hope, and experiences more pain and irritability of the bladder. The attention being necessarily directed to the ailing organ, the condition often seems to the patient far worse than it really is. If unchecked, the above-mentioned conditions react upon each other, and the patient's condition is possibly becoming serious. The quantity of pus formed in the bladder increases considerably, and the calls to micturate are perhaps incessant.

Now, in such a case, it often happens that, if the stomach be set right by dilute acids and pepsine—if stimulants, which, perhaps, have been withheld altogether, be given in moderation at meals—if the diet be simple but nutritious—if the patient be allowed to take moderate walking or carriage exercise in the open air, especially if he be sent to a pleasant part of the country, or to the sea-side, where he can at the same time be amused—if he be ordered the tincture of the perchloride of iron, beginning with ten drops, and gradually increasing the dose to half a drachm three times a day, in infusion of quassia, or with a grain or two of quinine,—a great improvement may take place in a very short time. As already stated, diluents are of great use. Upon the whole, I think linseed tea or barley water, flavoured with lemon juice—a quart in the twenty-four hours—the most useful, but Sir Henry Thompson prefers an infusion of the root of common couch grass (*triticum repens*). The proportion is an ounce of the dried rhizome to a pint of boiling water. Triticum repens has been incorrectly called the "common bindweed," but the plant usually known as "bindweed" is the large convolvulus with white flowers (*convolvulus sepium*).

After such a plan of treatment as above indicated has been adopted for a short time, the night sweats cease, the patient gains in strength and increases in weight, and is able to retain his water for two or three hours or longer, while the proportion of pus formed is considerably lessened. I have seen patients put upon this plan steadily improve for six months, and I have given the iron regularly for a twelvemonth, in some cases with real benefit. In fact it will often happen that a patient will resume the remedy himself, after having given it up—than which there can be no stronger evidence of its usefulness. It is true that many patients get tired of taking one remedy for so long a time, unless the improvement is decided and obvious. It too often happens that, by yielding too much to a patient's caprice in trying this thing and that, valuable time is lost.

The patient might have been relieved, by steady perseverance in one judicious system, in considerably less time than he has spent in trying first one reputed remedy and then another, without success.

It is clearly right, in such a disease as this, to tell a patient at once that he cannot recover in a week; and it is not right to allow him to suppose that, by any special remedy, the disease can be cured as by an antidote. If patients, who are utterly ignorant of the nature of the malady from which they are suffering, will obstinately persist in acting according to their own prejudices, and insist upon being misled, to their own detriment, it is out of our power to help them. All that can be said is, that, if they had a little knowledge of physiology and medicine, they would have more confidence in us than in an ignoramus who, ignorant of the anatomy and healthy action of the organs he is treating, to say nothing of the complex changes these undergo in disease, and with little or no experience in the management of bad cases, confidently promises off-hand a certain and rapid cure.

In all bad cases, more especially if the pus is converted into the ropy mucus-like mass *in the bladder*, it is of the first importance to use injections of warm water. This is a very simple operation, and affords, even in extreme cases which cannot be cured, the greatest relief. Sir H. Thompson recommends that not more than an ounce should be introduced at a time. This is allowed to escape, and then another ounce injected, and so on, till the water escapes clear. Some use injections of dilute nitric acid (one drop of the strong acid to two or three ounces of water). The chief benefit, I believe, arises from removing the decomposing matter which irritates the mucous membrane and excites decomposition in the fresh urine as fast as it reaches the bladder, so that plain water (warm distilled or rain water) answers in almost all cases perfectly well. It may be injected through a double catheter, or through an ordinary flexible catheter, and drawn off by the same instrument. The bladder should, of course, never be fully injected, as distension of its coats always does harm. In bad cases it is desirable to wash out the bladder in this way once every day, or oftener.

In all cases in which the formation of a considerable quantity of pus goes on in any part of the organism from day to day, it is of the first importance to pay attention to the state of the patient's general health, and experience has proved that the remedies which do most good are those included under the head of tonics. In many cases, too, stimulants may be required for a time. The quantity of pus varies, increasing if the blood becomes poor, while the formation of pus diminishes as the patient's health improves. A greater quantity of material becomes pus when the system is weak and low than when the nutrition of the body is properly carried on. This fact has been explained in different ways. It seems probable that, when the blood is poor, transudation of nutrient

matter occurs more freely than in the opposite condition of health; and it is, I think, mainly by diminishing the tendency of the fluids to transude, that iron, many tonics, and alcohol act favourably. Pus, like other forms of bioplasm or living matter, grows the faster the more freely nutrient matter is supplied to it, and it may take up the pabulum which is really required for the nutrition of the healthy tissues. Pus lives faster than any healthy tissue.

I have often been gratified at the great change for the better which has resulted from a prolonged course of iodide of iron in cases where the mucous membrane of the bladder was seriously disturbed in its action, perhaps from chronic ulceration and destruction of the outer layer of epithelium over a considerable area of its surface, perhaps from a state of congestion only, with changes in the epithelium approaching but not amounting to actual ulceration. Many of the most obstinate cases improve after some months, during which tonic treatment and careful management, as regards diet, have been steadily persisted in. Rest alone has no doubt much to do with the favourable result, but it stands to reason that in a prolonged state of exhausting disease depending upon an abundant discharge from a mucous surface accompanied with emaciation and much lowering of the general health, the patient's chances of recovery will be much more increased if the nutritive processes are assisted by good management of the digestive organs and the careful selection of foods and tonic remedies than if the case be left to the curative effects of time alone, when, for want of good management, the strength may fail and the powers become exhausted to a degree which renders recuperation improbable. Seeing the terrible forms of chronic disease from which patients do recover, one cannot resist the conclusion that the favourable or unfavourable result in some cases may depend upon whether the patient is placed under favourable or unfavourable conditions for a certain period of time, and it is, therefore, above all things necessary, before we attempt to give advice to be acted upon perhaps during many months that we should endeavour, as it were, to grasp and to consider the whole state of affairs and circumstances bearing indirectly or directly upon the patient's condition as well as the tendency and probable course of the morbid actions, and not attempt to grapple only with the pus in his water or the disease upon which this depends.

Irritable Bladder and frequent Micturition.—Catarrh of the bladder and all forms of inflammation of the mucous membrane, as well as various other morbid affections, are associated with frequent desire to evacuate the organ. The mucous membrane is, as we say, irritable, and a very moderate accumulation of fluid in the organ will produce the same effect upon the nerves as the distention effected by many times the quantity of urine in the healthy state of the bladder. But this irritability

or undue excitability is met with in many conditions where no pus is produced and when no inflammation exists, and it may be well to refer in this place to a few of the most common circumstances which seem to be connected with this most troublesome symptom. Irritability is often caused by severe congestion of the vessels of the mucous membrane, and passes off without any actual inflammation or the formation of pus. Any swelling or inflammation of parts or organs near the bladder may cause irritability and excitation of nerves at a distance, irritation of the lumbar region of the cord, or of afferent nerves which pass through the centres of origin of the nerves distributed to the muscular coat of the bladder. Enlarged prostate often causes irritable bladder. In a man of fifty-seven, besides enlarged prostate there was frequent pains at the tip of the penis of the character of that which often accompanies renal calculus, but evidently caused by the state of the prostate. This patient lost flesh rather rapidly for a time, but he subsequently improved. In another case the patient had experienced pain at the tip of the penis immediately after passing water, for a period of fifteen years. The urine contained much mucus and was highly ammoniacal. The patient had to pass water nine or ten times at night. He was much relieved by a long course of tincture of perchloride of iron. In neither of these cases was there or had there been any evidence of stone or grit in the kidneys or bladder.

Irritability of bladder of a very troublesome kind is often due to mere concentration of the urine irrespective of any undue acidity. Indeed, when the specific gravity is 1030 or upwards some degree of irritation is often experienced, and it will be found that the bladder is excited to contract as soon as a few ounces of this highly concentrated urine have accumulated. The condition in question is often met with in hot weather, and in tropical climates, especially when people live too well, it is frequently a source of the greatest annoyance and discomfort. It occurs at all ages, and in children it is not an uncommon cause of the practice of "wetting the bed." Nurses and injudicious mothers not uncommonly increase the severity of the trouble they think to cure by reducing the allowance of liquid to the poor child, and thus add thirst to the scolding and other hardships needlessly inflicted upon the unhappy victim of bad management.

The general plan of relieving irritability of the bladder caused by highly concentrated urine is at once suggested by a consideration of the facts. Dilution of the secretion is required, but in addition we must take care the patient is not supplied with too much nitrogenous food. Milk pudding and a moderate allowance of well cooked fruit, lemonade, oranges, grapes, often help the cure of chronic cases; but in some instances, when the state of the secretion in question has been kept up for a considerable time by injudicious management, it may be necessary

in addition to give an occasional dose of gray powder or blue pill with citrate of potash, bicarbonate of potash, or soda or lime-water, for a week or two. Whenever alkalies are recommended care should be taken that the patient or his friends are instructed as to the importance of not continuing alkaline remedies without interruption for too long a time for fear of producing another form of "irritable bladder," which is more severe and more difficult to cure than the one for which the remedies have been prescribed. In cases of irritable bladder from concentrated urine, and in cases in which the irritability is increased by this circumstance, linseed-tea or barley-water, flavoured with lemon juice, will be found of great service, and will be extremely grateful to the patient, ice being added to the infusion if the weather is very hot. Considerable draughts of iced liquids must not, however, under any circumstances, be allowed. The mere dilution of the urine frequently brings relief, but the exhibition of considerable quantities of diluents for a couple of days now and then should be persisted in for some weeks after the attack has passed off. There is no hope of relieving chronic cases of this trouble as long as the ordinary diet and mode of life, with little exercise and too high living, are persisted in. The formation and elimination of the urinary constituents, like other physiological actions, may be increased or decreased to a certain extent, which may become habitual without occasioning organic disease, although not within the range of what we call healthy limits. People who suffer from faulty physiological action, both as regards excess and deficiency, can hardly be considered to be in health, although they do not suffer from actual disease, and many live to be very old, dying of old age after having passed a complaining, and, to themselves, a not very happy if not actually miserable existence.

In some forms of irritable bladder, and in inflammation, the nerve ramifications are themselves affected by the congested state of the vessels, and their nuclei or bioplasts concerned in nutrition and growth as well as action, increase in size. There is increased activity of the nutrient processes through the whole thickness of the mucous membrane. That this is so is manifest from the growth of pus-corpuscles from the youngest epithelial cells and in the follicles of the mucous membrane, as well as the rapid growth and multiplication of the pus-corpuscles themselves. In this increased nutrition all the tissues of the bladder participate. Young children often suffer from over sensitiveness of the mucous membrane of the bladder, which causes the greatest trouble to the mother or nurse, and is sometimes associated with an irritable condition of the mucous membrane of the lower part of the small and large bowel, resulting in the discharge of three or four or more watery motions during the day, and sometimes the discharge cannot be restrained. The trouble often begins during an attack of hooping

cough. Improvement in the general health is usually accompanied by the disappearance of the troublesome symptom. Tonics, cod-liver oil, small doses of belladonna, often afford relief. The child must not be punished, for in this way fear is caused, and the patient gets worse instead of better.

Irritable bladder may be a purely nervous affection, in which case it ought to be classed with nervous affections occurring in other parts of the body. Gout and rheumatism affect the nerves and muscles of the bladder occasionally.

Frequent discharge of urine in young children may depend upon almost any peripheral irritation, such as dentition, intestinal worms, enlarged glands, &c., but very often it is connected with a naturally excitable state of the nervous system. When arising from teething, or from worms, the treatment is obvious. Commonly enough, it occurs only during the night, and sometimes the child acquires a *habit* of thus voiding the urine, unless care is taken by the nurse to take him up regularly after certain intervals of time (three or four hours), so as to prevent much urine accumulating in the bladder. In many cases the urine is a little too acid, when a few doses of bicarbonate of potash, lime water, or liquor potassæ, and attention to diet, will relieve the affection.

This troublesome symptom occurs in young persons of both sexes, and is occasionally very obstinate. Not unfrequently it seems to be due to the habit of sleeping on the back, when a blister applied to the buttocks will generally cure the malady by compelling change of position. I have seen it in youths of scrofulous habit whose strength had suffered from growing too fast. Such cases are almost certainly cured by a generous diet, the tincture of perchloride of iron, quinine, and cod liver oil, but it is often necessary to keep the patient under this plan of treatment for two or three months.

Nervous old men often suffer a good deal of inconvenience from irritable bladder, not dependent upon organic disease. If they take a little more wine than they ought, or a richer diet than usual, or become a little more irritable in temper, they will be called up several times in the night. The state of urine causing this annoyance is generally dependent upon the stomach being a little out of order, and a few doses of liquor potassæ or bicarbonate of potash, after meals, a mild sedative and a gentle purge, will generally remove the annoyance. Sometimes a small dose of blue pill or calomel cures the troublesome affection at once. If obstinate, it is well to try the effect of an opium or henbane suppository.

In old age, although there may be no morbid change in its structure, the bladder often becomes very irritable, and a patient is unable to retain his water for more than half-an-hour or an hour at a time. Patients who suffer thus, by concentrating their attention too much

upon their ailment, often make matters worse. Any disturbance of the digestive organs will sometimes produce increased distress. In many of these cases it is very important to prevent the patient from thinking continually about the bladder, and it is probable that the advantageous effects sometimes following the application of a blister are due to the attention being diverted to another part.

In some cases irritability of the bladder seems to be due to the organ being congenitally small, and not growing in proportion as the body grows, or in proportion to the increased quantity of water secreted. As the demand for larger capacity arises, the bladder very soon gets distended and it empties itself very frequently, to the patient's great inconvenience and distress. This is fortunately not a very common case, but it is a very difficult one to treat successfully. The physician must do all he can to reduce the secretion of urine to the most moderate amount consistent with health, and in some cases he will be able to effect a cure in this simple way, and if he explains to the patient the extreme importance of taking as little nitrogenous food and fluid as he can do with, he will sometimes, in addition to "curing" his troublesome affection, greatly improve his general health and strength. The wonder is not that we occasionally find a bladder too small for the organism to which it belongs, but that bladders in general do not rebel at the greatly increased and worse than needless amount of containing power that is expected from them by their owners.

I have known patients suffering from very frequent calls to make water, and from what they concluded to be irritability of the bladder, for some years; but as soon as the case was investigated the bladder was found to be full and distended to overflowing. In one case the patient had suffered for five years, when five pints were removed from the bladder by a catheter. After this the instrument was used three times a day for a week or two, and then less frequently. The patient, although upwards of seventy, completely recovered, and regained full control over his bladder, and lived to an advanced age. The urine was clear and perfectly healthy. It is curious how people become gradually accustomed to this state of distension, and consider the uneasiness they experience due to some change consequent upon old age, and it never occurs to them that the bladder may be full to overflowing. Sometimes, although they have a suspicion as to the nature of their malady, they forbear to obtain advice from the ridiculous dread they feel of instrumental relief. It is a pity people should make themselves uneasy about interference, which will afford them certain relief in a few minutes, while there is not the slightest risk and seldom more than very slight pain accompanying the careful introduction of a flexible catheter. Nay, it is an operation which, with a very little instruction, the patient can perform for himself.

When the bladder is very irritable, and especially in cases in which the desire to empty the organ at very short intervals is accompanied with uneasiness or actual pain in the bladder itself, or in the course of the urethra, from twenty drops to half a drachm of tincture of henbane, or ten drops of laudanum, may be added to each dose of tincture of perchloride of iron; or extract of henbane or opium may be used as a suppository the last thing at night. In cases in which the pus becomes decomposed in the bladder and the urine is ammoniacal, it may be necessary to have recourse to injecting the bladder and other modes of treatment.

Some time since I was consulted about a gentleman who was sixty years of age and had been suffering for a year from great irritability of the bladder, the water not being retained for more than twenty minutes at a time day or night. The urine was alkaline, and contained $\frac{1}{30}$th of its volume of pus and numerous crystals of triple phosphate. The patient had been losing weight for some time, and was very weak. Pareira brava, buchu, uva ursi, belladonna, tincture of perchloride of iron, nitric acid, opium, copaiba, leeches to the region of the bladder, blisters, and many other plans had been carried out but with no relief. I recommended that the patient should be put on a nourishing diet, with pepsine if necessary, and ordered him to take twenty drops of tincture of perchloride of iron in infusion of quassia twice a day. This plan was adhered to steadily for a month with marked benefit, and the patient was persuaded to go on with the treatment. In three months the patient had much improved, and could retain the urine for an hour at a time. His general health was much better, and he had increased 14 lbs. in weight. The urine contained no sediment of pus. The patient was persuaded to persist in the same plan, and at the end of a year from commencing this system he considered himself pretty well, could retain the urine for three or four hours, and had gained more than 20 lbs. in weight. Another case with similar symptoms, in which the state of the bladder clearly depended upon a chronic gouty state of system, greatly improved in six months upon tincture of perchloride of iron, henbane, and quassia, and I might bring forward many others, differing as regards the severity of the symptoms, which illustrate the same point.

OF CASTS OF THE URINIFEROUS TUBES.

No one has contributed so much valuable work towards the elucidation of the many very important questions bearing upon the clinical significance of casts than my colleague, Dr. George Johnson, whose memoirs in the "Medico-Chirurgical Transactions," and works on Kidney Diseases, have been before the profession for more than

thirty years. Casts are never found in healthy urine, though it is possible that some of the so-called "mucus" present may be composed of the same material as that which under certain circumstances takes part in the formation of a "tube-cast." Casts occasionally present in the urine are, however, sometimes found in some of the smaller glands, which open into the urethra, as well as in some of the ducts of the prostate, in the seminal tubules, and as well as in the convoluted and straight part of the uriniferous tubes of the kidney.

Some of the most important forms of casts are represented in Plates III, IV, and VIII of "100 Urinary Deposits."

The diagnosis of many forms of renal disease is much assisted by taking note of the character of the cast, and in the case of fatty kidney may sometimes be made from an examination of the casts only; for there is no other condition in which numerous casts containing collections of oil globules are passed during a period extending over several weeks, except that form of renal disease which is due to the fatty degeneration, and which occurs in children and young people belonging to a scrofulous or tubercular family. Blood and pus-corpuscles, epithelium in various states, urates, phosphates, crystals of uric acid, and dumb-bell crystals or minute calculi of oxalate of lime, are often seen in casts, and afford to the observer indications of the changes that are proceeding in the uriniferous tube at the time of the formation of the mould or cast. Casts sometimes enable us to decide whether blood diffused through the urine or forming a deposit comes from the kidney or from some other part of the urinary apparatus. If casts be present which contain blood in their substance it is certain that blood has escaped from the vessels of the Malpighian body or from those surrounding the uriniferous tube,—which last is probably quite an exceptional, though a possible, mode of renal hæmorrhage. In cases of stone in the kidney casts are often found, probably from the influence of the pressure of the calculus in the immediate neighbourhood upon the epithelium and other structures,—increased action of the epithelial lining and the formation in quantity of that modified epithelial material of which the cast is formed, being caused. In these cases the cast often contains blood, but more frequently disintegrated blood only is found. The blood-corpuscles have evidently lain for some time in the tube, and have undergone disintegration before the cast was produced. Sometimes the presence of even a very small stone has occasioned hæmorrhage amongst the tubes in a certain part of their course. The little blood-clot that has thereby resulted has slowly undergone change, and a portion of the *débris* finds its way into some of the adjacent tubes which have been damaged but not completely destroyed. In women, by the presence of casts we are often enabled to distinguish a case of renal calculus from mere menstrual disturbance.

Very transparent casts may be present, and in considerable numbers, in urine which does not contain a trace of albumen. These casts are formed in the convoluted portion of the uriniferous tubes, and their formation seems to be due to changes which, if they proceeded farther, would lead to the escape of albumen. Casts of the kind described I have seen in many cases in which a small calculus was impacted in the kidney, and it is probable that when minute concretions occupy a part of a uriniferous tube, the secretion of a form of mucus-like matter takes place, and this is moulded in the tube and afterwards escapes with the urine. In cases of renal calculus, however, besides the casts described, a few blood-corpuscles and a little albumen are also present in the urine. Some of these cases present many of the symptoms of chronic structural renal disease, and are mistaken for them. The patient is kept for months upon milk diet, and a very unfavourable prognosis is given while in truth there is no danger to life, and in most instances complete recovery takes place, sometimes the calculus being passed, sometimes becoming impacted in the renal tissue, and ceasing to produce any irritation whatever.

I think it probable that if careful search were frequently instituted, a number of cases would be met with in which casts are present without a trace of albumen, for although casts and albumen are generally associated, it is as certain that casts may be formed without the escape of serum from the blood, as that the latter may escape without the formation of casts. Casts are not composed of modified albumen, nor are they generally composed of fibrinous material, but rather of a substance nearly related to mucin, which, I think, may be correctly regarded as being formed by the bioplasm of the tubes, which, under ordinary circumstances, forms the outer part of the epithelial cells, but which, if produced under certain conditions, constitutes the very transparent material which forms the chief bulk of the cast. In some cases it seems as if the changes which result in what is known as exfoliation of the superficial layers of epithelium of some mucous membranes occurred in the uriniferous tubes, or if the morbid processes are not identical, they are probably closely allied. The exfoliation which takes place in the vagina and uterus affects many layers of epithelium, while that which occurs in the secreting follicles of glands and in such organs as the uriniferous tubes affect only what must be considered to be a single layer ; but I think that in the latter case the transparent substance which, in the normal state of things, would form the bulk of the epithelial cells, accumulates in the tubes, and when it is slightly hardened and condensed is urged downwards by the flow of urine behind it and forms the "cast."

The subject of casts being intimately connected with that of albumen in the urine, it will be more convenient to consider the different

kind of casts found in the urine when the different forms of renal disease, accompanied with albuminuria, are treated of. In the same section of this work will be found some remarks concerning the treatment of the disease characterised by the pathological changes in question, while under the head of renal calculi the management of cases in which transparent casts are formed, which are not due to the same series of changes in the secreting structure which occur in chronic albuminuria, will be discussed.

SPERMATOZOA. DERANGEMENT OF THE SEXUAL FUNCTION. PUBLIC MORALS.

Spermatozoa.—The presence of semen in the urine is a fact of little consequence. In healthy men it is not uncommon for a small quantity to be discharged now and then into the urethra, and become mixed with the water. Nor are any special symptoms associated with the circumstance. The expulsion of seminal fluid, after it has accumulated in the vesiculæ seminales and passages from the testicles, does not indicate the existence of disease. It is even a natural process. But when the discharge of the secretion is very frequent, that is, when spermatozoa are almost always to be found in the urine, their presence is of clinical importance, and, at least, may be taken as indicating unusual or undue excitement of the organs in which they are formed, or of the passages concerned in the discharge of the seminal fluid. This increased activity may be due to changes taking place in connection with the external parts, or with the surface of the mucous membrane of the genito-urinary apparatus, or it may be due to deeper and more serious changes in some part of the very extensive portion of the central nervous system which presides over the function of the organs.

Any unusual excitement of the secreting organs and the frequent discharge of semen, may be a matter for investigation and may be of the greatest consequence. The resulting disturbance may be serious and far-reaching, and may exert a most important influence upon the psychological as well as upon the physiological condition of the patient during a great part of his life. Partly from exaggerated fears on the part of the patient, partly from extravagant description of the possible consequences, as stated in various books and suggested by some practitioners, every derangement of the sexual organs of the male has been made to assume an importance in the eyes of unprofessional men, as artificial and fanciful as it is in every way unfortunate. Not only are men made wretched by fears and suggestions as to what may happen, but a class of predatory advisers has established itself and has been patronised and fostered by silly and terrified persons. Such practitioners seem to prosper according to the degree of terror they are able to excite in the minds of their unfortunate victims.

The full consideration of this complicated question is beyond the province of this book, but as it seems to me to be almost the duty of every one who has seen much of the evils referred to, and of their direct and indirect direful consequences, to give expression to the views he has been led to form, I propose to offer a few remarks upon the general bearing of this question.

In some specimens of acid urine, in which bacteria are not developed, spermatozoa may be preserved for days without any decomposition. They usually form a light flocculent cloud, suspended in the urine, but when few in number there is nothing in the appearance of the urine that would lead us to suspect the presence of spermatozoa. They may be distinguished with a power of about two hundred diameters ("100 Urinary Deposits," pls. I and II, figs. 18, 20, 21, 22, 26), but unless the eye is familiar with them, it is better to employ one of from four to five hundred. In some cases I have met with spermatozoa covered with urate of soda, which renders them very easy of detection, pl. II, fig. 22. Curious crystals of phosphate of lime are sometimes found in seminal fluid, pl. II, fig. 20.

Sometimes a large quantity of viscid secretion, partly from the vesiculæ seminales and partly from the testicles, is discharged and becomes mixed with the water. A patient of Dr. Wilson Fox's brought him one day a test tube nearly full of viscid, transparent, almost clear and colourless fluid, which under the microscope was found to contain very many spermatozoa, and no doubt consisted of a little semen mixed with a considerable quantity of viscid matter secreted by the vesiculæ seminales.

By the use of very high powers, I have demonstrated some points of great interest concerning the structure of spermatozoa. The oval body or head of the particle is hollow, and contains a small quantity of bioplasm, which extends a short distance into the filament. This, like other forms of bioplasm matter, is easily tinged by an ammoniacal solution of carmine. The quantity of this transparent living matter varies in different instances, but usually it does not extend higher than the middle portion of the body. It is always less in spermatozoa which have been passed a long while than in those which have only recently escaped. The shape of the body of the spermatozoon varies according to the quantity of bioplasm present. Those bodies containing little being flattened towards the apex as compared with those which contain much. The amount undergoes gradual reduction after the spermatozoa have left the organism, and it is probable that its reduction is connected with the performance of their active movements.

This bioplasm constitutes the important part of the spermatozoon, and in it alone probably reside the marvellous powers of the fertilising element. The mass of the body consists of a hardened albuminous matter, not differing much in properties and composition from the

outer part of epithelial cells generally. The vibrations of the tail, like the movements of the cilia of ciliated epithelium, are no doubt due to changes taking place in the living matter which occupies the body of the cell. When the spermatozoon has made its way into the interior of the ovum, all this outer material becomes softened and dissolved, and the bioplasm of the spermatozoon or sperm cell thus comes into actual contact with the living matter of the ovum or germ cell, and probably the living matter of the two cells becomes incorporated. From this very intimate admixture of two kinds of living matter or bioplasm, each of which has at last resulted from the slow origin centre within centre of masses of living matter, the germ of the new being possessing newly acquired powers, proceeds.

We are sometimes called upon to examine stains upon linen, or the vaginal mucus, in cases of suspected rape. Such an investigation must be undertaken with the greatest care, and a positive opinion must not be expressed if the observer have the slightest doubt as to the nature of the bodies in question; neither should a positive conclusion be drawn from the presence of only *one* structure like a spermatozoon, nor from *supposed fragments* of their bodies. Fragments of cotton or linen sometimes assume forms very like those of spermatozoa. The mucus which has been dried on the linen, even after it has been kept for some time, in which they are suspected to be present, may be remoistened with distilled water, without the spermatozoa being destroyed. This is an investigation which should be conducted with the greatest care.

A little girl was brought into King's College Hospital in July, 1857, upon whom it was said a rape had been committed about three hours before. Mr. C. Heath, who was House Surgeon at the time, removed with a pipette a little of the mucus from the vagina at a point beyond the hymen, and after placing it upon a glass slide sent it to me for examination. It was not examined until six hours afterwards, and being uncovered it became quite dry. Nothing definite could be made out by submitting the dry mass to examination. It was therefore moistened with a drop of distilled water, covered with a piece of thin glass, and examined with a quarter-inch object-glass. Numerous cells of vaginal epithelium were seen, and amongst them as many as six spermatozoa were discovered in various parts of the field. All these were well defined and free from the epithelium.

Dr. Munroe, of Hull ("Archives of Medicine," vol. I, p. 139), reports a case in which by microscopical examination of spots on the linen three days after an alleged rape, he detected the presence of spermatozoa. Dr. Munroe thus describes the method of examination. "On cutting out some of the greyish and coloured stains, macerating them in distilled water for some time, and afterwards concentrating very

much the solution and placing the same under one of Ross's best quarter-inch object-glasses, with an angle of aperture of 130°, and a magnifying power of 215 diameters with the lowest eye-piece, numerous whole spermatozoa were seen and also many others much mutilated,—here only a head, there only a tail,—indisputably proving the stain to be seminal."

The only structure occurring in urine, or of renal origin, at all liable to be mistaken for spermatozoa, as far as I am aware, is a form of vegetable growth which I have only once met with, in a specimen of urine sent to me by my friend Mr. Masters. Mr. C. Roberts, of St. George's Hospital, has taken very careful notes of the case. Some of the bodies in question very closely resembled spermatozoa, but their true nature was ascertained by comparison with many other specimens of the vegetable growth, "100 Urinary Deposits," pl. II, fig. 31. *See* "Archives," vol. I, p. 251.

Mucous Casts from the Seminal Tubules are sometimes found in the urine, and must not be mistaken for casts of the uriniferous tubes. Some of these casts are represented in "100 Urinary Deposits," pls. I and II, figs. 18 and 20. The casts of the seminal tubes are usually much longer than those of the kidney tubes, but they may be easily mistaken for them, especially if broken into fragments. They are usually less than the 1-1000th of an inch in diameter and vary little. Not unfrequently spermatozoa are packed together in great numbers, so as to form, with the mucus in which they are embedded, casts of considerable dimensions. A very good specimen is represented in "100 Urinary Deposits," pl. I, fig. 18, from the urine of an old man of 80.

Discharge of Seminal Secretion.—Very much contradictory matter has been written on the subject of seminal emissions, but there are obvious objections, while there is no corresponding advantage to be gained from discussing the subject in detail. To state the exact facts would render it necessary to go minutely into matters which have no scientific or clinical bearing, and to the exposition of which both reason and good taste are in my judgment opposed. The discharge when frequent is undoubtedly often followed by exhaustion and depression of the nervous system, but the exaggerated statements that have been made upon this head have done, and will continue to do, as much harm to the morals as to the pockets of patients.

As is well known, seminal emissions are not unfrequently due to irritation of some part of the urinary apparatus or of parts or organs in its neighbourhood. Peripheral irritation may excite contraction of the organic muscle of the prostate and its ducts, the vesiculæ seminales, the urethra, and other parts, and thus a sudden discharge of the secretion be induced. The irritating cause may be an ulcerated or excoriated patch of mucous membrane in the bladder, urethra, or even the pelvis

of the kidney—a renal calculus, or crystalline grains of uric acid or oxalate of lime in the kidney—prostatic calculi—worms or hardened fæces or other irritating matter in the large bowel, or even inflammation, accompanied by or independent of the formation of abscess. A superabundant prepuce—accumulation of secretion between the prepuce and glans—is occasionally the cause of much irritation, which sometimes results in the contraction of the vesiculæ seminales and all the parts concerned in the ejaculation of the secretion. Anything that irritates the prostate, urethra, or bladder may occasion nocturnal emissions. It is possible that by frequent attacks of this kind improper habits may be suggested and afterwards encouraged, and unless the patient is taught the great importance of exercising proper control over himself, he may soon become a sufferer from a state of mind and body which will necessitate medical help, and he is fortunate who is led to apply early for advice, and at the hands, if not of the family doctor or some medical friend whom he knows intimately, at least of some practitioner of known character and eminence, rather than to a reputed curer of what has been called spermatorrhœa—the favourite specialité of a not very charitable or self-denying class of advisers.

Periods of undue excitation of the nerve centres concerned in the expulsion of the semen are followed by exhaustion, and if very frequently repeated irreparable structural damage to nerve tissue may result, and within a short time. The artificial stimulation of the nerves of parts concerned in the ejaculation of the semen is especially harmful. Like other bad habits and vices to which men give way, it tends to increase until weakness or paralysis from over excitation of nerve centres may result. At last discharge may take place involuntarily without the ordinary stimulus, and apparently without any muscular contraction. It is this state of things which is sometimes brought under our notice, and in the treatment of which we may be of very great service to the unfortunate patient. Bad habits are sometimes contracted at a very early age, and if persisted in they produce an effect upon the nervous system which leads to impaired health, and the boy may suffer as regards both mental and bodily development. In the great majority of instances there is practically as little difficulty in discovering as in correcting the evil at a very early age. It is in early manhood that the help of the medical friend of the family or other sensible adviser and medical confidante is of importance, in order that the possibly injurious effects upon the future health may be properly explained to the patient, and suggestions offered which will enable him to get over the difficulty, and perhaps escape troubles of the most serious character. Upon this subject much that is at least injudicious has been written, not only by professional, but by non-professional and especially clerical advisers, who though they try their utmost, often fail to produce the effect they desire,

and sometimes misunderstand the case they suppose they have made themselves masters of.

Public Morality.—The question is so far apart from matters of ordinary knowledge and conversation, that many a young imagination is allowed to feed in solitude on the miserable horrors of its own creation, or on the abominable misrepresentations in some literary productions of the lowest and most degraded minds. Many of these, written avowedly for his assistance, are likely to add to his confusion and misery; and it is to be hoped that those induced to buy these bad books may have strength of mind to see the bearing of the suggestions, and courage to discard them. It is a pity that what is called public opinion has not been brought to bear upon some matters connected with this question long ago. No doubt in many individual cases the advice of wise and good men has prevailed in the long run, and from time to time the "society" of the future is saved from horrors and miseries which, if permitted to increase, might have threatened its very foundations. But, alas! how many cases which might have been prevented have resulted in needless misery, and wrecking of the fairest prospects and lives of great promise! In how many homes has not happiness been rendered impossible, hopes dashed, minds crushed, simplicity and purity for ever lost, because no one liked to interfere, when a very little interference might have entirely prevented a disastrous course! Cases are allowed to go from bad to worse, and the deterrent effect upon the many that may perhaps be produced by the ruin following the recklessness, the wickedness, the wilfulness of the few, is practically nearly all in the way of prevention that we have to rely upon. But there can be little effect in this direction without publicity, and publicity is neither likely to be given nor is it to be desired in most cases. The healthy physical and moral training, and the means taken to encourage self-restraint and the curbing of individual passion, are questions of national importance. It must be obvious to every thoughtful person that the theory of individual freedom and liberty of action does not involve or include any clearly defined line which shall indicate where liberty passes into license and dissipation; while underlying wilful misrepresentations, are the most monstrous perversions of physiological truths, and the falsely implied necessity of obedience to natural inclinations which would shock and insult a savage. The vilest thoughts which by the aid of great literary skill can be embodied in language, are allowed to be publicly diffused to corrupt and ruin the stupid and the weak, though they can only disgust the good, the sensible, and the strong, because it is doubtful whether public opinion would sanction their suppression, while, if it did, there would be the greatest difficulty on the part of those armed with power to decide precisely where the process of purgation and purification was to stop. At present public opinion seems to rely upon the law, while

the law awaits the mandate of public opinion. So it comes about that questionable or abominable acts which may irreparably damage or destroy individuals, and would, if allowed to prevail unchecked for but a few years, undermine and ruin the strongest society, and render certain the deterioration and downfall of the most vigorous race, are permitted in our midst. In these matters many seem to be capable of learning only from their own painful experience. It is the same story generation after generation. The young in too many instances decline to regulate their conduct according to the advice of their friends, their teachers, or those senior to them, who are more experienced than they can be. It seems impossible to prevent the occurrence of some cases of individual misery, though it is certain that the number is many times greater than it need be under conditions worse than those which actually exist. We have knowledge more than enough as well as the results of the experience gained by this and many preceding generations, to justify far stronger preventive measures than have yet been carried into practice. It is to be hoped that the time is not far distant when better counsels will prevail, and the public sense of what is right induce men to insist that a way shall be found by which the vile shall be prevented from wrecking so many of the innocent and foolish, or by which at least the process shall be made far more difficult and risky than it is at this time. It may be freely conceded that by excessive refinement, exaggerated sentiment, and an artificial mode of life, the most unhealthy views concerning the questions under consideration may be created and fostered, and by too much unoccupied time in which the imagination feeds upon love, or rather upon fancies which masquerade for love, the way for the professors and workers of malevolence is prepared. By encouraging the love of ease and luxury, and dislike of work, a morbid development of tendencies resulting in a lowering of the standard of morality, and an unhealthy way of regarding offences against morals, are almost of necessity engendered. Thus is the standard of morality by degrees lowered. The vigour and progress of a race may be estimated by its moral force, and its advance among nations will almost depend upon the moral standard which it has reached.

It is often said that the young cannot be expected to avoid the pitfalls made for them at every step, unless they are made aware of their existence; that in fact, as regards the relations of the sexes, a good deal more should be taught to the young than has been considered by the best men and women to be necessary or desirable. Not only is the plea, as it seems to me, absurd on the face of it, but the force it is supposed to have is destroyed by the fact that those who, so far from having been instructed, have been kept in ignorance, their minds being entirely occupied with other matters, for the most part escape, whilst the precocious, who learn and peer into all the details of questions which

ought to be considered only by adults, are those who fall. The truth is that restraint is not in the least degree burdensome to the healthy in mind and body. It is that juvenile precocity and artificial precession of maturity which, if allowed and encouraged, invariably brings such disastrous results to individuals and to the race. A walk through some of our manufacturing districts will show any one the truth concerning the evil of encouraging that anticipation of maturity between children which is the bane of some forms of civilization. See how the diffident and boyish young athletes contrast with the mature but ill-grown and ill-developed children who in some of our manufacturing districts ape the manners of men and women years before the age at which the ordinary run of people arrive at adolescence.

Sexual enormities are seldom perpetrated by the members of any class of thoughtful hardworking people who have to earn their living, and whose "living" is by necessity kept within the bounds of moderation, or by those who are so deeply interested in the works of nature or of man, or both, as to have their minds so thoroughly occupied that they have no time even for harmless amusements. It is when the necessity of breadwinning does not exist, when ease and time for all those delicate refinements of behaviour and strict attention to the smoothness of the cuticle of the digits, the gloss and set of the hair and the like, which though possibly adding to the frivolity of life for a decade or so, result in loss, and take away more from the enjoyment of later decades than they contributed in youth.

Generally, it may be laid down as certain that where healthy exercise, games, amusements which excite interest and encourage skill, carpentering, mechanical work of various kinds, natural history, entomology, botany, conchology, and the like absorb the interest, the mind is put in a better condition for the exercise of self-restraint, while it is led away from the contemplation of the many artificial creations of pampered silliness, and those dangerous introspections and analyses which excite and encourage the most false and dangerous desires and longings, which soon destroy the judgment, waste the most precious time of life, and lead to the sacrifice of what may be a glorious future for the gratification of a silly and impulsive caprice.

It is curious how differently different forms of sensual indulgence are regarded by the "public." An opulent person who gets frequently drunk, or is habitually fuddled and stupid, is soon shunned and turned out of society, but opulence squandered in the perpetration and encouragement of worse vices scarcely excites the notice, much less the condemnation of society, though the injury is a thousand times greater. In the first case, the ruin and degradation is limited to the individual, or to the family, while in the last, misery, horror, disgrace, ruin, disease, may be spread far and wide. How far, or for how long, or

how many successive generations may be injured by the reckless selfishness and unbridled license of a single individual, happily can never be known, but the glimpse now and then obtained of the far-reaching, deep-seated, irremediable misery hidden in a glamour of sham luxury and enjoyment is sad enough. It is the interest of society, as it is the safeguard of national progress, that all excesses in the direction under discussion should be checked with a firm hand. The true check should be public opinion, which ought to discountenance all habits and customs likely to foster and encourage boys and girls in looking upon themselves as men and women, while of course everything should be done to prevent early marriages when the means are small, and the prospects of the man being able to earn enough to keep a home not good.

Of all the vices invented for the indulgence of the weak and wilful, those which are in a way the outcome of unbridled luxury, or, as some would say, of the highest refinement and cultured civilization, and which destroy not only individuals but families, are the worst. Successive generations of hereditary badness are requisite for their full development. The surroundings necessary to their successful nurture could only be found where long courses of wickedness had damaged and destroyed the moral vigour of a considerable proportion of the family, and familiarized them with much that was bad. Of the enervating effects of vice the evidence is only too patent. Of its effects upon the physical development, and of the transmission of baneful morbid affections, gradually intensified as they descend generation after generation, there are unfortunately illustrations among the highest families, as well as in the lowest among the working classes. The only physiological consolation to one who tries to look hopefully as to the future prospects of family and race is, however, this very fact: because as moral necessarily brings in its wake physical deterioration of the family, after a longer or shorter period characterised by individuals with varying defects, bodily and mental, incapacity for work, consuming without producing, leading lives characterised by unhappiness and bad health, multiplication will cease. It would be right if individuals with terrible defects as regards constitution were not permitted to marry, and contribute to the perpetuation and increase of misery, incapacity, and crime, of which there is always more than enough. That degeneration of a race results from procreation being carried on in successive generations at a too early age is certain. Not only so, but the deterioration advances at continually increasing rates as the mental and bodily vigour of individuals declines. The danger of widespread degeneration from this cause is perhaps greater at this time than at any preceding period of our history; for in old and ancient times a number of circumstances contributed to destroy weak offspring during infancy and the early period of childhood; but now advancing medical

and sanitary science, as well as the ever-increasing efforts of philanthropists, I may almost say ensure the arrival at puberty of a very large number of weak and sickly children, with ingrained inherited badness of tissue. Moreover, all the circumstances, favourable to the preservation of the sickly and feeble, will persist and must operate in an ever-increasing ratio, so that we must look forward to the preservation of numbers whose physique will not contribute to the advantage of the state. It becomes therefore more than ever necessary to discourage in every possible way the early union of the half developed but precocious children in many of our large centres of population. No one who feels interested in the state of the country a hundred years hence can contemplate the then probable condition of the people without grave forebodings. I know that the mandate has gone forth "Take care of yourselves, and let posterity take care of itself." Such sentiments, however, I wholly repudiate. The low but unanswerable argument that since we are obviously indebted to our ancestors for many of the advantages we enjoy, we are therefore bound in common fairness to do all we can for the well-being and success of those that are to follow, is surely enough. Do we not see throughout nature, even among the lower forms of life, arrangements of the most perfect kind always working for the benefit of creatures yet to come? Is man then to be the only animal that lives for the moment and for himself? Enjoying as he does the most mighty inheritance and advantages from the past, is he alone to contribute nothing to, and have no concern for, the future?

It is to be hoped that public opinion, formed upon the views and experience of the best and wisest of our time, and which has already done such incalculable good for the rising generation of the upper and middle classes, will insist upon the immediate adoption of the same principles as regards training mind and body in respect of the working populations, especially those of our large manufacturing cities which have contributed so much to the making of middle class England what it is at this time. The principle which has been inculcated in every public school, and which has guided and regulated the conduct of every boy who has grown into a good man, is self-restraint, and had the progenitors of our working population learnt the meaning of that magic word, understood and acted upon it, how different would have been the moral standard of the people at this time. But held up for general admiration at this very time, is a principle which is far enough removed from self-restraint. Under the guise of reasonable liberty, license and cruel wrong have been inculcated.

Moreover, another principle of action has crept into notice—a principle very far removed from self-restraint, and which if it passes from the abstract into practice, is calculated to do infinite harm in

retarding moral progress. It is wonderful that a philosophy which essays to explain the great problems of the natural world should accept as a cardinal doctrine of belief the proposition that the chief if not the only end for which everything living exists is the production of successors, that the reason why things live is that the race may continue from generation to generation. According to such a philosophy not only must the individual wither, but he ought not to be allowed to exist longer than just sufficient to produce descendants, and everything should be made subordinate to this one end. The old selfish notion that a living thing lives for its own advantage and for the advantage of others, and that it was formed to fulfil some definite purpose in the world, is abandoned in favour of the new command—the sum and substance of Nature's law—Increase and multiply, and destroy one another. Meditation upon the lines of this new philosophy on the part of the young, and an inquiry into what it means, what it includes, and what it excludes, and whither it tends, is not calculated to raise in the mind a moral ideal very lofty, or very hopeful in character. If acted upon, great changes would soon follow, and civilized life would be wonderfully modified.

Every now and then society receives what it professes to consider a rude and tremendous shock in consequence of the perpetration of some monstrous moral irregularities. A philosophical speculation, the germ of origin of which had long been hidden in the mysterious recesses of some grotesque imagination, receives the mandate to grow. Bursting into activity, it is soon found to be a practical evil of appalling magnitude which rapidly spreads and threatens to produce widespread horror. Then is some correcting machinery set in motion, and with effect, and evil which ought never have been allowed to culminate in serious harm, is at last checked, society having possessed during the whole time of its development, the means of effectual suppression. But society acts as if it considered that recklessness, wickedness, and sin ought not to be interfered with until numbers of persons have been inoculated with the disease, and have suffered its penalties. Society is not to be saved until its very existence is threatened. It is seized with horror at the sight of fallen numbers, while it could look on with composure if only a few individuals here and there were being engulfed. To prevent future trouble, it is only required that we should act as we pretend to act, insisting upon the truth of the principles upon which we pretend that our actions are based. It only requires the courage on the part of the good to decide that terrible moral evil shall not be allowed, that under no circumstances in England, shall wealth, or culture, intellect, birth, or position, be permitted to foster vice. Society has but to insist that well-known principles shall be acted upon; for is it not obvious that a civilised community cannot long continue unless the great majority of its members agree to exercise that self-restraint which every

human being from the first dawn of the consciousness that there were others like itself in the world, would practise?

Though all who truly love liberty will rightly condemn legislation which interferes in any way with the rational freedom of each individual, surely that is but a mockery of liberty which allows in the midst of a highly civilised community vicious conduct on the part of a very few, which must result in the beggary, enslaving, ruin, and early death of many. The knowledge of the existence of a state of things in itself disgraceful, and its practical condonation by the powers that be, cannot but degrade the whole body politic, and delay or prevent that improvement in public morals which alone can lead to true advance in virtue on the part of the community. And yet to ensure this advance towards a constantly improved and improving condition, it would seem to be necessary only that the well-disposed should be determined that the evil complained of shall no longer increase, and in one single generation the greatest change would be effected. A determination to interfere can be fully justified on grounds historical, psychological, as well as physiological. Tenderness as regards interference with grave moral evils produces only an abundant crop of iniquities, which at last has to be cut short. But instead of mildly checking the downward progress of a few in the beginning of a ruinous career, many have to be disgraced, degraded, and ruined in the end before the evil can be stayed. A decided step is the most merciful. To allow wickedness, which is certain to increase in intensity, to be fostered until very stern authority is compelled to interfere, is cruel not kind. Real kindness towards and consideration for all would render impossible the fall of the mass by simply insisting that the faults of a very few should be checked. It is the countenance given to evil amid a profuseness of profession of love of good which does the harm. Timidity on the part of people generally to interfere with the wilful, the fear of being harsh, the desire not to be too hard upon human weakness, undoubtedly actuate us. The influence of these feelings may be freely admitted, but everyone will allow that there is a point beyond which non-interference means disaster, wreck, ruin, crime, destruction. To decide when this point has been reached is the practical difficulty, and the source of difference of opinion in practice. It is not possible to lay down a reliable method by which this may be determined with accuracy. Only to many of us it seems perfectly clear that for some time past, active interference has been postponed until there can be no doubt that it inclines considerably to the side of leniency, and as a consequence the misery and ruin of many have been needlessly encompassed. By the moderate punishment of a few, might not the wretchedness of many have been entirely prevented?—nay, but for the want of courage on the part of parents or teachers in checking offences against morality at an early period of a vicious career by simply saying "you shall not,"

what an amount of sorrow and crime might have been saved. Let it however be remembered that at least in one department, the consequences of moral recklessness are well understood and appraised. Every year life insurance directors are becoming more and more convinced that the very worst lives they can accept are those in which the effects of reckless dissipation in early life form an item in the proposer's history. In spite of good family distinguished for longevity, good personal health and strength, the life of a fast young fellow is practically uninsurable, and where the individual has reformed, there is no certainty how long the reformation may last, while a number of morbid processes which may not appear till middle age has been reached or is past, may have been started by early indiscretion. Although there are some individuals whom no amount or kind of dissipation will destroy, if you take a number, say one hundred, the average duration of life would be so far below the ordinary average that no office could accept such risks at less than what would seem to be exorbitant rates. Nay, I believe, enquiry would show that the worst class of invalid lives assured would yield a better result than the perfectly healthy young votaries of dissipation, even though at the time they assured they were reformed characters. As time goes on, I believe we shall find that bad habits damage the prospects of living in a far greater degree than many forms of disease.

There is, upon the other hand, much that may be regarded as inspiriting and hopeful concerning the probable physical and moral health of the future. Those who have to direct education will, it is hoped, allow themselves to be greatly influenced by the truth that although strong and vigorous individuals may be morally bad, physical improvement will be found generally to precede, and afterwards to proceed *pari passu*, with advance in morals and mental power. It is of the first importance to improve the physical health and encourage the development of nervous and muscular activity among all classes, and especially during school days. Never was there a time when everything that favours the health of a community, bodily and mental, was more anxiously considered than at this period. Not only are efforts made to improve the health of the rising generation of working men, but care is taken to provide healthy amusement for those who will take advantage of it. Those who take part in these laudable endeavours may feel that they are not only improving the physical, but the moral health, and not only of this and the next generation, but of many generations to come, long after our own shall have been forgotten.

The Besetting Trial of our Boys.—A great deal has been written on what has been termed "the besetting trial of our boys," and Dr. Pusey some years ago drew public attention to this very delicate subject. It would, therefore, seem to be well that the matter should be brought

under the consideration of the profession, more particularly as great difference of opinion exists as to the best means of preventing boys from becoming victims to "the besetting trial," and of curing those who have already fallen under its baneful influence. I then considered it my duty to speak against the system of habitual confession to the priest which Dr. Pusey strongly recommended as a preventive of this sin, and as the best means of stopping the habit when it had been unfortunately acquired. I think it is much to be regretted that one with Dr. Pusey's authority should have expressed himself so strongly upon this subject, for I fear that his remarks may have had the effect of leading some silly persons to place more reliance upon many of the statements in disreputable books which may be forced under their observation than they would otherwise have done. His observations are calculated, seriously and most unnecessarily, to alarm parents. And I cannot help thinking that if he had been able to look upon the matter more from the medical point of view, he would not have arrived at the same conclusion. Judging from many of the cases which have been brought under my own observation, I should say that the system likely to foster and intensify this evil is the very one recommended by Dr. Pusey for its destruction. The temperament of many of the sufferers to which their unfortunate condition must at least in some measure be attributed, will benefit under the influence of circumstances very different from, if not the very opposite of, those advocated. Of course I speak only as a student of physiology and medicine, but in this capacity I think it right to remark that frequent self-examination, as deemed necessary by dismal despairing men who have been disappointed with the world, and who take a too gloomy view of everything,—habitual confession to melancholy persons trained to deplore the wickedness of man,—the frequent concentration of the attention upon one of the most mysterious and complex of all the phenomena of our being, are not under any circumstances supposable likely to benefit the majority of boys. All this is antagonistic to their very nature, and its effect on the developing mind must be, at least in many instances, to cramp and distort it. No physician who has carefully regarded the gradual development of the mental powers in young persons, and has at all studied the marvellous influence of the mind upon the bodily health and vigour, would advocate habitual confession as a desirable part of the training of the young. Those who aim at making our boys into upright, generous, hardworking, vigorous, thoughtful men, will laugh and rejoice, and work and play with their boys instead of encouraging asceticism. Your active minded, hearty, busy boy or youth never thinks of anything of the kind. His mind is interested, well filled, and he is happily ignorant of every thing connected with the subject. He will probably remain so till he grows up if his attention be well

occupied, his life happy, and filthy books be kept out of his way. He will instinctively shun the society of boys or young men who discourse upon the subject, if with a good object, I venture to think, certainly with a mistaken view.

There is no doubt that some of the mental and bodily derangements affecting the sexual function in the young are due to want of knowledge on the part of the parents and guardians of children and young people, and to an indisposition to consider these matters even with the family medical adviser. Actual malformations sometimes remain unnoticed for years after the time when they ought to have been detected by the nurse or the parent. It seems to me strange indeed that such cases should continue unobserved till attention is called to them by very patent derangements. The fact seems to show that for some reason or other, the medical adviser is not so generally regarded as the family friend and counsellor as in the interests of the public he ought to be. Whether it is that people have more confidence in nostrums than in the advice of sensible professional men, I cannot say, but the cases that from time to time come under notice, seem to suggest an extraordinary want of confidence and trust in well-trained sensible practitioners, most difficult to explain or account for, nay, not unfrequently one sees indications that in these days quackery and nonsense prevail, when knowledge, sense, and very high moral qualities are either not recognised, or are counted as nothing.

Many of the worst cases of the class I am considering are due to the encouragement of the contemplation of a condition of life very far removed from the ordinary state, and from dwelling too much upon the deplorable weakness and wickedness of man. For the thoughts to be entirely taken away from our surroundings is as bad for the mind as allowing it to be concentrated on and occupied exclusively by trivialities and sillinesses. In many cases there has been too much introspection, too much analysis of thoughts, that come unbidden, but which ought not to be dwelt upon, or feelings or supposed sensations of an unusual kind, which do not trouble people generally, but which are said to trouble the unfortunate individual.

There can be no doubt that he who is so foolish as to indulge himself by frequently thinking about and dwelling upon the many unpleasant sensations he experiences in different parts of his body, creates for himself wretchedness, from which, as time goes on, he will find it difficult or impossible to entirely escape. The habit of frequent introspection should be guarded against, as it sometimes leads to evil as great as that opposite state of mind in which anything like quiet and repose appears to be impossible. The over-active restless person is ever going from one thing to another, and is busy beyond measure. The individual who permits himself to fall into one or other of these unfor-

tunate mental extremes may gradually become a fidget, a bore, a hypochondriac, or a maniac. That many such, though often complaining of their aches and pains and their weak bodily health, or their depressed spirits, or the intensity of their sorrows and misfortunes, or their tendency to premature decay and early death, nevertheless live to be old, should be regarded as evidence sufficiently convincing to deter others from falling into the same unhappy course, but the race of self-made hypochondriacs, is, it is to be feared, ever on the increase, and constantly receiving accessions from all classes of people; but too often from among the intelligent and those who have highly distinguished themselves in intellectual competition, and who ought to have been aware of the mental discipline by subjecting themselves to which the misfortune might have been averted; for neither contemplation nor learning, nor art nor physical science, can alone be relied upon as a cure of this unfortunate condition or as a certain preventive of its development. Its origin in many cases is very obscure, but in some it seems to be a habit, acquired at a very early age and afterwards diligently fostered, of dwelling upon any slight disturbance or derangement of mental or bodily function, and of allowing thought to be too much concentrated upon its own morbid fancies. In consequence of constant dwelling upon every slight disturbance of mental or bodily function, the individual body or the mind soon seems to the perverted imagination of its possessor to assume such transcendent importance, that all other minds, bodies, and outside things are completely overshadowed or blotted out. Environment is obliterated, horizon is lost, and the unsatisfiable ego is all in all. Although in the majority of cases change of scene, variety in work, exchanging ideas with others of about the same age and in the same position, will prevent or cure the malady, it must be borne in mind that there is hardly a department of duty or work, hardly a calling from which instances of this weakness are not drawn. Even successful athletes contribute their quota to the hypochondriacal host. Too much concentration of the mind upon any single object of desire or interest seems to foster and increase the malady, and especially is there danger of its rapid development when intellectual or physical efforts have been attended with great success in open competition. I am sure that the majority of these cases are preventible by the individual himself, if only he can be made to see at a sufficiently early period the evil tendencies of his mind. Some of them are, however, hereditary, and whenever such condition or any tendency in such direction should exist in the parents, the training of the children should be conducted with exceptional care. Moderation in everything should be enjoined. Nothing should be overdone. Over exertion is as injurious as a sedentary life. Over-eating will be productive of as much mischief as insufficient food. Irregularity in the time of

eating and in daily work and habits must be avoided, and care must be taken to encourage free and regular action of the liver, if possible by diet, if not by the occasional administration of medicines which improve the action of that important organ. But although the greatest care may be taken to prevent the influence of any of the disturbing causes I have alluded to, and although by good management in early life the number of these distressing cases may be much reduced, we must, I fear, recognise the fact that from time to time some will be brought under our notice, and we must carefully consider the best method of dealing with them. There are minds that must ponder and meditate whether their owners will or no, and if such minds are to be kept in health and under due subjection to the will, something harmless must be found for them to feed upon and think about. It is certainly in each man's power, and to a great extent in the power of those who train and direct the young, to provide subjects which can be dwelt upon without disaster and without risk of loss of mental health and strength.

Hard work, interest, severe struggles, nay difficulties and hardship, may save the sufferer not a few serious troubles arising from nerve disturbances connected with the sexual function. In the case of a race like our own, it is probable that very active exercise during boyhood and early youth have much to do with the vigour and wisdom displayed by a considerable percentage in manhood and old age, as well as with the self-restraint which characterises the majority, and is acknowledged as a duty by all. Nobody would for a moment deny that the appetite for food and drink ought to be kept well under the control of the will, not only on account of the individual's own interests as regards himself, but for other obvious reasons. Civilization as it is could not be maintained if the majority of men just followed their inclinations and instincts, and allowed their appetites full swing. But there are instincts the rebellion of which against not only laws, but against good feeling, reason, taste, as well as the customs of every civilized race under heaven, which if not actually condoned have certainly not been met by the decided opposition which would have checked their redundant growth.

Looking only from the physiological point of view, leaving for the moment the teachings of experience and the recommendations of the wise, as well as individual inclination, out of the question, there is no doubt that everyone by the time puberty is reached and before as well as after this age, who desires to enjoy mental health, must have something to think about which will occupy his mind, and which is not necessarily connected with, and may be independent of, his daily occupation. The man whose whole time is taken up in work he is obliged to do is better off than the man who has no duty he is compelled to discharge, especially if the latter has not force of character, intelligence, or inclination to set himself to work—nay, it is doubtful whether the criminal

undergoing punishment for his offences is not in all respects better off, and experiences less suffering, than the unfortunate fellow brought up in the bosom of luxury and surrounded by artificial amusements and all kinds of incentives to kill time which hangs so heavily. To a healthy well-developed mind what is generally considered amusement is often boredom. Men who are too rich, with neither brains nor training for the work they ought to do, and for gaining the position they ought to take, have to serve life-long servitude under the restrictions of fashion, surrounded by dulness and ennui, and the simulacrum of satisfaction by which with the aid of lavish expenditure some of the idle and incapable and apathetic among the rich partially succeed in appeasing the longing for real work.

Tricycling and bicycling should be encouraged among all classes, because both body and mind are exercised. The tours which the young can thus take are likely to be of the greatest benefit. Cyclists have their own hotels where they can put up at moderate expense, and if the journeys undertaken are not too long, advantage to the health both of mind and body will result.*

No doubt these and many other pursuits and some favourite amusements entail some risk, and may be attended with loss of life, but it may be urged with reason that the risks incurred are as nothing compared with those which the same boys would run of suffering from deterioration of bodily and mental health, if instead they were subjected to a course of training in which active exercise formed no necessary part. All cannot of course be subjected to the exertion of hard muscular work, and those who are naturally weak ought not to be permitted even to attempt to play at games designed for the strong and vigorous only.

There are many so-called hobbies which may be taken up by those who are not strong and capable of severe exercise. Hobbies may be inexpensive, or extremely costly, according to the circumstances of the individual. But there is no doubt, as far as regards mental health, the object is as well secured by a hobby as inexpensive as a window garden as by a park—by a few domestic animals as well as by a zoological

* It is curious to notice in what an unexpected way some of the tricycling difficulties are resolving themselves. In the crowded streets of London these frail machines seem to have small chance of holding their own among the other and prior occupants of the road, and yet there is no law against them, nor, I believe, is there any limit as to the size of a wheeled vehicle. It may have been lately observed that tricycles have been used for advertising, and if this system succeeds the tricycle will have its proper status, and either part of the roadway will be tacitly assigned to cyclists or their right to travel will be acknowledged. If only some regulations could be enforced concerning the blocking of our streets by huge wagons and carts there would be room for everyone, but by some perversity of arrangement the only three or four hours in the twenty-four during which the majority of carriages are in the streets at all, seem to be the very time selected for the multitude of heavy vehicles to take up and deposit their burthens, and to rush recklessly through the most crowded thoroughfares.

gardens. Nay, there is really more to engage the attention, and for the mind to ruminate upon, in the study of a few living forms, even so very small as those in a drop of water, or a single plant, than the owner of half a county will discover in his rambles, or a very Crœsus have at his command. For the mind's capacity for taking in is not unlimited, and although the pleasures of vast possessions are undoubtedly great, their greatness is not entirely due to the gratification they afford to the highest mental faculties. All that is required is that the mind should be interested as well as occupied, should have something more than material acquisition to think about during its waking state—something to engage it so that it shall not fall back upon the contemplation and analysis of every little nerve disturbance in organs of digestion, circulation, secretion, or generation, which causes discomfort or worse, nor be exclusively concentrated upon the addition of money to money. Though the gradual increase of items from year to year, when it occurs, must be productive of keen enjoyment, this must not be permitted to lay a too exclusive hold upon the higher faculties, or these, instead of continually striving to attain to a higher standard of rectitude and greater freedom from mere material considerations, as the approach of complete emancipation becomes nearer and nearer, will be weakened and dwarfed long before the time when such a change is a natural one.

I feel anxious that the many subjects to which I have referred should be brought under the notice of the profession, because they have, as it seems to me, a very important bearing upon the management of many sad cases upon which we are often called upon to give advice. I think that the probability of the successful treatment of many and their restoration to a healthy mental state will be greatly increased if the general surroundings of the patient during childhood and growth be carefully investigated and considered, and if a broad view be taken of his mental and moral powers and his capacity for intellectual and physical work, than if the physician's attention be solely directed to the derangement for which his advice is sought. This is the excuse I have to offer for treating the subject at what some will consider inordinate length.

On raising of the Standard of Public Morality and on Social Purity.—I must here refer to the mischief wrought by certain publications which ought not to be allowed in any community which claims to be influenced by feelings of decency. The publication of the exact statements made by the unfortunate victims of practices all are ashamed of, ought to be protested against and prevented. In many instances the statements have no foundation in fact, but are the creation of a morbid and imaginative disposition only. The cruel plan of publishing in detail symptoms experienced by a few undoubtedly leads many to the

belief they are suffering or are about to suffer from the same horrid half-dreams. Years ago it was not considered right to act thus, and it was only done by those who thought rather of their own than their patients' or the public good ; but now, I regret to say, that writers not unknown to science, and in high position in cities of scarcely less importance in the world than London itself, have revived the injurious fashion, and have written works published at a very cheap rate, and which are no doubt only too widely diffused among English speaking people. Should one of these books fall into the hands of a young man not in the medical profession, I trust he will burn it without reading it. The thing is a disgrace to those whose duty it is to judge whether what is written for the public to buy is decent or not. It is very well for those responsible to shelter themselves behind supposed difficulties about freedom of expression, and statements requisite for professional information, and such like, but they should reflect not only upon the harm these things do, but on the fact that by non-interference they practically favour and support what is disgraceful, cruel, and wrong. All that is needed seems to be a committee of half a dozen well-known persons in whose judgment and discrimination and sense of justice the public would have full confidence, but from whose decision there should be no appeal. Such a committee should be instructed to condemn anything which encouraged immorality, upon the same principle that the performance of an indecent play is not allowed. The law ought to act.

In America public opinion seems to allow, if it does not actually encourage, free discussion of matters which at least in England have till now always been treated with extreme care and gentleness. Certainly it has been abundantly proved by professional experience that harm results from a premature knowledge of questions concerning the relation of the sexes on the part of boys and girls. Some of the most melancholy examples of mental and moral wreck seem to have had their origin in information derived from published books, and cases are not wanting in which the most terrible misery has been caused by young people having been led to take views upon complex physiological problems which are quite opposed to facts and to the conclusions of persons of experience whose views have been ridiculed or treated with scorn. The profound knowingness and superior wisdom of these vain and silly people, who in their mistaken intellectual security of new but false knowledge set at nought the laws of God and man, as well as the teachings of history, receive in many instance a tremendous shock. Ere the monstrous theories have been acted upon, real life opens in misery never to be alleviated or forgotten, and the prospect of living in subjection is only lightened by the hope that the end may be postponed until shame and disappointment shall have been in some measure softened and atoned for by the stern teachings of adversity, and the mind consoled

by the thought that calm of some sort has at last been obtained; passion and self-indulgence conquered after having been allowed to run riot in defiance of religion, reason, and the advice and experience of others, instead of having been kept under proper control from the first, as might have been done easily enough if good feeling and reason had not been wilfully overborne by the lowest form of selfishness.

From the view that matters having reference to sexual organs in both sexes can be publicly treated of in the plainest language without doing harm I entirely dissent, and feel confident that even among ourselves and in our lectures to medical students, not only is it neither necessary or desirable to do more than make general reference to matters of the kind, but that any minute consideration of the details is calculated to do great harm, and in more ways than I care to dilate upon. To give good advice upon these matters it is not necessary or desirable to go into all the nauseous details of terrible cases of obstinate determination, to enumerate the workings of an evil imagination, or the base promptings of the basest and vilest of degraded man and womanhood. The righteousness of self-restraint has to be taught through childhood, and inculcated with care and assiduity till the individual mind is sufficiently mature to understand and acknowledge the reasons upon which the teaching was based.

The question of what is called "social purity" is one of the greatest public consequence, and concerns alike every section of a civilised community. It is one which every church in the world considers it a duty to take in hand, and which the most unphilosophical of atheistic or theistic sects acknowledges to be of paramount importance. All engaged in teaching the young are well aware of the necessity of earnest care and vigilance, and the numerous communications on chastity and social purity to various meetings and conferences and congresses, the appeals in confirmation addresses, the establishment of purity societies, such as the White Cross Army, and of guilds, and of many other societies, for inculcating purity, bear witness to the need felt by many of considering this important matter, and making practical efforts to encourage and raise social purity at this time. Among the many memoirs which have been recently read upon this highly important matter, I desire particularly to draw attention to the paper, "On the best means of raising the Standard of Public Morality," by the Rev. E. Thring, M.A., Head Master of Uppingham School, read at the Carlisle Church Congress, 1884, and Mr. F. B. Money Coutts' little book "The Training of the Instinct of Love," Kegan Paul, Trench, and Co., 1885.

Of late years the responsibility of guiding the conduct of the young has not rested only upon parents and ecclesiastical authorities, as was formerly the case. Not only is much training and education entrusted to lay hands, but vast numbers of people actually decline to be guided

in opinion by members of any church or religious body whatever, and of these it is to be feared not a few repudiate every form of religion, maintaining that neither our conduct nor our duty as citizens ought to be governed or influenced by religious considerations of any kind. Whatever differences of opinion there may be on this matter, and they must needs be extreme, there will be thorough concurrence in the view that social purity and a very high standard of morality are absolutely essential to the well-being, to the happiness, and to the real progress of the community. Nay, this might be almost considered as the true test by which the value of systems and institutions, whether political, philosophical or religious, was to be determined. Not only is a low moral standard certain to be soon followed by disaster, but the tacit permission on the part of the many to allow a few to regulate their actions according to a low moral standard, would be condemned, whether the judges were religious, agnostic, or anti-religious, philosophical, or opposed to philosophy, aristocratic or democratic, nay, though they were composed of those only who had themselves passed through all the fiery evils of which a low moral standard is at once the cause and the result. There would be a unanimous agreement as to the pressing need of maintaining and raising the standard of public morality. Is it being raised, is it stationary, or is it being lowered at this time? The question is a difficult one to answer. Nay, it seems impossible to obtain the evidence which alone would enable us to form any general conclusion, but there is a vague impression that the true answer would not be satisfactory, while there is a certainty that the standard of social purity in all classes is far below what it might be and ought to be amongst us at this time, while it is also certain that in some parts of the country, but by no means only among the least informed and the least intellectual classes, the standard of morality could scarcely be lower than it is. The question concerns us all, and there ought to be remedial measures which the atheist, the agnostic, the sceptic would desire should be introduced, and would feel as anxious to see acted upon and carried into practice, as the religious man, the moral secularist, or the philosopher. Nevertheless, looking from the purely practical side, I cannot but regard with fear and sorrow the further evolution in thought development of the young agnostic, whose views are based upon the dim shadows of ideas and almost meaningless rhapsodical utterances of one or two self-confident loud-talking enthusiasts, who seem to be quite incapable of expressing anything more clearly than as vague longings and hopes and beliefs of what may be or might be, or is conceivable to a privileged imagination; and who are astonished that the doctrines they had vaguely propounded should have carried some of their unfortunate disciples so far in the direction of folly, that misery and ruin, and even crime, have, it is to be feared, been the result in some instances.

Hints on Medical Treatment.—I have spoken of the all-importance of prevention and the general method to be pursued in the management of cases in which there is or has been much disturbance of function, with perhaps considerable derangement of the nervous system, and possibly also of digestion and general nutrition. It remains to be considered whether assistance may also be obtained from medicines. Medicine alone cannot effect changes which are due to inherited peculiarity, or to the circumstances under which the patient may have to live; but when the derangement in question is due to or is made worse by disturbances of the stomach, liver, or urinary organs, much may be done to help the patient. Even in cases where the indications for medicinal treatment are very clear and distinct, the practitioner must always bear in mind that he may be of the greatest service to his patient if he will consider the points to which I have adverted concerning the general management of the case, as well as by prescribing any medicines which are likely to be of service.

In many instances the habit is unquestionably self-taught. It not unfrequently affects weak sickly children, and is often to be traced to irritation about the prepuce or glans. Occasionally accumulation of secretion between the prepuce and glans seems to be the exciting cause, and sometimes a superabundant prepuce, eczema, or an over sensitive state of the delicate surface of the glans exists. In many of these cases a cure is easily effected by operation; and it has been remarked that masturbation is virtually unknown in Jewish schools, "Medical Times and Gazette," vol. XXXIV, p. 79, note. It sometimes happens that every boy in a family is born with a redundant prepuce, with an exceedingly small orifice, rendering surgical interference imperative.

Many boys and young men who have acquired the habit are weak, nervous, excitable creatures, with little real energy or power of self-control, and little love for bodily or mental work. It is thought by some that for these cases spiritual advice and confession is the proper curative method. Such persons could no doubt be easily persuaded to confess, but it is very doubtful whether more harm than good will not result. I much doubt whether confession of such things to a priest is either good for the patient or for the confessor. Whether confession is right for a healthy vigorous-minded man I will not discuss, but certainly it is not very likely to cure a hypochondriac or encourage a weak-willed, nervous, lazy, fanciful fellow, full of himself, to exercise self-restraint and endeavour to do his work in this world honestly and well.

As for those sad cases which pass into our lunatic and idiot asylums, there is great reason for thinking that the masturbation so far from being the cause of their sad fate is but one of a long list of symptoms depending upon defects in the development of parts of the nervous system, or resulting from disease originating there. It is as much the

consequence of disease as paralysis, loss of sight, or loss of consciousness. Such cases, although incurable, are sometimes much benefited by proper medical treatment carefully carried out for a considerable time. It is surprising what a considerable degree of improvement sometimes follows residence in a good locality under proper management.

Tincture of perchloride of iron, phosphate of iron, or reduced iron with mineral acids, quinine, various preparations of cinchona and nux vomica, are most useful in the treatment of these cases, especially where the health is low and the patient weak, and the digestive organs much deranged, as is not unfrequently the case. Mild purgatives are often required, and mercurials in small doses often act favourably. Like drinking habits, these are much under the control of the individual. If he *wills* to control them, he can do much, and it is important to exercise all the moral control we can and encourage him to make strong efforts to regulate his conduct. When he first comes under notice he may be in such low weak health that there is no hope of him exercising the control desirable, but if we give tonics for a time and improve his general health, he will be able to follow our advice. We must do all we can to influence the patient for good, and we must get him to place confidence in us—and sometimes this is indeed a most difficult matter, while, strange to say, a very ignorant and perhaps very vulgar person may get such control over the patient, partly by threats, partly by persuasion, as to virtually get him completely into his power. What is most necessary is to find some means of thoroughly interesting the patient and occupying his thoughts till it is time to go to bed, and we should instruct him so to arrange that the exercise he takes shall be sufficient to tire him a little. He should put the feet in warm water just before he goes to bed, in order that he may get to sleep as soon as possible. Such little points as these are of great value in the treatment of this class of cases, and should be borne in mind. The patient should be instructed to rise as soon as he wakes in the morning, when a glass of Hunyadi or other purgative water, or Epsom salts, should be taken, unless the bowels act freely without medicine.

When the presence of spermatozoa is pretty constant, and is accompanied by various symptoms, such as extreme nervousness, dyspepsia, loss of flesh, weakness, anxiety, and general disturbance of the health, the practitioner will be required to take the case in hand, but he must be very careful to exercise great care as to what he may say. The mere suggestion that spermatozoa are present in the urine may frighten a nervous patient who has studied quack books and visited the demoralising museums in a way that is quite extraordinary.

Spermatorrhœa.—The occasional, nay the frequent, presence of spermatozoa in urine must not be taken as evidence of the existence of that condition to which the name of "*spermatorrhœa*" has been applied

—a term which I am sorry to employ at all, but which cannot be abolished. There is, in fact, no *disease* which can be correctly termed "spermatorrhœa." The secretion of the testicle, like that of other glands, must from time to time escape, and when it is formed in undue quantity, and discharged too frequently, it is usually but one of a train of symptoms possibly dependent upon general changes. Spermatozoa are very often found in the urine of young men in perfect health in great numbers, and I have seen multitudes in the urine of a hale old man above 80 years of age. This was a decided case of "spermatorrhœa;" and there is no doubt that if this old gentleman's urine had been examined by some of the quacks who pretend to make this "disease" a special study, he would have been favoured with a description of the frightful consequences of this escape of the secretion of the testicle, and have been subjected to treatment! I have long ago expressed my own opinion about the careless use of the word "spermatorrhœa," and I have found no reason to alter it; but as there is some difference of opinion in the profession upon this matter, it is perhaps well that I should state more fully the reasons upon which my opinion is based.

One author has complained that some of our hospital physicians have fallen into the '*error*' of making too light of this affection, and that one or two in particular have even gone the length of ignoring its existence altogether. I am glad to say that I fall under this stigma, for I hold that there is *no such disease* as "spermatorrhœa," as usually defined. It has been truly stated, that charlatans, for their own selfish purposes, too often work upon the fears of their patients, and exaggerate the evil consequences to be anticipated; but what encouragement does the practitioner afford, who, under the head of "consequences of spermatorrhœa," includes '*phthisis, cerebral congestion, epilepsy, general paralysis and insanity—lastly, enfeebled sexual power, and ultimately impotence*'? These have been stated to be consequences of "spermatorrhœa," but we are not informed whether '*possible*' or '*probable.*' Spermatorrhœa has been defined to be "all losses of seminal fluid not occurring as the result of sexual intercourse." Impotence it is said is not an uncommon consequence of "spermatorrhœa." I have seen many cases which have been called "spermatorrhœa," but I never saw one which ended in any of the above terrible consequences. Impotence, not depending upon some congenital defect, or some obvious structural lesion, is a most uncommon affection; indeed, I have myself never met with a single case. The occasional escape of semen is perfectly harmless.

Many who have in early days given way to bad habits, coming across in later life the catalogue of horrors which only follow as a consequence of reckless profligacy, are, indeed, very likely to take an ex-

aggerated view concerning the evils which are said to threaten them. From reading and re-reading the nonsense written, and getting into the habit of dwelling upon the miserable pictures drawn by humbugs, the matter may gradually assume proportions which appear really terrible, although in truth the whole thing is ridiculous. The thoughts may be so concentrated upon the imaginary evils, that soon the unhappy victim can think of nothing else, and has continually before his mind the horrid list of troubles above chronicled, and which he becomes convinced are to be his portion. He can see before him nothing but unutterable misery, ruin, disgrace, inability to work, and death the only possible escape.

All practitioners are well acquainted with the general nature of the cases included under the head of *spermatorrhœa*, and in the treatment of the condition the so-called specialist is not needed. Indeed a practitioner is required who will take a general view of the patient's mental and bodily state, and not think too much about the organs of generation. It is not necessary, and it would not be decent to allude to much that has been said upon the subject, or to recount the cruel and often useless and unnecessary means that have been proposed and adopted for the treatment of losses of seminal fluid. It cannot be too widely known that the importance attached to this so-called disease is not justified by observation—that some of those who claim to have made a special study of the disease, and to have discovered means of cure unknown to the profession, are mere pretenders—and that most practitioners are well acquainted with the state of things, and fully conversant with the treatment that ought to be adopted.

It is almost useless to refer to the injuries inflicted by charlatans, physically, morally, and commercially, because our laws afford no remedy. But it is a disgrace that most immoral exhibitions, under the title of "Museums," should be permitted to flourish in large cities. It is monstrous that it should be possible in law for an impostor to mulct a poor, foolish, labouring man of £5 or £10 for a dozen bottles of something closely allied to mucilage in composition, for the relief of an imaginary ailment. Charlatans, in all departments, well know that obstinacy, indolence, and wilful ignorance, form a part of the character of all dupes, and that in all classes of civilised society there are persons with these mental characteristics in sufficient number to afford them a favourable reception, to court and patronise them, and to load them with flattery and liberal and material support. Quacks well know that when their true character is found out, those who have been deceived by them will feel too much ashamed of themselves to expose the quackery; and the utmost inconvenience that can ensue to the quacks is the necessity of now and then changing the seat of their operations. The public prosecution of an extortionate rogue involves the public con-

fession of unutterable folly on the part of the dupe; and although nothing is more common than for people to be imposed upon, it is rare indeed for an individual to confess that he has been a victim. If people generally were a little better informed upon physiology and the principles of medicine, they would be able to protect themselves successfully from the imposition of pretenders—medical, social, and therapeutic, but neither art, nor literature, law, or learning will save them.

SUBSTANCES IN SOLUTION NOT FOUND IN HEALTHY URINE—ALBUMEN—BILE—SUGAR—ALKAPTON.

THE presence of the soluble substances to be considered in this section, which are not found in healthy urine, is ascertained by the application of *chemical tests*. In many cases, however, our first suspicion of the existence of one or more of the substances in question, is excited by the colour of the urine, or by its peculiar smell or unusually high or low specific gravity, or by the characters of the deposit which subsides.

The matters referred to, being perfectly soluble in the fluid, cannot be detected by microscopical examination; but, in some instances, we may infer their presence from the colour, as when bile is present, or from the microscopical characters of certain bodies in the deposit. Thus, the detection of epithelial cells of a yellow colour would lead us to test the urine for *biliary colouring matter;* if casts were found upon microscopical examination of the deposit, we should test for *albumen:* if the urine was high coloured and of high specific gravity, we should have a suspicion that it contained *urea*, if pale *sugar*. In all cases, our conclusions must be verified by the application of appropriate tests.

ALBUMEN IN THE URINE.

The occurrence of albumen has been regarded as a most important fact since Dr. Bright showed that albumen was present in the urine in cases of disease of the kidneys, and pointed out the intimate connection between renal disease and some forms of dropsy. Albumen, it need scarcely be said, is absent from the urine of healthy persons, although now and then it may be detected for a short period of time in the urine of individuals who are not suffering from any serious or permanent derangement of the health. The presence of albumen must always be regarded by the physician as a point of much importance, although at the same time, *per se*, it cannot be taken as evidence of the existence of

any organic lesion, unless it has been clearly detected from day to day for a certain time. Many of the causes which give rise to the escape of serum from the vessels in other parts of the body, independent of disease, will determine its transudation through the walls of the renal capillaries, and, as a matter of course, albumen will be found in the urine.

To recognise with certainty the presence of a substance in the urine having so important a bearing on the discovery and interpretation of certain grave morbid processes, is obviously a point of the utmost importance to the practitioner. In the examination of the urine of patients, the application of one or two simple tests enables us to determine at once if this substance be present or absent. Occasionally, however, an instance occurs in which, without great care, an erroneous inference is likely to be drawn, although the proper tests may have been applied to the urine.*

The quantity of albumen varies much in different cases, sometimes amounting to the merest trace only; while, in other instances, a proportion not greatly inferior to that present in serum has been met with. In one case as much as 545 grains were excreted in 24 hours (Parkes). For clinical purposes the albumen, after precipitation, may be allowed to subside to the bottom of the test tube, and the proportion its volume bears to that of the urine in the tube noted.

Albuminous Urine, from a patient suffering from acute inflammation of the kidney.

ANALYSIS.

		In 100 parts of solids.
Water	952·00	—
Solid matter	48·00	100·00
Urea	13·052	27·19
Albumen, mucus, and uric acid ...	19·204	40·00
Extractives	12·864	26·80
Alkaline salts	2·784	5·80
Earthy salts	·096	·20

The deposit contained numerous granular casts, but no fat-cells were

* On testing the urine for albumen, *see* Dr. George Johnson's book "On the Various Modes of Testing for Albumen and Sugar in the Urine." Smith, Elder, and Co., 1884. Recent papers by Dr. Roberts in the "Lancet," 1882, vol. II, and Dr. Oliver's work "On Bedside Urine-testing, including Quantitative Albumen and Sugar," 2nd Edition. H. K. Lewis, 136, Gower Street. I would also direct the reader's attention to the "Discussion on Albuminuria; its Pathology and Clinical Significance," in the Glasgow Pathological and Clinical Society, reprinted from the "Glasgow Medical Journal," 1884. In this discussion the following physicians took part:—Drs. David Newman, William Roberts, Hamilton, Gairdner, J. Mortimer Granville, Mahomed, James Finlayson, Leishman, Greenfield, Coats, M'Gregor-Robertson, Robert Kirk, G. S. Middleton, Lindsay Steven, Cleland, Robert Perry, Geo. Oliver, Francis Henderson. The remarks form a very instructive volume of upwards of 160 pages published by Alex. Macdougall, 81, Buchanan Street, Glasgow.

present. Specific gravity 1015, acid. The albumen coagulated by heat and by nitric acid.

A variety of albumen is sometimes met with which is only imperfectly coagulated or not coagulated by heat. It is possible that some of the peculiar reactions met with from time to time, may depend upon the presence of other substances dissolved with the albumen. Dr. Bence Jones met with a peculiar form of albumen in one case. Albumen peptones of different kinds are also sometimes met with.

It has been stated that a modified kind of albumen is present in healthy urine, but it need scarcely be said this substance is coagulated neither by heat nor by nitric acid, and it is therefore doubtful if it ought to be regarded as a form of albumen.

Paraglobulin is usually present with albumen, and, as has been shown by Dr. Roberts, if urine containing it be diluted with water, it is thrown down as an opalescent cloud. This substance is insoluble in pure water, but it is soluble in water containing a little free acid or chloride of sodium.

The clinical significance of albumen in the urine cannot be determined in every case at once by chemical tests alone. Indeed, the presence of albumen in the water may be a fact of very small consequence or of the gravest import. The albumen may be due to slight temporary congestion, which may pass off in a few hours, or to long standing disease of a very serious nature, from which there is no probability of recovery.

It has been said that small quantities of albumen may appear in the urine even of the healthy, and that the discharge persists for a time and then disappears. This undoubtedly happens occasionally, but for one such case I should say one meets with twenty in which, although for months there are no grave symptoms, sooner or later indications are afforded of more than mere temporary change. Eventually the existence of chronic disease is established, and the case, after some years it may be, assumes a grave form and ends fatally. That "physiological albuminuria" may occur is possible, but I believe it to be one of the rarest of events. I am unable to understand what is meant by "insensible albuminuria," a condition which Dr. William Roberts compares with "insensible perspiration." The author seems to forget that what is called "insensible perspiration" can be demonstrated at any moment by allowing it to condense upon a piece of cold glass placed near the skin, when it becomes sensible enough; while the "insensible albuminuria" seems to be a mere assumption or hypothesis or conjecture, neither to be proved nor disproved. The suggestion is, I think, fraught with some danger; for while on the one hand there is no doubt that certain cases of albuminuria have been foolishly condemned to die a quarter of a century too soon, it is quite certain on the other that far

too little importance has been attached to some serious cases, which in the commencement might have been adduced as examples of "physiological albuminuria," the merest traces only of albumen being occasionally present. Of course it is of the greatest consequence that the practitioner should do his utmost to avoid erring, either on the side of making too much of a case of temporary albuminuria, and thus, perhaps, ruin a career by needlessly stopping study at a critical period, and by unnecessarily insisting that the patient should winter in the south; or, on the other hand, by making too light of a case of a chronic disease in its early stage, lose the only chance of curing the patient or of greatly prolonging his life by recommending a judicious course of treatment.

I have seen many cases of slight albuminuria in young people, who in every other respect seemed perfectly healthy. The course of the malady, in the great majority of instances, rendered it quite certain, I regret to say, that the very slight traces discovered could not be due to temporary derangement or to physiological albuminuria, but depended upon the commencement of organic disease. I should certainly decline to recommend such cases of very slight albuminuria for life insurance, until at least one year had expired after the observation, the urine having been examined at intervals during this time, and invariably found free from albumen. I am aware that the most confident assurances have been given in cases of the kind, but I can call to mind several in which I believe great mistakes would have been made by practitioners who feel very certain of being able to arrive at a correct conclusion, cases in which a favourable opinion would have been given at any time during three or four years, although they ended fatally in five or six years from the commencement—cases which did well where a very unfavourable prognosis would have been made—cases again which seemed to completely recover for a period of more than a year, and then relapsed into ordinary chronic albuminuria, and died in the course of five or six years.

For my own part, I feel sure that the greatest caution, as regards committing ourselves to an opinion, ought to be exercised. The patient should be seen a few times, and several examinations of the urine taken at different times of the day and night should be made. Taking into his consideration all the general and special points of the individual case, the physician will often be able to arrive at a correct conclusion and give advice that should be acted upon. But with all the care he may take, he will be led to make a mistake now and then, and regard the case as more serious or less serious than it turns out to be. I have no doubt that now and then, a case which in the beginning was very obscure and concerning which I had been unable to give a positive opinion, has at a later period, when there could be no doubt as to its nature, come under the notice of another physician, who would then

no doubt feel surprised that I had not expressed myself more decidedly as regards diagnosis.

The significance of mere traces of albumen in the urine is a question which often comes before us in connection with life insurance. Decide we must, and it is needless to say how very important it is that we should arrive at a correct conclusion. There may well be conflicting opinions with regard to a definite case. One adviser, considering that a trace of albumen is of no consequence, recommends that the life be accepted by the office, while another considers it necessary to give an equally confident opinion, and holds that the trace of albumen is an indication of commencing disease, which will destroy life long before the ordinary period of life is reached, and regards the risk as too hazardous for the office to accept.

Sometimes very decided traces of albumen will be found towards evening or after unusual fatigue, while the water passed in the early morning will be quite free. There are cases in which albumen is found in the water almost constantly for a period extending over some years, and then ceases to be detected for several months and reappears, again disappears for a year or two, and then returns and persists till death occurs from chronic structural change in the kidney.

Cases are from time to time met with in which it is probable that the albumen of the chyle finds its way into the urinary passages and becomes mixed with the urine. Chyle itself obtains entrance in those rare and remarkable cases known as chylous urine (*see* page 47), and it is probable that in a far greater number of cases the serum of the chyle, from time to time, somehow filters through the walls of lacteal vessels which have become temporarily obstructed, and may at last find its way by a circuitous path into the urinary passages, and escape with the water. A substance nearly allied to albumen is probably formed under certain circumstances upon the surface of mucous membranes, and may perhaps be correctly regarded as a modification of the material of which the outer part of epithelial cells is composed, but in a less perfectly formed state than the substance ordinarily produced. Possibly in some cases the albuminous substance present is due to the action of the epithelial cells, or rather to the bioplasm of the epithelium. So many modifications of albumen are discovered that there can be no doubt that some forms are variously altered and modified during their ormation, while every form is not produced in the same way.

Disturbances in the nervous system by reflex action may cause contraction of the muscular fibres of vessels, and in consequence the transudation of a small quantity of albumen through the capillaries may occur.

Small quantities of albumen in the urine sometimes appear in cases where there is unusual excitement of the testicles. In some of these

cases the albumen is due to slight hæmorrhage, but it cannot always be accounted for in this way, as no blood-corpuscles can be found. It may therefore be discharged with the semen or find its way into the vesiculæ seminales.

The presence of albumen may be due to temporary or permanent changes in some part of the urinary apparatus—to serious structural changes of the gland structure or some part of the mucous membrane, or to mere temporary derangement. It may depend upon transudation of the serum of the blood in a diluted state, or it may be due to the escape of a little blood from the capillaries of the secreting structures of the kidney, or from the mucous membrane of the pelvis of the kidney, ureters, bladder, or urethra. Just as hæmorrhage occasionally takes place from the capillaries of the mucous membrane of the nose or mouth without there being any definite disease, so bleeding may occasionally take place in some part of the urinary tract without being due to any actual lesion or leading to any definite morbid change.

Among the most important of the circumstances which determine the presence of albumen in the urine, are the following :—*Pressure upon the large veins, particularly the renal veins and the inferior vena cava.—Passive congestion of the capillaries of the kidney.—Alterations in the blood.—The escape of blood into the urinary passages.—The presence of cancerous growths.—In females the menstrual discharge.—Affections of the mucous membrane of the urethra, bladder, or pelvis of the kidney.—Stone in the kidney, ureter, or bladder.—Acute or chronic, functional or structural, temporary or permanent changes in the kidney itself.*

Albumen in the Urine from Pressure upon the Large Veins.

Wherever any physical impediment to the return of blood in the emulgent veins or inferior cava exists, and in some cases of obstructed portal circulation, as in cirrhosis of the liver, traces of albumen may be detected in the urine. No casts or at most only a few transparent mucus casts, are to be found in the deposit, and for the detection of albumen we must rely on chemical tests. In some instances a tumour may be distinctly felt, and then the nature of the case is at once demonstrated, but when it is situated in the posterior mediastinum or behind the liver, the diagnosis is often extremely difficult. The pressure of the gravid uterus may occasion the albuminous urine in some cases of pregnancy, but the presence of albumen cannot always be referred to this cause, for it is not unfrequently found at an early period of pregnancy, when the uterus is too small to exert sufficient pressure. Dr. Tyler Smith considers that in some cases in which there was no organic disease, the albumen might be accounted for by some influence exerted upon the nerves. Out of 112 specimens of urine from pregnant

women, Dr. H. Van Arsdale and Dr. Elliott only found albumen present in two instances ("New York Journal of Medicine," 1856), but in England it has been found by some physicians in much a higher percentage. Regarded from a clinical point of view albumen in the urine during pregnancy is of less serious import than under other circumstances, seeing that the great majority of such cases completely recover after the birth of the child.

In some cases of ascites albuminous urine seems to be due to the pressure upon the veins, for after tapping, the albumen ceases, while it reappears with the reaccumulation of the ascitic fluid. In some forms of cardiac disease albumen in the urine seems to be due to impeded venous circulation.

It has been suggested that spasm of the minute arteries caused by reflex nervous actions excited by poison in the blood, may occasion such disturbance in the circulation in the kidney as to lead in some cases to the escape of serum. In cases in which the albumen in the urine depends upon obstructed venous circulation, the amount often varies much at different times from a very decided quantity to the merest trace.

In treating cases depending upon pressure upon the large veins, we must endeavour, particularly if the patient is robust and his vessels full of blood, to reduce the quantity of blood in order to relieve undue tension, taking care not to reduce his strength more than absolutely necessary. Little exercise should be taken, but the patient should get as much air as possible without fatigue. Purgatives are of great use in many cases, but should only be given from time to time when there are indications of unusual accumulation or actual constipation. In some cases great benefit is derived from hydragogue purgatives, but such remedies should be prescribed with great care, and only in cases where the indications in favour of their exhibition are very clear and decided.

Albumen in the Urine from Passive Congestion of the Capillary Vessels of the Kidney.

The capillary vessels of the kidney may become congested in consequence of general congestion of the vessels of various organs without any special change having previously occurred in the kidney itself. The renal congestion under these circumstances would probably be due in part to the blood not having been properly changed during its passage through the lungs, liver, and other organs, in consequence of which it would not flow freely through the renal capillaries, and in part to changes in the nerve centres, induced by the altered blood, and the influence thus indirectly brought to bear upon the renal circulation.

The quantity of albumen in these cases is seldom very considerable, and generally mere traces are present in the urine and only for a very short time. As soon as the systemic circulation is relieved, and the blood is properly depurated, the circulation in the vessels of the kidney improves, the congestion ceases, and albumen no longer escapes.

In pneumonia and some other inflammatory and febrile affections there is not only a considerable degree of internal congestion, the veins and capillaries of nearly all the viscera and internal organs being filled with blood to extreme distension, but generally speaking, important alterations, there is reason to think, have taken place in the albumen, and perhaps other constituents of the serum, whereby the fluid more readily permeates the walls of the capillaries than in its healthy state. Very slight disturbance in the circulation or in the composition of the blood may determine the escape of a little albumen into the urine. The practitioner must therefore be careful not to make too much of this fact when the escape of albumen occurs in the course of or follows an attack of acute disease, or he may cause needless anxiety to the patient and his friends, and perhaps be the means of serious and needless expense being incurred, as for sending the patient abroad on the supposition that he is suffering from chronic renal disease. Such serious view could not be justified by the results of experience, and could only be adopted from imperfect knowledge.

It is probable that albumen will be found in the urine for a few days in as many as 50 per cent. of all the cases of febrile conditions characterized by considerable internal venous congestion, with slowing of the circulation and stagnation of the blood here and there in the capillaries.

It is doubtful whether the escape of albumen is due to a mere filtering through the vessels of the Malpighian body. Some think that albuminous fluid, instead of being reabsorbed by lymphatics, passes into the tubules. Others attribute the escape to diminished "vitality" of the capillary wall, in consequence of which not only serum but blood-corpuscles pass through. The fact of the occurrence of œdema in anæmia and after excessive hæmorrhage, would seem to show that albumen may filter through the walls of the capillaries if the blood is poor and diluted.

The presence of albumen in the urine cannot be explained by supposing the pressure upon the walls of the vessels is increased. Increased blood pressure alone seldom or ever causes albuminous urine or dropsy, but when there is congestion of the renal capillaries there must be increased pressure upon the walls of the small vessels of the glomerulus. Retardation of the circulation without pressure may cause the escape of serum from the blood. In the first place, increased pressure will not, in many cases, satisfactorily account for the state of things. Indeed, there is great doubt whether any case of pathological hæmorrhage is due to this

circumstance only. In some of the very worst forms of capillary hæmorrhage, as, for example, in some forms of fatal hæmorrhage from the mucous membrane of the intestinal canal, so far from there being increased or indeed ordinary pressure, after the first few hours, there is considerably reduced pressure or no pressure at all upon the walls of the vessels. Neither do I think that the hypothetical factor, "diminished vitality" of the capillary wall, has anything to do with the result. The question of vitality of a capillary wall is purely conjectural. It has been put forth for the purpose of accounting for certain phenomena which may be more satisfactorily accounted for in other ways. I think it would be as unreasonable to speak of the "vitality" of a piece of the ligamentum nuchæ, which has perhaps existed in the neck of an animal for twenty years, as the vitality of the elastic tissue of which the capillary wall is composed. The walls of capillary vessels may be torn, or may be caused to increase or diminish in thickness without assuming the vitality of their walls. Nor has it been in any way suggested what properties or powers are comprised in this term as applied to the walls of vessels. Indeed, the hypothesis of diminished vitality is of a purely fanciful and conjectural character, and must be discarded.

Albumen then may be detected in the urine in many cases of pneumonia and pleurisy, especially when the inflammation is extensive. I have found it in the urine in bad cases of acute rheumatism, and especially when there was pericarditis, with pneumonia and pleurisy. In continued fever, it is not unusually discovered in the urine. In puerperal fever it is often met with, and, as is well known, it is almost constantly present in cases of puerperal convulsions. Indeed, Dr. Lever failed to detect it in but one case out of fifty.

Albumen is very commonly found in the first urine secreted after the stage of collapse in cholera. In scarlet fever, in typhus and typhoid, in erysipelas, in small-pox and in many other febrile and inflammatory conditions, albumen is often present in the urine for a few days. Its presence is probably due in part to the passive congestion of the vessels of the Malpighian body and capillaries of the kidney, and in part to changes in the blood itself.

In all such cases the free action of the kidneys is desirable, and, if there is no evidence of active inflammation in the organs themselves, should be encouraged. Even cases of double pneumonia, in the course of which albumen is found in the urine, may do well if the kidneys can be got to act freely, and generally the albumen ceases as soon as free diuresis and diaphoresis are established. There can be no doubt that the prompt adoption of free elimination which often saves life in these cases, rests upon the very secure basis of experience as well as reason. By free purgation many things which had been accumulating in the blood, and which tend to poison the nerve-centres are removed. The

blood, in consequence, soon returns to its normal condition in which it nourishes the tissues and oxidises effete matters instead of checking action and allowing substances to accumulate, which must destroy life if their proportion rapidly increases, even during but a short period of time. Dry cupping over the loins is sometimes almost immediately followed by free action of the kidneys and the quick removal of the noxious matters from the system, and the restoration of the normal function of the tissues and organs.

Albumen in the Urine depending upon Changes in the Blood.

In some of the cases mentioned in the preceding sections, the escape of the albumen from the blood is no doubt due as much to alterations in the composition of that fluid as to the other causes referred to. Albumen may appear in the urine, and be detected for a considerable period of time (two years or more) without the existence of renal disease. It is well known that the state of blood following exhausting hæmorrhages, which gives rise to œdema and various kinds of dropsy, also occasions in many cases the escape of serum from the renal vessels. After continued fevers, as well as intermittents, after extensive inflammations of important organs, after severe febrile attacks, diphtheria, and many exhausting diseases, the blood serum may become so much modified that it very readily permeates the vascular walls. Not unfrequently much blood extractive matter escapes in the urine as well as albumen. Little is known concerning the exact changes which take place in the characters of the serum in these cases, but the accumulation of water and chloride of sodium in the blood, which invariably occurs when the action of the kidneys is impeded, is in itself sufficient to account for the result, although no doubt many other as well as more important alterations are induced. In many of these cases the extractive matters are considerably increased, and the substances which are dissolved by extracting the dried blood with boiling distilled water are present in larger proportion than in health.

Changes in the serum and in the blood itself constitute an important factor in determining the escape of serum, or of this and disintegrated blood-corpuscles through the stretched and attenuated capillary wall in many forms of albuminuria, which changes probably have been going on, it may be for a considerable time, before the escape of any albumen occurred. As is well known, dilution favours the escape of serum through the capillary walls. This dilution of the blood follows hæmorrhage. In certain febrile attacks not only does serum readily transude through the vascular walls, but the red blood corpuscles undergo rapid disintegration, and the products escaping with the serum stain the adjacent tissues. This escape is due rather to change in the

blood itself than in the tissue which it traverses. Of those who are inclined to attribute the escape of the serum to some change in the tissues outside the vessels, and to regard this the starting point of the series of phenomena we are considering, not one has attempted to explain in detail the nature of the change he assumes, or to define with accuracy either the exact extra-vascular anatomical element in which, according to this hypothesis, the departure from the healthy action begins, or the precise character of the change itself.

We must bear in mind that in many cases in which serum without or with altered blood-colouring matter escapes through the capillary walls, the masses of bioplasm or living matter—the so-called nuclei of the capillaries—die and become disintegrated, and it is probable that the extravasation occurs at these points where there would, in fact, be little resistance, and in some cases, no doubt actual apertures exist where the bioplast was situated. Through these openings matters from the blood would readily pass. In some cases of low fever the red blood corpuscles are rapidly disintegrated in great number, and the colouring matter is dissolved by the serum, which, in consequence, assumes a dull reddish colour, sometimes intense enough to stain the tissues with which it comes into contact.

The treatment of these cases resolves itself into the exhibition of iron and other tonics in addition to an easily digestible and highly nutritious diet, with change of air, but little exercise, until the health is thoroughly re-established. In some of these cases the blood seems to coagulate very readily, and it is not uncommon to find that clots have formed in some of the veins of the extremities or in the small veins of internal organs. When this is the case the patient must of course rest, but the more good air he gets the better.

Various preparations of iron, and particularly the phosphates and the iodides, quinine and acids, liquor cinchonæ, and other bitter tonics —cod liver oil—pepsin if the digestive powers are weak—and occasional purgatives if the bowels are sluggish, are the principal remedies to be given in cases in which the albumen in the urine is to be traced to a low state of the blood.

Albumen in the Urine from affections of the Mucous Membrane of the Urethra, Bladder, or Pelvis of the Kidney.

When only a small quantity of albumen is present in the urine it may come from some part of the surface of the mucous membrane, where from some cause there is congestion of the vessels or superficial inflammation. Just as the surface of a cutaneous sore is moistened by albuminous fluid which transudes from the blood, a small quantity of serous fluid may be poured out upon the surface of a mucous mem-

brane, which is the seat of ulceration or excoriation. Chronic ulceration may exist for many years, and during the whole time traces of albumen may be found in the urine derived from this source, and not in any way dependent upon renal disease or derangement.

Urine which contains pus invariably exhibits traces of albumen. In inflammation of the mucous membrane of the kidney with pus-formation (pyelitis), of the bladder, or urethra, traces of albumen are commonly found; and when the proportion of pus is considerable, a very distinct precipitate is produced when the ordinary tests for albumen are applied. Great irritation and inflammation of the seminal tubes also occasion the escape of serum from the blood, as happens when other organs are the seat of corresponding pathological changes.

In the case of urine containing pus, more albumen may be found in the supernatant fluid than can be accounted for by the quantity of pus present in the urine. In some of these cases the albumen is due to renal disease, associated with the vesical catarrh, but sometimes neither the facts nor the history of the case permit such a conclusion. Just as in catarrhal inflammation of the vagina, a considerable quantity of albumen may escape from the mucous surface at the time of the formation of the pus, so in some cases of inflammation of the bladder an unusual amount of albumen filters through the walls of the vessels and becomes mixed with the urine, and it may be difficult to decide as to the exact nature of the case. Cases have come under my notice in which the undue amount of albumen was caused by the irritation excited by the presence of a calculus in the pelvis of the kidney, and I have met with more than one instance in which a considerable quantity of albumen in urine containing pus was found to be due to the presence of a papillary growth in the bladder. In some of these cases a considerable quantity of what appears to be closely related to pus, though not actual pus, is formed. In one case under my care the bladder had been examined by an exploratory incision only six months before, when it was ascertained that there was no stone, as had been suspected, nor any growth projecting from the surface of the mucous membrane within reach. The discharge came from a small growth situated in the fundus, which did not project much from the surface of the mucous membrane. Cases then are met with from time to time in which a quantity of albumen, considerably in excess of the amount to be accounted for by any pus present in the urine, is found, but which are nevertheless not due to the existence of chronic renal disease.

In some cases of slight superficial inflammation of the mucous membrane of the urethra, bladder, and vagina, traces of albumen are found in the urine. Such cases are particularly difficult to diagnose, for it often happens that there is no epithelium nor corpuscles of any kind present which will enable us to judge concerning the seat of origin of

the albumen. The treatment of cases of pus in the urine has been considered under that head. Linseed tea and half-drachm doses of citrate of potash four to six times in the twenty-four hours are often useful. *See* page 117.

Albumen in the Urine from the Menstrual Discharge.

For some days after the cessation of the menstrual discharge a trace of albumen is sometimes found in the urine. Care must be taken not to mistake the state of urine present under these circumstances for that which is dependent upon chronic renal disease. In some of these cases there are no blood-corpuscles whatever, and mistakes have been many times made. The escape of fluid containing albumen may continue during the interval between the catamenial discharge; and the urine, no matter when it may be examined, will be found to contain albumen. Not taking cognizance of this fact has led to serious error in diagnosis, and cases have been attributed to chronic renal disease, and the patient sent abroad and treated upon this supposition, although the kidneys were perfectly healthy.

Albumen in the Urine due to the escape of Blood into the Urinary Passages or from the presence of Morbid Growths.

Whenever blood is discharged into any part of the urinary tract, albumen is of course present in the urine. Bleeding may take place from any of the mucous membranes, hæmorrhage from that of the nose being the most common form. The hæmorrhage in these cases is from capillary vessels, and generally only lasts a short time, except in persons who possess what is known as the hæmorrhagic disposition or diathesis (hæmophilia). Bleeding of the same kind may occur from the Malpighian vessels of the kidney. Albumen is of course present in the water, and occasionally in considerable quantity, and may persist for some weeks after the escape of blood has ceased. This form of simple hæmorrhage not unfrequently alarms the patient and his friends, but it usually ceases after a few days, and perhaps never recurs.

The diagnosis often long remains doubtful, and the case may be regarded for a time as some form of commencing renal disease, or calculus in the kidney, or some unusual form of intermittent fever or malignant disease. It is only by a careful consideration of all the circumstances of the case, and the peculiarities of the patient, that a correct conclusion as to its nature can be deduced.

The escape of blood from morbid growths in the kidney and bladder has been considered in page 86, but the practitioner must remember that in some of these cases there is a little oozing of serum without any

escape of blood corpuscles. I have seen cases in which the albumen in the urine was found to be due to this cause, and the nature of the case remained extremely obscure and doubtful for many months.

Albumen in the Urine from Stone in the Kidney, Ureter, or Bladder.

Albumen in the urine may be due to the escape of serous fluid only, or of blood from the vessels of the Malpighian body, or from the capillaries around the tubes, or from the vasa recta, in consequence of disturbance excited by the presence of renal calculus. The change may be due to an exceedingly small stone; the pain and disturbance, the severity of the symptoms, and the amount of albumen being in no way dependent upon the size of the concretion. These cases are sometimes mistaken for chronic structural renal disease, and possibly may have been treated for months or years upon this view.

Concerning the precise way in which a renal calculus may cause the escape of blood or serum only into the urine, there is much to be said. A small stone impacted in a tube, by the mere pressure exerted upon adjacent capillaries as it increases in size, might fully account for the escape of albumen. In some cases the concretion damages by compression many adjacent tubes, and causes the rupture of capillary vessels. The escape of blood takes place into tubes which may remain pervious below the point of injury. This blood passes into the pelvis of the kidney, and becomes mixed with the urine. There is reason to think that reflex irritation may not only cause congestion but actual rupture of the vessels of the Malpighian body.

When traces only of albumen are present it is often most difficult to decide whether the escape of serum depends upon the chronic structural changes consequent upon long-continued renal degeneration or upon the lesions in adjacent uriniferous tubes and vessels, caused by the pressure of a calculus. In some cases the symptoms are sufficiently marked to enable us to come to a decision, but not unfrequently in cases of renal calculus there is no pain sufficiently localised to indicate its seat or cause, and oftentimes the discharge of blood is very small, varying little in quantity from day to day, though continuous. Moreover, not only are casts often found, but in some cases of renal calculus I have known casts to be present in the urinary deposit for years—and casts containing minute cells of renal epithelium and granular matter, such as are often detected in chronic cases of granular kidney, are not uncommon. One is more likely to mistake a case of renal calculus for chronic kidney disease, than a case of the latter for renal calculus. Although time is an important element to take into consideration in endeavouring to arrive at a decision, there are cases of renal calculus which have lasted for so long a time with little or no change in the

symptoms or in the character of the urine, that a mistake may be easily made.

As regards the character of the urinary deposit the physician must, in doubtful cases, make frequent examinations—once a week or oftener for a time—and his opinion will necessarily be influenced by the following facts and considerations:—If the urinary deposit often contains dumb-bell crystals of oxalate of lime, more especially if these are sometimes found in small collections or aggregations, or if minute globular or oval grains (that is very minute calculi) of uric acid are present in some of the specimens of the deposit submitted to examination, or minute masses of phosphate of lime, or of hardened grains of mucus and phosphate of lime, or minute collections of blood-corpuscles and fibrinous matter, the presumption will be in favour of renal calculus. If uric acid or cystine, or amorphous granules of phosphate of lime be common, the same conclusion will probably turn out to be correct, especially if collections of epithelial cells from the pelvis of the kidney or the ureter, or both, be often present in the deposit.

On the other hand, if the substances referred to above are not detected, while on frequent examination we find casts present, and especially if the casts contain disintegrated epithelium or a number of epithelial cells, or cells like pus-corpuscles or leucocytes, or cells containing oil globules, or free oil globules in considerable number—if the casts, though perfectly transparent, are very narrow or very broad, the conclusion will be in favour of chronic renal disease. The casts present in cases of renal calculus, and they are common, appear to be composed of a clear mucus-like material, very different from the smooth hyaline matter of which the broad and narrow hyaline casts of chronic renal disease consist. "100 Urinary Deposits," pl. IV.

As regards the density of the urine:—If the specific gravity is usually high or about normal, the presumption will be in favour of calculus; while on the other hand, if it be nearly always low, 1012 or below this point, the fact, as far as it goes, will favour the diagnosis of chronic renal disease. In many doubtful cases it is very unwise to attempt to come to a positive decision as to the nature of the malady after only one examination of the case. Not only does the urine vary much in character, but the symptoms alter from time to time, and in doubtful cases the patient should be seen at short intervals.

The general nutrition and aspect of the patient are important elements in arriving at a conclusion, but I have seen many cases of renal calculus, and in both sexes, which have lasted for many years, and in which the emaciation was great, and the pallor and pinched appearance of the face were as marked as in advanced chronic albuminuria. In cases where there is no acute pain in one or other loin, there is often a dull aching which is intensely wearing to the patient. It may not

amount to actual pain, but to mere uneasiness which the patient cannot forget, and which may trouble him day and night for years. Such suffering affects the bodily health, depresses the nervous system, and may render his life, for the time being, miserable. If he is so fortunate as to get rid of the stone, all is changed. His health is restored, and he feels himself a new man. This happy crisis may occur quite unexpectedly at any moment, but alas, it is sometimes delayed for many years, and in some instances the patient dies of some very different malady, and carries with him to the grave the, it may be, very small and even microscopic stone still impacted in the same position it had occupied for years.

A stone impacted in the ureter does not always occasion changes resulting in the escape of albumen or blood. But if the stone should be rough with sharp spicules projecting from its surface, more especially if it undergoes slight alteration in position from time to time, the surface of the mucous membrane is scratched and abraded so that blood as well as serum will escape.

A rough stone in the bladder may by mere rubbing movements give rise to congestion and inflammation of the surface of the mucous membrane, so that serum or blood may from time to time be discharged with the water. I think that in some cases the irritation of the epithelial surface causes an increased action of the cells which results in the formation of an albuminous material as well as the increased multiplication of rapidly growing bioplasts, and at length pus-corpuscles. This subject is further discussed in Part IV, where also will be found some observations concerning the treatment of calculous disorders.

Albumen in the Urine from acute or chronic functional or structural Changes in the Kidney itself.

The kidney, like some other organs of the body, manifests great variability as regards the degree of its activity. It has been already stated that not only the quantity of urine secreted in a given time varies considerably during the twenty-four hours, but the amount of the principal constituents secreted is sometimes very considerable, sometimes very small. It is not surprising that a gland which greatly varies in activity within the range of health should be somewhat easily deranged or seriously disturbed in its action when subjected to the influence of unusual conditions.

As certain constituents normally pass from the blood through the capillary wall and are discharged in the urine, no wonder that under modified circumstances, and especially when the capillary wall is unduly stretched so that minute rents or fissures are temporarily made in it, other or all of the blood constituents should pass through. In renal

disease, serum may be present in the urine or only some of its constituents in a high state of dilution,—serum and fibrin with leucocytes, or in addition to these a large number of the red blood-corpuscles. The conditions which favour the escape of blood constituents may be temporary or may become established, and last for many years or all through life.

Regarding cases of albuminuria dependent upon changes in the kidney from the clinical point of view, the physician would divide them into two great classes. In one of these acute cases would be placed, while the other would comprise the chronic forms of renal disease. Acute albuminuria may end in recovery or in death within a very short period. Although some cases of chronic disease are ushered in by an acute attack, the great majority commence by changes so obscure and so slightly marked, that disease may exist for many months or even years before it is detected, and then its existence may be unexpectedly discovered, as, for example, when the person presents himself for examination for life assurance, or for medical examination for the army, or for some other professional work in which strength, endurance, and good health are absolutely essential, and every candidate is therefore ordered to pass a careful medical examination.

The difficulty of giving a clear account of the structural changes of the kidney, as of many other tissues and organs, arises from the practical necessity of accepting or modifying a phraseology which when used is found to be so artificial, and so far removed from an accurate description of the changes as they occur in nature, that from the description given even by the highest authorities it would be impossible for the student to recognise the disease with certainty. So that besides studying the accounts given by authors, we, as learners, have to see actual cases which are diagnosed for us. For some time past efforts have been made by various writers to compensate for this defect, but from the very nature of the case with only very partial success; and I fear the time is yet far distant when from the descriptions only as given in books an observer will be able to determine the nature of a disease brought under his notice without previous study in the wards of a hospital amongst the sick, and under the guidance of those who have already learnt in like manner from actual patients to recognise disease, and have been instructed by trained physicians how to manage it.

Each morbid change, notwithstanding that it has received a definite name as though it depended upon one morbid process, is highly complex, and often made up of so many phenomena intermingling and as it were interlocking and sometimes mutually disturbing one another, that although the actual working and the effects of the change may as it were be seen by the mind, their complexity baffles all attempts to describe them, and while no doubt much more information might be

conveyed by series of drawings than has yet been rendered possible, the method is most difficult to carry into practice, and requires exceptional powers as well as great patience and unusual opportunities. It is, too, a most costly mode of recording observations and of conveying information.

In the course of many chronic morbid changes the process known as fatty degeneration is very prone to occur; but any one who has studied the subject will not subscribe to the theory that there is any close pathological connection between say "fatty degeneration" of the liver, "fatty degeneration" of the kidneys, as met with in children and young people, and "fatty degeneration" of muscle, arteries, or nerves. Fatty matter it is true is present in all, but its pathological significance, as well as the mode of its deposition, is very different; the course of the diseases is different, and the three conditions are distinct as regards their origin and causation, as well as in the influence they exert upon changes in other organs, and the duration of life, and also as regards the probability and possibility of improvement. The same kind of remarks would apply to many pathological processes, and the doubts and difficulties referred to tend, I think, to keep open and even widen the breach between pathological science and the detection and management of disease in the living. Although every now and then mistakes may be made as to the incurability of certain conditions by erroneously connecting symptoms with assumed irreparable and irremediable morbid structural changes, no one can hope to be of real use as a practitioner until he has become well acquainted with the results of morbid changes as they are to be seen and studied in the tissues after death. Indeed, he will certainly be the best physician whose mind, stored with the results of observation, gives him the most accurate picture of the actual pathological changes which are proceeding, or which have already taken place in the tissues of the patient whose case is under investigation. The formation of a very clear mental picture is possible to very few. Never probably does it amount to an accurate representation of nature, but the approach is nearer the greater has been the amount of minute painstaking observation and reflection exercised through life, and the greater the skill with which the facts interpreted by the mind have been grouped, and then reasoned upon and thought over.

Clinical Significance of Varying Quantities of Albumen in the Urine in Various Cases.—In the majority of cases in which the urine contains a very large quantity of albumen, and especially if the specific gravity be 1020, or higher, and the urine of a dark brown or smoky hue, caused by the action of the acid upon the colouring matter of the blood,—the inference will be that the case is an acute one, and that this large quantity of albumen has not been passing away from the kidney for any length of time. In very many of these cases, blood

and numerous casts of the uriniferous tubes are present. Whenever blood escapes from any part of the kidney or mucous tract, albumen will, of course, be detected in the urine, for serum will obviously pass through fissures which permit the passage of leucocytes and red blood corpuscles.

In the majority of cases, in which the presence of albumen in the urine is due to structural changes in the kidney, the vessels of the Malpighian tuft doubtless form the precise seat of the escape of albumen; but there are reasons for believing that serum sometimes passes from the capillaries surrounding the convoluted portion of the uriniferous tubes, and in some instances from those in contact with the straight portion ("Archives of Medicine," vol. I, p. 300).

In chronic fatty degeneration of the kidney, there is often also a very large quantity of albumen, but the urine is pale and of low specific gravity. The history of the case, the appearance of the patient, the symptoms present, and the microscopical characters of the deposit, render it almost impossible to mistake a case of chronic fatty degeneration for one of acute inflammation of the kidney, caused by cold, or following scarlet or some other eruptive fever.

If the quantity of albumen was small, amounting merely to milkiness or opalescence when heat was applied, or nitric acid added to the urine, and especially if the urine was pale and of specific gravity 1012 or lower, we should be led to conclude that the lesion giving rise to the escape of the albumen was chronic.

As a general rule, if in a case of albuminous urine the proportion of the urea to the other constituents of the solid matter turns out to be large, we should form a more favourable opinion than if the percentage of urea in the solid matter were very much less than in health. In the latter case a great part of the renal structure would probably be involved; but, in the former, there would be reason to think the disease had so far only affected a small number of the secreting tubules. Many exceptions to these general statements are, however, met with in practice. In short, we must not permit ourselves to form an opinion upon the characters of the urine only, but must consider all the facts in connection with each individual patient. Patients have passed small quantities of albumen in the urine for many months, and yet it has entirely disappeared. In other cases, the progress of the disease is exceedingly slow. I have known a man pass urine of the character above mentioned for upwards of twelve years; and I believe that in some cases this goes on for twenty years, or even longer, and the patient at last dies of some other malady. If organic disease of one organ of the body progresses so very gradually that ample time is allowed for alteration in the activity of other functions to take place, the duration of life may not be affected; and if the patient lives under

really favourable circumstances, he may long outlive persons who were in good health some years after he became the subject of fatal organic disease. It must, however, always be borne in mind, that such persons are more likely to suffer from exhausting influences, cold, fatigue, &c., than others in whom the kidneys are healthy, and therefore they should always place themselves under medical supervision.

On the Nature of Structural Renal Changes.—Before we can decide upon the nature of many morbid processes, we must ascertain what was the exact change which constituted the first departure from the normal state, for this was the true starting-point of the derangement or disease, and we must make out which of the many textures present in the organ was the particular one first affected. Of late years far too great an importance has, in my opinion, been given to the interstitial tissue—many pathologists having apparently satisfied themselves that it is in this interstitial connective tissue that many morbid changes really begin. Thought has for some time been running along the lines long ago laid down in favour of the paramount importance of what was called intercellular substance supposed to be deposited from the blood, and subsequently by the suggestion of the very important part supposed to be played in the process of inflammation by the so-called connective tissue corpuscles.

In the acute and chronic changes in the kidney an importance has been given to the interstitial tissue, which I for one cannot allow that it deserves. The conclusions rest in part upon theoretical grounds, and in part upon observations made upon specimens of organs in very advanced disease, which have been for the most part mounted in Canada balsam—a method which is quite unfitted for researches having for their object the determination of the real nature of the changes which occur in tissue elements in disease.

The nucleated fibrous tissue which is supposed to support every uriniferous tube and every Malpighian body is one of those many inventions which has retarded, and seems likely to continue to retard, physiological and pathological progress. This fancied supporting framework of intertubular fibrous or connective tissue has led to the superposition of hypothesis upon hypothesis until a purely artificial pathology based upon tissues and processes which do not exist in nature has been built up. The tissue itself is differently described. According to some authorities it is a firm framework of fibrous tissue, while by others it is spoken of as clear and transparent, translucent, structureless. It is said to be of definite structure, and to be composed of indefinite connective tissue. It is, however, certain that at an early period of development, when the tissues are soft and more in need of support than at any other time, it is absent. In inflammation the so-called nuclei of this supporting framework of connective tissue are said to be

intimately concerned. The fibrous tissue is increased according to some in consequence of hypertrophic changes, while by others it is supposed that the lymph exuded from the blood is the source whence the fibrous tissue is eventually derived. In any case there is an increase of the fibrous tissue which as time goes on condenses and contracts, and constricts the uriniferous tubes and vessels so that they are caused to waste and to undergo other pathological changes, such as fatty degeneration and granular or fibrous alteration. The consideration of these changes has led to the division of renal diseases into two classes, according as the secreting tubes or the intertubular connective tissue is the seat of pathological change.

Although such an arrangement may be supported by appeal to the pathological alterations in structure observed in some forms of renal disease, it is too arbitrary and artificial to be accepted as satisfactory or final. The cases which are regarded as exclusively due to intertubular changes often exhibit evidence of tubal alteration, while the tubes themselves are seldom exclusively affected. In both classes the starting-point of renal change is the cells, and the degree of disturbance occurring in them may determine whether there shall be slight or considerable intertubular alteration. It seems to me that any classification founded upon such principles is open to the objections which attach to the old division of inflammation into purulent and plastic, or suppurative and adhesive, or the more modern catarrhal and croupous. The differences do not depend upon differences as regards the inflammatory process itself, but are determined rather by the particular tissue affected, and the extent to which the inflammatory process is carried, or to its intensity.

In endeavouring to determine the nature of the initiatory changes in renal disease, I think the interstitial matter may be entirely left out of consideration. The changes begin in the cells of the uriniferous tube or in the blood. It is doubtful whether the interstitial matter which does exist in the adult, and which increases as age advances, takes any active part in the changes which occur, for the pathological actions may run their course at an early period of life before any such tissue is formed, and in animals where it cannot be demonstrated.

I attach immense importance to blood composition and blood-change in inflammatory diseases of various organs, and believe this to be the true origin of most acute inflammatory diseases. In all fevers and most acute inflammations blood-change precedes the characteristic phenomena. Blood-change is the starting-point, and may be looked upon as the cause of what follows. The other factor must be some unusual "tendency" or "susceptibility," or inherent weakness or developmental defect of the particular organ which is the subject of attack. It is in this way I should venture to answer the difficult question which presents itself for solution in so many cases. Why, for

example, is the lung the organ involved in one case, the kidney in another, the stomach, the intestines, the liver in others? In contagious fevers the poison gets into the blood and works changes therein; nay, in the case of many the poison germ itself will be inoperative unless some prior changes in the individual's blood shall have prepared the circulating fluid for its reception and nutrition. I feel convinced that if only the blood could be kept right thousands of serious cases of illness would not occur, while I am of opinion that the persistence of a healthy state of the blood is the explanation of the fact that many get through a long life without a single attack of illness of the class under consideration, although they may have several weak organs.

If the renal epithelium be unequal to the work assigned to it in cases of physiological pressure, the circulation of the surcharged blood in the vessels is slowed, distension of the capillaries occurs, thinning of their walls, and escape of liquor sanguinis with multitudes of bioplasts. These last grow and multiply in their new situation outside the capillary walls, and are the agents concerned in the development of the fibroid material which gradually accumulates. Now could the renal epithelium have adequately discharged the extra work put upon it the blood would have been depurated at the proper rate, free diuresis would have occurred and all would have gone well; or if at the right moment free purgation or active diaphoresis had been adopted the same effect would have been produced. An altered state of blood, a departure from the normal physiological condition, and a disturbed state of action of the bioplasm of an organ due to inherent weakness, often hereditary, sometimes of developmental origin, will enable us to adequately explain the first step in many forms of acute and chronic disease. In acute renal inflammation the blood change seems to be the first alteration, the epithelial failure next in order, and the exudation or effusion of matters interstitially the third. This last may occur or not according to the intensity of the disturbance. In an attack of acute nephritis there seems to be rather sudden stretching of healthy capillary vessels almost to bursting. No blood necessarily escapes. The distension may be merely temporary, and may gradually subside without anything more serious than the escape of a certain quantity of serum. Or the stretching may be carried to a degree sufficient to allow of rents or fissures being formed, through which many blood-corpuscles may pass, the vessel nevertheless returning to its former condition perhaps in a few days, just as when hæmorrhage takes place from the capillary vessels of the nose, lung, or stomach in certain cases. In chronic nephritis slow changes take place not only in the capillaries, but in too many cases in small arteries,—changes affecting the nerves and the muscular fibres of the vessel, and preventing their physiological action. Gradual filtering through all the renal tissues of a weak solution of albumen which finds

its way at frequent points into the tubes occurs. The renal changes in both chronic and acute affections seem to commence in the epithelium lining the convoluted part of the uriniferous tubes.

Acute Inflammation of the Kidney.—Although an acute attack often initiates chronic renal disease, the practitioner must bear in mind that happily by far the greater number of cases of acute renal inflammation, whether coming on from exposure to cold, or following scarlatina or other febrile condition, quickly recover.

There is no more reason to suppose that in the majority of these cases the renal structure is permanently injured than there is for concluding that the lung tissue is necessarily damaged by an attack of acute pneumonia, or the pleura, or the pericardium, by inflammation of these structures. In many cases undoubtedly the inflammation does result in structural change, but not necessarily so. The inflammation, after having lasted for a time, may cease, or as we say, resolve, effused and formed products be absorbed, and the membrane return to its normal state. Both kidneys may be the seat of violent inflammation which may continue for some time, and the organs regain their normal state without having undergone the slightest damage. So also there may be complete recovery from an attack of acute dropsy or dropsy after scarlatina without any permanent tissue change. The patient after recovery would be as likely to live as long, and in my opinion his life might be considered as safely assurable as if he had never had an attack.

With regard to acute inflammation of the kidney, as of many other organs, there has always been the question still undecided, where does the pathological change begin—which structure, which anatomical elements, are the first to suffer derangement? Nor is it possible in the existing state of knowledge to give a clear and unqualified answer to these questions. As already stated, I believe that in some cases the true cause of the first change exists in derangement and alterations in chemical composition of the blood, and that in others, the gland structure, the epithelium, is primarily at fault. Of the last cases most are to be attributed to aberrations at an early period of development, resulting in imperfect or weak action, and a few perhaps to what was originally normal cell-structure being long influenced by adverse conditions operating on the gland itself, and affecting the nerves or the distribution of the blood. Lastly, some cases of sudden disturbance of renal action usually included, on account of the symptoms, in the category of inflammatory diseases, commence in deranged nervous action, and are caused by some sudden and important disturbance in the ganglia which govern renal action; the nerve derangements themselves perhaps resulting from changes higher up in the nervous system.

As regards the precise seat of the escape of the serum or of the

blood there has been much difference of opinion, but at least as to the blood there is no room for doubt that the vessels of the Malpighian body are those from which the blood is discharged into the uriniferous tube. Look at the large quantity of albumen in the urine in cases of acute dropsy, and dropsy after scarlatina. Consider the fact of the almost constant presence of blood, the presence of blood and its accumulation, filling and blocking the convoluted portion of the uriniferous tubes, as demonstrated in case after case where death has occurred early in the attack, and then say whether we are not forced to accept the conclusion that the albumen and the blood escape from the vessels of the Malpighian body. The evidence allows no other conclusion. But as regards the cause of the escape and the precise changes which end in the discharge of the blood, we have yet much to learn. It has been shown by Dr. Mahomed that there is increased arterial tension, and that hæmoglobin sometimes transudes through the vessels into the urine some time *before* the occurrence of albuminuria, and this condition of increased tension is usually preceded by constipation. After scarlatina it would therefore seem to be prudent, in order to prevent the occurrence of albuminuria, to give purgatives. The judicious use of these remedies is very likely to prevent an attack of acute renal inflammation.

It is probable that when the inflammatory state is about to be established the epithelial cells of the kidney fail to separate, as fast as they are presented to their influence, the urinary constituents which have already unduly accumulated in the blood, the epithelial cells enlarge, the blood passes more and more slowly through the capillaries, and at last scarcely moves. The vessels, after being for some time much distended, allow serum to traverse their walls, and in many cases more or less blood escapes. The bleeding is often followed by relief, the secreting cells discharge their superabundant accumulation and diminish again in size, more fluid passes down the tubes, the blood is depurated by the increased activity of the cells, and the patient's condition soon exhibits a change for the better. In some cases, however, this favourable alteration does not occur. The exudation poured out, and which collects between the capillary vessels and the tubes, is considerable. The colourless blood-corpuscles or particles of living matter detached from them grow and multiply. In this way a large number of living particles growing and multiplying, with much albuminoid matter, gradually occupy the spaces between the tubes and vessels, compressing them more or less, and no doubt causing important changes in the gland by the influence exerted upon the nerves, many fine fibres of which run amongst the tissues. The new particles resulting from the growth of the bioplasts are sufficient to cause considerable enlargement of the kidney, and from the nature of the pathological change it must be obvious that if recovery occurs it must take place slowly, because

the absorption of the matters poured out can only be effected very gradually, while if actual fibrous tissue has been formed, it is doubtful whether the absorption of more than the fluid in the interstices of the fibres is possible. Damaged as the natural healthy structures must be by the changes referred to, it is not surprising that degenerative processes should follow such an attack. The tubes, with their epithelium, may shrink considerably in diameter, and some of the capillaries may shrivel. The interstitial exudation, as already hinted, undergoes complex changes which result in its contraction in bulk. The watery matter is absorbed, the soft fibroid tissue first formed probably undergoes diminution in bulk, and gradually shrinks. In time the kidney contracts to half its size, or even less than this, and may after years present the usual characters of ordinary granular kidney.

What is the origin of the particles which are found in such numbers, and which there can be no doubt are the agents concerned in the production of the interstitial material? That these particles consist of living matter there can be no question whatever, but as to their origin there may be much difference of opinion, since they may result—1. From the growth and multiplication of the "nuclei" of the interstitial tissue held by many to be present as a necessary structure in the healthy kidney.—2. From the growth and multiplication of particles of living matter which have passed through fissures in the walls of the stretched and distended vessels from the blood, or partly from this and partly from the first process.—3. From the aggregation of minute particles suspended in the exudation. The second is the view concerning the origin of these bodies which I accept as the correct one, the third I consider quite untenable.

Chronic Inflammation of the Kidney with Enlargement.—In ordinary attacks of acute inflammation probably very few of these particles of living matter pass through from the blood, and relief is afforded before these can grow and multiply, but occasionally it happens that the circumstances favourable to their escape from the blood persist for a considerable time, in which case serious, if not irreparable, damage to the secreting tubes results. Sometimes, indeed, the bulk of matter resulting from the multiplication of the living particles and the matter formed by them is considerably greater than that of the original tubes and vessels around which the formation has taken place.

It is probable that minute particles of living matter were actually growing and multiplying in the blood long before the attack commenced. A careful consideration of the probable changes in the blood antecedent to the attack leads to the suggestion that it might have been prevented if suitable means had been taken at this early period to favour the removal of accumulated products from the blood.

The form of slow inflammation with enlargement above referred to

no doubt often succeeds an attack of acute inflammation of the kidney, but it may come on gradually without any acute symptoms at all. In many of those cases where we meet with rapid enlargement of the liver from injudicious living in men of from thirty to fifty, the kidneys are often also affected with inflammatory enlargement, I believe, of this nature, and when death takes place within a few months of the first appearance of albuminous urine, the kidneys may be found to be much larger than natural. The epithelial cells are large, granular, and opaque, those in some of the tubes being here and there affected by fatty change. This change is sometimes limited to a convolution or two, but sometimes many adjacent tubes are affected for a considerable part of their length.

If the patient lives, the kidneys, like the liver, gradually degenerate and waste, and at last present examples of the small contracted kidney with its degenerated tubes, reduced cortical structure, and wasted vessels, the last change affecting not only the small arteries of the kidney, but those of the body generally. I do not think that even in the majority of cases the small contracted kidney is preceded by an enlarged and inflammatory condition of the organ. I think that the kidney may pass, so to say, direct from its normal condition to a state of condensation and contraction, or, from increased work being suddenly thrown upon it, may first enlarge and then subsequently undergo contraction.

There is also the question of the interstitial origin of the disease to be considered. Why should we suppose that any form of inflammatory renal disease begins interstitially? No doubt the intercellular-substance-deposition hypothesis and the connective-tissue-corpuscle theory lent support to the view of the occurrence of intertubular inflammation as distinct from epithelial or catarrhal inflammation, but both these views seemed to be very artificial, and neither was adequately supported by the results of observation. In most of the cases in which the inflammatory change seems to be mainly interstitial the epithelium was probably affected first, but as I have already remarked, the first change in order is in the blood, the second epithelial, and the third interstitial.

Chronic Wasting of the Kidney with Contraction.—The gradual wasting, contraction, and condensation of the structural elements of the kidney is by far the most common form of disease which seriously deranges the action of the organ, and which results at length in its irreparable damage and destruction as a secreting organ. These changes are associated with, and sometimes are the cause of, changes in the structure of the walls of the small arteries and capillaries affecting the nutrition and action, it may be, of all the tissues of the body.

This chronic wasting of the renal structure seems to be, at least in

many instances, a consequence of the state of system which induces gout, and is often associated with other effects of long continued alcohol taking and irregular living, both as regards the quantity and nature of the food and the time of taking it. A form of the affection accompanies degenerations of various tissues which result from chronic poisoning by lead. But occasionally the disease is met with at so early an age that it cannot be accounted for by any of these circumstances, and must be attributed to developmental defects, or to pathological changes occurring during intra-uterine life. Cirrhosis of the liver is another structural disease of middle life and old age which also occasionally occurs during early childhood. But although it may be regarded as certain that the degenerative changes above referred to are favoured by high living, and particularly by indulgence during several years in regular alcohol taking, even though it never be carried to excess, I have seen it in many healthy-looking men between sixty and seventy whose mode of life had been healthy from the first, and who had never exceeded in any way. I think that in not a few of these cases the result of the disease is due to inherited predisposition, a circumstance which probably plays a far more important part in the causation of many diseases than is generally supposed.

In some cases chronic wasting gradually succeeds to an attack of acute renal inflammation with great enlargement. Some have held that this is invariably so, but there can be little doubt that a kidney may very gradually pass from the healthy into the chronic condition of gradual wasting and condensation without there having been any enlargement at any period of the disease.

The general contraction, the wasting, the shrivelling and shrinking and reduced activity of the secreting structure, the increase, as we say, of the interstitial connective tissue, which takes place in advanced age, may be regarded in the main as a normal process of degeneration, but which occurs at a much earlier period of life in some persons than in others. A corresponding series of phenomena—condensation and contraction and diminished function—may be watched, proceeding slowly in some, quickly in others, but going on in all in other textures, notably in many parts of the muscular and nervous system. But I believe the change in question is more correctly regarded as a degeneration than as a chronic inflammation. What was once active muscle, or nerve, or gland tissue is becoming, or has already become, what we call connective tissue. But this so-called connective tissue is probably more truly the insoluble *débris* of textures which have ceased to be active, and have wasted, leaving behind this fibrous-looking residuum consisting of material not to be absorbed or removed, and which in years or in decades becomes further condensed and contracted, but which remains to the end, useless and passive, but serving to mark the situation where

once perpetual change and never-ceasing activity prevailed. The rate of the degenerative process, and, as I have said, the periods of life at which it begins are indeed very different, and I have no doubt whatever it may be accelerated or retarded—retarded by good management, even in those who unfortunately inherit, it may be, through several generations, an inveterate proneness to reach full development at a too early period of life, and to begin to decay many years before the degenerative changes in the tissues should have commenced.

It is here that the results of scientific work and thought may be of the greatest practical benefit, for what can be of more consequence or of higher advantage than to ward off, or retard, or render slower than they would otherwise progress, the inherited tendencies to early degeneration? That if permitted we can in many instances do this I have no doubt. When such tendencies have been manifested in one generation, what can be more in accordance with common sense and the teachings of physiology and pathology, than for to allow the physician to do all he can to place the rising generation under circumstances more favourable to their health and vigour than those to which their predecessors had been exposed. No doubt it will be seldom indeed that we can make a strong vigorous man out of a weakly child of bad inheritance, but we can do much in the way of improving his health if only we are permitted to do so. Early deaths may have occurred in the family, and but too often the survivors share the same fate; frequently, it must be admitted, in consequence of their wilfulness, obstinacy, and reckless disregard of advice, patients actually encourage the changes we would avert or retard. Few parents allow us to advise them concerning the general management of their children, unless there is decided illness, fewer still consult us as to the right course to be pursued during youth, and perhaps fewer can bring themselves to seek advice during the strength and vigour of manhood; and of these few, it is to be feared not many follow the advice given, or allow their conduct or their work to be influenced by health considerations. The victims of tissue degeneration, it is true, will do anything we advise, after the pathological changes have commenced in earnest, in order to keep themselves alive as long as possible. That we can materially help seriously damaged organisms to live on there is not the smallest doubt, though for people to alter their conduct, to regulate their mode of life, to exercise the self-control necessary to retard the progress of degenerations, is sufficiently difficult and exceptional, and few can be persuaded to alter the course they have been obliged to take or have selected for themselves in degree sufficient to produce the desired result.

There are few facts in connection with chronic disease of the kidney which are of such consequence in helping us to form a judgment as to the extent and degree of degeneration which may have already occurred,

and the probable duration of life in a given case, as the quantity of urea, uric acid, and other organic matters passed in the twenty-four hours. The amount of these often varies greatly during the progress of the disease, rising when improvement occurs, falling when the patient gets worse. It is important for the physician to ascertain the amount of urine passed in the whole period of twenty-four hours, because the proportion may vary greatly in the several quantities of urine passed during the day and night. By making observations at intervals of a few months upon a portion of the whole urine collected during the twenty-four hours, we are sometimes able to form a tolerably correct estimate as to the probable rate of progress of the disease, and the duration of the patient's life.

Syphilitic Renal Disease.—Of all forms of albuminuria that have come under my observation this has proved the most tractable, or I might say curable, for unquestionably many cases of very serious albuminuria with extensive anasarca have completely recovered, notwithstanding the illness had lasted for two years or longer. In these cases the amount of albumen may reach two-thirds or more of the bulk of the urine tested. The specific gravity is usually 1020 or higher, and the quantity of urea not less than that found in healthy urine. If we regarded symptoms only, cases of albuminuria which depend upon syphilitic disease would seem to be among the most serious forms of renal disease. The dropsy is often excessive. Heart and lung complications are frequent. The stomach is often much disturbed, and sometimes uræmia seems likely to destroy life. And yet these cases are seldom fatal. Indeed, in many we may promise early improvement, and if not actual cure, certainly mitigation of the most serious symptoms within a short time.

As regards pathological changes due to syphilis, it may be remarked that while on the one hand they are of a very persistent character, and last in some instances for many years, ceasing perhaps for a time, and then reappearing in the same or in other tissues, syphilitic deposits are undoubtedly more amenable to remedies than ordinary chronic inflammatory thickenings, contractions, or deposits, or amyloid or cancerous changes. It is remarkable that the organs of the nervous system, many of the glands, especially the liver, are more seriously, and I think, more permanently affected by deposits of a syphilitic character than the kidneys. I have no explanation to offer of the fact, but I have certainly had under observation more cases of syphilitic disease of the kidney in which permanent benefit has resulted from treatment than I have met with among cases of syphilis affecting other organs of the body. As compared with other cases of albuminuria depending upon chronic renal disease, I look upon those depending upon syphilis as by far the most hopeful. Not a few of the cases occurring in people under thirty

completely recover, and even in bad cases occurring after that age the grave symptoms often cease, and the albumen falls to a mere trace which may continue through life, varying from time to time in amount, according as the patient manages himself wisely or injudiciously. The general health, the strength, the look of the patient are less affected in syphilis than in other chronic diseases of the kidney, and on this account cases may be easily overlooked in the early stages.

Although tumours and gummata of syphilitic nature are found in the kidney, I think that most of the cases of albuminuria of syphilitic origin that come under notice are due to changes closely allied to those which occur in chronic inflammation with enlarged kidney, which has been considered to be interstitial or intertubular in its origin; but the particles of bioplasm are of peculiar, and as is said, specific character. These particles of syphilitic bioplasm are small and granular, but I know of no means by which they can with certainty be distinguished from the particles of bioplasm which grow and multiply interstitially in ordinary inflammation. It is probable that these particles of living matter, like those in ordinary inflammation, after growing and multiplying for a time, die, and undergo disintegration and liquefaction. The state of blood, which results from the long-continued introduction of small doses of mercury and of iodide of potassium, no doubt favours the death and disintegration of these particles, and promotes the absorption of the resulting products.

ALBUMEN IN THE URINE DEPENDING UPON FATTY DEGENERATION OF THE KIDNEY.—The opinion has been expressed by some that fatty kidney is invariably preceded by ordinary inflammation with enlargement —that the fatty degeneration constitutes a secondary series of changes which may be succeeded by wasting, or may destroy life before attaining this stage of pathological degeneration. That this is correct in some instances there is no doubt, but in the opinion that the large white fatty kidney occurring in children and young people is invariably the result of acute inflammatory affection I cannot concur, for one often sees cases where the change has gradually proceeded for many years without any acute or sudden derangement of the health from first to last.

In several forms of renal disease, with the exception of amyloid kidney, fatty degeneration affecting some of the epithelial cells as well as the walls of the capillaries and other tissues, is very frequently observed, and in varying degree. There is, however, one form of disease to which the term "fatty kidney" is very properly applied. It occurs for the most part in young people, is probably developmental in its origin, and in all but a few exceptional cases, in which only a portion of the kidney is involved, is fatal, generally within four or five years from its commencement. The urine of these cases contains usually a large quantity of albumen, generally amounting to a third or half the

bulk of urine subjected to the influence of heat or precipitation by nitric acid. The urine is pale and of low specific gravity, from 1005 to 1015. There is usually a whitish deposit which gradually subsides, and is found upon microscopical examination to consist of tube-casts containing oil globules and epithelium filled with oil globules, free epithelial cells and free oil globules, and small collections of the same. As these cases cannot be cured, all we can hope to do is to retard the progress of the disease, and prolong life for a time. As the disease advances, the blood becomes poor in red corpuscles, and the surface pallid. Dropsy supervenes, and as time goes on the patient suffers from distressing vomiting, and death sometimes results from exhaustion, sometimes from uræmia and coma, and is sometimes accelerated by the occurrence of pericarditis; occasionally the case is complicated by the occurrence of pneumonia or pleurisy, or both.

Fatty kidney is a very fatal form of kidney disease. I must, however, state that recovery occurred in two cases (girls under twelve), in which all the symptoms of large, pale, fatty kidney were most marked. The urine contained a large quantity of albumen and numerous casts containing oil and free cells crowded with oil globules. There was general dropsy with vomiting and pallor lasting for several months. Preparations of iron were given in both these cases, and after the lapse of five or six months the patients began to improve. In these cases and others of the same kind to which my attention has been drawn, I think that probably only a portion of one kidney was affected, and that as the general health improved, the fatty degeneration ceased to extend. The tubes already affected probably slowly wasted, their place being taken by new tubes which were gradually developed. Although it would be unreasonable to suppose that where the renal structure generally of both kidneys was the seat of fatty degeneration, recovery might occur, it is certain that in many cases the morbid change begins in one part and slowly progresses. If therefore the condition is detected at the commencement, and the state of the patient's general health can be completely changed, it is reasonable to suppose that the disease may be arrested, the disintegrated secreting structure replaced by new tissue, and even complete recovery take place.

Albumen in the Urine depending upon Amyloid or Lardaceous Kidney.—In waxy amyloid, lardaceous, or albuminoid degeneration, we have a series of very remarkable morbid changes, the origin, causes, and precise nature of which are still obscure. The kidney is larger than normal, having on section a peculiar transparent appearance, the cortex pale, the pyramids dark, in consequence of the vasa recta and the veins being injected. The texture is firm and brawny looking, giving the idea that the tissues are suffused with transparent material. The surface of a section becomes white on being moistened with nitric

acid from the large quantity of albumen present. Iodine exhibits a peculiar reaction, and stains all the tissue of a deep brown colour. The transparent amyloid matter which gives these reactions is deposited first in connection with the smaller arteries, and particularly the vessels of the Malpighian body, the coats of which are in consequence much thickened, irregular in their outline, and having their calibre in some places much reduced; while in others the tube seems to be dilated. The tubes are very tortuous, and one branch can sometimes be followed for a long distance as it twists about in the semi-transparent tissue. The loops of the vessels of the Malpighian bodies are early affected, but the capillary walls are also thickened from the deposition of the same substance, and as the disease advances, every part of the renal tissue becomes infiltrated. The epithelium of the tubes is altered, and a quantity of the glistening material often occupies the cavity of the tubes, and escapes from time to time as long elongated cylindrical casts, around which new layers are deposited as they pass downwards towards the pelvis of the kidney. Several have been figured in "100 Urinary Deposits," pl. IV, figs. 49, 50. The tissue of the tubes, like that of the vessels, becomes stiffened by the deposition of the transparent matter, and the tubes are therefore freely open for the passage of casts, or any exudation that may be poured out. The morbid change affects other organs, and the liver and spleen usually exhibit the morbid change in remarkable degree. They may attain a large size, and not unfrequently before the kidneys begin to be invaded. The vessels of the Malpighian body seem to suffer first, and from the appearances resulting, it is probable that the glistening substance is deposited as the fluid which holds it in solution gradually filters through the tissue.

At first there is no œdema, either of the most dependent part of the body or of any tissue, but as the disease advances it appears and gradually extends. Many of the textures become infiltrated with fluid, and in the liver all the tissues suffer from its presence. The hepatic tissue occupies a greater bulk than in the normal state, and its specific gravity is lower than that of healthy liver. Ascites not unfrequently appears, and in some cases fluid accumulates to a very great extent. The quantity of urine is increased, and in some cases to a considerable extent. It is usually of low specific gravity, and contains albumen, which increases as the disease advances.

Amyloid kidney occurs in persons of phthisical constitution, prone to the occurrence of caries of bones, and scrofulous abscesses, and in those who have long suffered from extensive chronic suppuration or from certain forms of syphilis.

In amyloid kidney the blood is poor and pale in colour, and it is probable that the glistening albuminoid material is formed in it. After

a time tissues and organs become infiltrated, and the transparent matter is deposited in connection with the tissue, while the fluid is reabsorbed into the blood. The disease may last for many years, but it is very doubtful if recovery occurs after the morbid change has once become established, although it is quite conceivable that in the very early period of the change, good air and careful attention to diet, may be very beneficial, and even that a state of system might be established in which the absorption of the amyloid matter already pervading the tissues might take place, and the matter itself be removed and eliminated.

Casts are very commonly present in the urine of amyloid kidney. Some are composed of glistening wax-like material and flattened epithelial cells are sometimes attached to them. New matter is added as the cast passes down the tube, and it is not uncommon to meet with specimens which consist of several layers superposed upon the original cast. It is more probable that the new matter thus deposited circumferentially exudes from the wall of the tube, and is deposited as the cast passes along, than that it escapes from the vessels of the Malpighian body, and is thence conducted into the tube.

ON THE TREATMENT OF DISEASES OF THE KIDNEY.

By the careful and minute study of renal physiology and pathology we hope to be able to distinguish those cases of renal disease which it is possible to relieve or cure, or which may be restored to health by remedial measures, from those which are absolutely incurable,—and among the latter to distinguish those which will be rapidly fatal from those which are likely to become very chronic and last for many years.

Those who are familiar with this class of diseases know that cases have been needlessly condemned which have made complete and rapid recoveries. On the other hand, persons suffering from certain serious and fatal forms of the disease in which there were no observable general symptoms, who have scarcely believed themselves to be out of health and have even been recently accepted by Insurance Offices as perfectly healthy lives, have succumbed within a few weeks. The diagnosis between many slight and serious maladies of various kinds, although still far from precise, is, thanks to modern investigation, becoming more and more practicable. Even in the case of renal diseases, which in their course and progress are among the most uncertain with which the practitioner has to deal, something approaching precision, as regards prognosis as well as diagnosis, is attainable in an increasing number of instances. So slight are the general symptoms in some of the most serious cases, that it may be difficult to persuade the patient there is anything really the matter with him, and his life may become very much shortened for want of ordinary care. Observation and experi-

ence have shown that by judicious management and proper treatment during the early stages of the disease, cases which some years ago would have been considered among the least hopeful, may be kept alive for a considerable time, or may be restored to comparative health, even for many years.

The importance of recognising the existence of albumen in the urine cannot be exaggerated, and conceding all that has been said about physiological albuminuria, the accidental presence of traces of albumen in the urine, and the frequent cures said to have been effected in those who have been recently attacked, there is no doubt whatever that the greatest care should be taken by everyone whose urine frequently contains traces of albumen, for at least in many of these persons degeneration of important textures has already taken place, and they are not in a condition to bear fatigue or exposure. What in a person of ordinary health and constitution would be a mere cold, or at the worst an attack of bronchitis, pneumonia, or other acute disease, from which recovery would be almost certain, and without any damage to the structures involved, in the subjects of renal disease would be a very serious and very likely fatal malady. In how many of those terrible cases of such acute maladies, fatal within a few days, do we not find albumen in the urine and evidence of renal disease, which had probably existed for years, but was quite unknown to the patient! Not unfrequently we hear of men who had been considered and had considered themselves healthy, dying ere middle life has passed of a sudden attack of bronchitis, or pneumonia, or congestion of the lungs, after an illness of only a few days. Many of these rapidly fatal cases are due to long standing chronic renal disease, which ought to have been discovered years before. How often does, or I should rather say, did the surgeon years ago, when the water was less carefully examined than it is now, lose cases of operation which ought to have done well! The simple operation of passing a catheter will often excite dangerous febrile disturbances in a person suffering from renal disease, which sometimes ends fatally. Even in ordinary health the operation is sometimes followed by serious nervous disturbance, but the very severity of the derangement may be evidence of a highly active and healthy state of those nerves and nervous centres by which the circulation of the blood is governed and regulated; and although violent rigors, extreme pallor of the surface, and syncope of an alarming character may ensue, the patient generally passes into a profuse sweat, and soon afterwards gets well. Experience shows that in a very large percentage of cases the patient makes an excellent recovery, and, I think, that in the happily rare instances in which death does occur, a sufficiently careful examination would have afforded evidence of long existing tissue-change of some kind.

Sir Andrew Clarke adduces two cases of "catheter fever," uncom-

plicated with kidney disease, which resulted in death. In the cases of serious degree of febrile disturbance, resulting in long illness or death, that have fallen under my own notice, there was either chronic renal disease of an advanced character, or evidence of old progressive tissue degeneration, or both. While considerable functional disturbance very frequently follows the introduction of a catheter or any very slight surgical operation, such as the removal of a pile, or a slight cut, injury by an insect, or the bite of an animal, I do not think that the functional derangement results in death save when serious structural change has occurred or some grave disease which has not been detected. We must also bear in mind that cases of renal degeneration are not uncommon in which the presence of albumen entirely disappears for a time, and then recurs. This disappearance and reappearance of the albumen, as I have before remarked, may occur several times before the disease becomes established. Many such cases are very difficult to explain, and the most contradictory opinions are given as to the nature and probable result of the malady by those who see them. In such cases a state of system must be brought about which would render recovery from an acute malady far less probable than in the case of a person attacked in ordinary health.

Changes taking place in the kidney can only be influenced by remedial measures in two ways. 1. Through alterations effected in the composition of the blood, by air, food or medicine. 2. By reflex nervous action through the instrumentality of peripheral nerve fibres distributed upon the external cutaneous surface, or upon the mucous membrane of the intestine.

1. **Acute renal disease.**—The broad principle to be acted upon in the treatment of acute affections of the kidney is to relieve the renal organs as much as possible of their work for a certain time—in short, to allow them to rest, while we endeavour to excite the skin, the bowels, and perhaps the lungs, to assist in performing for a time the work which it is the duty of the kidney ordinarily to discharge. When in the case of acute disease there is reason to believe that the bowels are overloaded or that the quantity of excrementitious substances has accumulated in the blood in undue proportion, or that the proportion of blood in the system is greater than is advantageous to the economy, it will be still more necessary to act upon the principle above referred to. Blood letting, free purgation, the administration of sudorifics, and the application of heat to the cutaneous surface may be employed.

Bleeding has been recommended in acute inflammation of the kidney, but it is only necessary in exceptional cases. If blood is to be taken, cupping over the loins should as a general rule be resorted to, but in most cases dry cupping will be sufficient to relieve the congestion of the kidneys. In children, especially if there is lumbar pain, dry cupping, or the application of a mustard poultice sometimes gives much

relief. Rigollot's mustard leaves may be used, a piece of writing paper being interposed between the mustard and the skin.

Free purgation should be excited by castor oil, colocynth, jalap (pulv. jalap. co.), scammony, gamboge, elaterium, or other vegetable purgative, but mercurial preparations should be avoided in all forms of kidney disease, as mercury is very liable to excite salivation, and sometimes sloughing results from its exhibition, even in very small doses, in renal diseases.

Sweating is to be encouraged by the application of external warmth which is the best and most effectual method of exciting rapid diaphoresis. The patient may be well covered with blankets or eider down coverlets, and placed near the fire. The ordinary warm bath or the vapour bath may be used with the same object, but hot dry air is preferable. A very simple but effectual method of exciting perspiration is to saturate a blanket with very hot water, wring it in a sheet, and then spread it out. When it has cooled a little the patient may be placed upon it, and the hot wet blanket well wrapped round him—the head of course being left uncovered. Another blanket or other covering is wrapped round the wet one, and the patient placed on a sofa before a good fire. In the course of a quarter of an hour free sweating will be induced. This may be allowed to go on for half an hour or so, and then the patient, after being quickly wiped dry, may be transferred to a dry blanket and put to bed. Sweating may also be promoted by the solution of acetate or citrate of ammonia, or the granulated effervescing citrate of magnesia may be given, and is a most pleasant remedy. Small quantities of ipecacuanha may be prescribed with the same object, but no preparation of opium must be given, for a very small dose of this drug may do serious mischief, especially if there is any tendency to coma.

Hot-air Baths.—The hot-air bath is a valuable remedy in many forms of renal disease accompanied with dropsy, and even patients who appear to be very weak often bear free sweating well. The patient should, however, always be carefully watched, and if faintness comes on, a little ammonia or brandy should be given, and the bath suspended.

There is often some difficulty in administering the hot-air bath satisfactorily. The simplest apparatus consists of a wicker frame, like a half cylinder, which is placed over the patient and then covered with blankets, the head being left out. The lower end of the frame is closed with a piece of wood having an opening, into which a tin or iron pipe made without soldering, and about two inches in diameter, is fitted. The lower end of this pipe is placed over a large spirit lamp or ring gas burner. The heated air passes up, and in this way profuse sweating may be induced. An excellent form of hot-air bath was introduced by Dr. Joseph Rogers, medical officer of the Strand Union, and described by him in the "British Medical Journal" for November 16,

1867. It is made by Messrs. Addis, ironmongers, of 6, Leicester-street, Leicester-square. The late Surgeon-Major Wyatt also devised a convenient form of hot-air bath. The following description is in Mr. Wyatt's own words :—

"The under end of the pipe is covered with thick felt and perforated, so as to allow of the lateral escape of the hot air or vapour, when it is required for the use of the extremities only. The spirit lamp is so contrived, that the flame can be extinguished without any effort of the attendant to blow it out, and the perforated diaphragm above the lamp is moveable, so that drugs can be placed upon it (through which the hot air easily permeates), or a small dish for subliming powders, or generation of moist vapour in a vessel which is adapted to hold half a pint of water, which will commence to boil in ten minutes after the lamp is lighted, and be dissipated in forty minutes.

"The cradle is made of wood and iron in sections, being contrived for packing and portability, and of little weight. I may remark in conclusion, that independently of any consideration of a medical character, all the requirements and comforts of a Turkish bath can be well procured by this simple domestic contrivance, with the use subsequently of the hot and tepid water arranged by the bedside in a common slipper bath." This apparatus was made under Mr. Wyatt's supervision by Mr. Nettleton, ironmonger, Sloane-square, Chelsea. An excellent arrangement for a hot-air bath or portable Turkish bath, has been carried out by J. Allen and Son, of 21 and 23, Marylebone-lane, Oxford-street. The same firm supply bronchitis kettles, croup and diphtheria kettles, and many other appliances of great use in the sick room.

Diet.—A patient suffering from acute inflammation of the kidney should be restricted to slop diet. Beef-tea and milk may be given, but not in too large quantities at first, as it is not desirable to encourage a very free secretion of urine immediately. A day or two after the commencement of the attack, diluents act very favourably. The patient may then take plenty of weak beef-tea or broth or even plain water. A drink composed of two drachms of bitartrate of potash to the pint of water, flavoured with lemon and a little sugar, will be grateful to the patient, and will increase the quantity of urine without irritating the kidneys, or linseed-tea, flavoured with lemon juice, may be given to the extent of two pints in the twenty-four hours.

There is often pain in the back, which is sometimes of a very violent character. This may be relieved by linseed-meal poultices to the loins, with the occasional application of mustard, or the linseed-meal poultice may be sprinkled over with a little mustard flour once or twice a day. This lumbar pain is also generally relieved by dry cupping. If, however, the pain is very severe, and there is tendency to coma or convulsions, or to both conditions, dry cupping over the loins

may be tried and repeated twice or thrice in twenty-four hours if not followed by relief. Some blood may be also taken by cupping in many cases with advantage, or a few leeches may be applied.

Convulsions may be sometimes relieved by ether or chloroform inhalation, which should not, however, be pushed to the full extent. A few whiffs may be given from time to time when an attack of convulsive action seems likely to begin.

Œdema. Anasarca.—Œdema of the ankles and of the areolar tissue over the tibia requires no special treatment, but the patient should keep the legs up as much as possible, and if he is obliged to move about, the legs should be carefully bandaged soon after he rises in the morning.

In cases in which anasarca becomes considerable, and the integument is much stretched or brawny, it may be necessary to relieve the tension; but a moderate degree of anasarca, after lasting for a time, often passes off without requiring any special treatment. Acupuncture may be performed by any sharp-pointed instrument, but experience has fully proved that the punctures made by a common sewing needle seldom become inflamed and are rarely followed by erysipelas; and although such slight orifices often heal up very quickly, fresh ones may be made every few days if necessary. In many cases the areolar tissue of the scrotum and penis becomes enormously distended with fluid. Punctures with an ordinary needle give great relief and seldom occasion trouble. I have so often seen *incisions* followed by erysipelas or very troublesome sloughing sores that I seldom now resort to this plan of treatment in renal dropsy. In many cases a blush may be observed here and there on the distended skin, and in these it is desirable to avoid puncturing altogether, but if punctures must be made, pale skin should be selected and an ordinary sewing needle used. In certain cases of cardiac dropsy, however, incisions about an inch in length near the inner ankle sometimes answer satisfactorily, and afford great relief within a few hours.

Uræmia results from the accumulation in the blood of many of the urinary constituents, in consequence of the defective or suspended action of the kidneys. The condition is sometimes accompanied by actual coma or convulsions or tendency thereto. These serious symptoms are often preceded by headache and nausea, or actual vomiting. A patient exhibiting any tendency to uræmia should be very carefully watched, and should be seen at least twice during each period of twenty-four hours. Purgatives should be resorted to as soon as possible. Indeed, in any condition in which uræmia is expected, every effort should be made to promote free elimination—particularly by the skin and bowels. The hot air bath (p. 191) or hot blankets often afford relief, and should be used daily unless the heart's action is very weak and there is decided indication of faintness. Many sudorific remedies,

such as acetate and citrate of ammonia, are useful. Tartrates, acetates, citrates, carbonates, and nitrates are prescribed by some physicians, and sometimes excite free action of the kidneys, but stimulating and irritating diuretics like cantharides, juniper, and broom, should not be given in cases of congestion or inflammation of the kidneys.

Free purgation should be commenced at once, and in cases in which a comatose state seems to be imminent, especially if the symptoms have very quickly increased in gravity, hydragogue purgatives should be prescribed. Elaterium may be given in doses beginning with $\frac{1}{12}$ of a grain and increased if necessary. This drug often acts very promptly and beneficially, but jalap, scammony, common colocynth pill, often answer well if given in moderate doses and repeated every six or twelve hours till the desired effect is produced. The compound jalap powder of the Pharmacopœia is a very favourite remedy, and generally acts promptly if the jalap is good.

Ascites is to be treated by purgatives while the strength is at the same time supported by a nutritious easily digestible diet and tonics, and if no improvement occurs, or the fluid increases considerably and presses upon the large veins and the diaphragm, it may be necessary to perform paracentesis. The fluid should be removed by a small trocar, to which is attached a long piece of small india-rubber tube, by which the fluid is conducted to a tub or pail placed by the bedside. In this way the fluid may be very gradually removed without the slightest inconvenience or risk to the patient.

Digitalis is a useful remedy in many of these cases. Fifteen or twenty drops of the tincture or a drachm of the infusion in an ounce of water may be given three or four times a day.

2. **Chronic Renal Disease.**—In the treatment of chronic diseases of the kidney it is very necessary to act upon principles deduced from a careful study of the physiology of the gland and a knowledge of the morbid changes which occur in it, and which may re-act upon almost all the gland and tissue changes going on in the body. It is obvious that the physiological changes in the kidney can only be influenced through the blood, and as there is no hope of producing immediate improvement it is desirable that the right plan of treatment should be selected in the first instance, and steadily prosecuted, more especially as it has been proved that judicious interference during the early stages of many forms of chronic renal disease is productive of the greatest benefit. By careful management, the progress of some structural changes, which cannot be altogether prevented or cured, may be retarded, and the patient's life considerably prolonged. In certain instances, under favourable conditions, a patient may live for twenty or five and twenty years, although afflicted with incurable renal disease. It is, however, of the utmost importance that the practitioner should make the patient

clearly understand what circumstances favour and what tend to retard the progress of his malady. He who is the subject of a chronic renal affection is in constant jeopardy, and even a violent cold may cut short his life in a very short period of time. If such a person gets an attack of pneumonia, or bronchitis, or pleurisy, the malady may perhaps be fatal in a few days. He would probably succumb to a severe attack of fever; and an injury from which a healthy person would recover without an untoward symptom might prove fatal to him. It need scarcely be said that such a life is not insurable on any terms; but, nevertheless, some patients attain a good old age in spite of structural renal disease.

Warm Clothing.—The observations already made will have led the reader to conclude that in my opinion not much benefit is likely to result in these cases from mere physic-giving; while the greatest improvement is frequently observed after the patient has been placed for a few weeks or months under judicious management. It is important that the clothing should be warm, and in all cases woollen or wash leather should be worn next the skin. Shetland wool garments, socks, &c., of every kind, for summer and winter wear, may be obtained at Standen and Co.'s Shetland warehouse, Jermyn-street, St. James's. Some consider a suit of wash leather more efficient than flannel for persons who suffer much from cold and from sudden changes of temperature, but it is not so pleasant to wear and is far more expensive.

Air and Exercise.—Patients should take little exercise, and should never allow themselves to get fatigued. It is very important in the treatment of many cases to distinguish between air and exercise. If people are told they require plenty of air, they sometimes walk until they become very tired and exhausted and suffer in consequence. The air must be obtained without fatigue. If they can, so to say, live in the open air, all the better, care of course being taken to protect themselves from draughts and to avoid risk of taking cold. It is also desirable to encourage free action of the skin from time to time. If the temperature is not sufficiently high to cause perspiration, an ordinary warm bath, vapour or hot air bath, may be taken two or three times a week.

In chronic renal disease the greatest benefit results from sea air, and I believe life is often prolonged by wintering in Pau, Rome, Naples, Cannes, Madeira, Egypt, Torquay, the south of the Isle of Wight, or St. Leonard's, or Bournemouth. Patients suffering from this class of diseases require plenty of air, and during the winter it is very important that they should live in a climate where they can be out of doors for several hours on most days and get as much sun as possible. A sea voyage is often of the greatest advantage, and, although the disease may not be entirely cured, the general health is usually much improved and sometimes the morbid change ceases to progress. The journey to

Australia or New Zealand and back seems to have conferred lasting benefit in many cases.

The diet should be generous and good, but simple. There is I think little doubt, that many persons comfortably off, healthy as well as sick, take far more food, especially in the shape of meat, than is required for the perfect performance of the work of their organism or than is conducive to a thoroughly healthy and vigorous state of body. It is probable that excessive eating is as frequently the cause of hepatic and renal disease, as excessive drinking. A large proportion of any excess of meat taken passes off from the body in the form of urea and other urinary constituents, which it is the special work of the kidney to remove from the blood. It is obviously of the utmost importance to relieve the kidneys of at least this unnecessary and useless work in cases in which they are diseased, when their working power is seriously impaired. The diet should therefore be carefully regulated, so that while the organism is well supplied with the full amount of nutrient materials which it requires, a useless excess which would still further damage the diseased organs is carefully avoided. I have often noticed that patients suffering from chronic renal affections bear cod liver oil, and a diet containing a larger amount of fatty and starchy matters in proportion to the meat, than is usually taken by persons in health. Fat bacon may be recommended, and glycerine or the pancreatic emulsion where cod liver oil cannot be taken. Provided the lungs and the liver be sound, it is easy to understand why the patient might progress favourably upon such a diet, in spite of serious damage to the kidneys.

Although we should undoubtedly recommend a patient suffering from chronic renal disease to consider milk his staple article of diet, we ought not advise him to absolutely restrict himself to pure milk. We should remember that long before the milk treatment was thought of, many patients suffering from chronic renal disease lived for twenty years or longer on ordinary diet, and not a few of those who died early were destroyed by some malady not connected with the renal pathological changes. To condemn a patient to live upon milk only for twenty years of his life would be cruel as well as unnecessary. In some cases I have recommended patients to take milk for two or three months, then to change to ordinary diet, bread and butter, bacon, and fish or meat, in small quantity, besides milk and milk puddings, for a few weeks, and then to return to the milk treatment for two or three months, and so on. This system has answered well, and patients who could not continue to take milk incessantly for many months, can get on very well on this plan.

In all cases, the quantity of fluid in proportion to the solid should be considerable, and especial care should be taken to guard against too much ordinary nitrogenous food. The beneficial effects resulting from

the milk treatment of chronic renal disease are probably in part due to the large quantity of water continually filtering through the tissues, partly to the oily matter being in a state of very minute division and in a state favourable for absorption, and partly to the nitrogenous (casein) and saccharine constituents of the milk being in a very diluted and easily digestible state. It is not, however, everyone who can live exclusively upon milk. Oftentimes digestion gets deranged and more often still the patient, after a month or two, gets such a dislike to the diet that he rebels. Nothing that I have observed convinces me that there is any advantage in the very rigid adherence to milk which is considered so important by some physicians. Milk puddings made with egg and flour, sago, tapioca, rice, maccaroni, relieve the monotony of a milk diet without in the least impairing its efficiency.

In cases of chronic disease of the liver or kidney, we must endeavour to improve the action of the stomach, rather than to influence the organs implicated, for as I have already remarked, we have no means of acting upon these, except indirectly through the blood. In this class of diseases the blood is often poor, and the digestion weak, and the condition of the patient is often wonderfully benefited by remedies which improve the state of the blood, and act upon digestion.

The character of the blood and the state of the nutrition generally must indeed be altered before we can hope to benefit the local malady. Bitter tonics, small doses of hydrochloric acid before meals, and pepsin often do much good.

Pepsin.—Many practitioners doubt the efficacy of pepsin in any case, and some consider it perfectly useless. I believe that such conclusions have been arrived at from bad pepsin having been used. Some years ago (1856), I made some experiments in connection with the action of artificial digestive fluids, and found that, by the following simple method, a very powerful digestive powder, almost tasteless and inodorous, could be readily obtained from the pig's stomach. The pepsin prepared in this way is more active than any of the other preparations now in use. I have used it very frequently during the last thirty years, and it is well known to many other practitioners. The method of making this form of pepsin is as follows:—The mucous membrane of a *perfectly fresh* pig's stomach is carefully dissected from the muscular coat, and placed on a flat board. It is then cleansed with a sponge and a little water, and much of the mucus, remains of food, &c., carefully removed. With the back of a knife, or with an ivory paper-knife, the surface is scraped very hard, in order to press the glands and squeeze out their contents. The viscid mucus thus obtained contains the pure gastric juice, with much epithelium from the glands and surface of the mucous membrane. It is spread out upon a piece of glass, so as to form a very thin layer, which is dried at a temperature of 100° over hot water, or in vacuo

over sulphuric acid. When dry it is scraped from the glass, powdered, and kept in a stoppered bottle. A good digestive fluid may be made as follows :—

Of the powder	5 grains.
Strong hydrochloric acid	18 drops.
Water...	6 ounces.

The fluid may be filtered easily, and forms a perfectly clear solution, very convenient for experiments on artificial digestion, or as a medicine. The pepsin may be taken in doses of from three to five grains, made into a pill with a little glycerine, and taken about twenty minutes before a meal, with ten drops of dilute hydrochloric acid in a wine-glassful of water, or infusion of quassia ; or the powder may be mixed with the salt taken with the meals, or sprinkled upon the meat or on bread and butter, as it is tasteless and inodorous. Eight-tenths of a grain dissolve 100 grains of white of egg.

This pepsin from the pig's stomach is made by Messrs. Bullock and Co., of 3, Hanover Street, Hanover Square.

Stimulants.—With reference to alcohol, some have advised that it be altogether withheld, on the ground that stimulants, especially spirits, provoke chronic renal diseases. There are some persons who actually require a little stimulant for the due performance of the digestive process, and, as is well known, many forms of dyspepsia may be completely cured by the administration of a stimulant, or by changing the kind of stimulant which the patient has been in the habit of taking. Light wines often do good. If the patient's digestion is improved by taking with his dinner a small quantity of wine, he may have it. Anything like excess must of course be avoided. Although it may be open to doubt whether in the majority of cases stimulants have anything to do with the causation of the malady, it is certain that renal disease may be induced by the free use of ardent spirits, indulged in habitually for a certain period of time. The theory not infrequently propounded as an argument against the use of alcohol in renal disease, that the alcohol acts directly on the renal tissues, causing their condensation and wasting, will not bear a moment's consideration. It is simply untenable. The harm done by alcohol does not depend upon its direct action at all, but is due to a much more complex and less direct action upon the tissue elements than is generally supposed.

Life may be much prolonged in some cases by the judicious administration of stimulants. Some time since I had a man under my care suffering from fatty and contracting kidney with excessive dropsy, who appeared almost to be kept alive by brandy. For six months this man's urine contained half its bulk of albumen. He was frequently delirious, but was so exhausted that we thought it right to give stimulants. Immediate benefit followed, and the stimulants were continued.

He lived to our great surprise more than four months, and there can be no doubt that his life was prolonged for several weeks by brandy. Sometimes we gave as much as eight ounces in four and twenty hours, but usually from four to six ounces. Light Burgundy, Hock, and Chablis, are wines which often suit the patient, but in some cases a tablespoonful of whiskey and an equal quantity of lemon-juice seems to answer better than anything.

Medicine.—The appropriate remedies will, in many cases, at once suggest themselves to the mind of the practitioner. Iron, various bitter tinctures and infusions, the mineral acids, and many remedies included in the class of tonics may be employed. Mercury, even if given in very small doses, in chronic renal disease, often causes profuse salivation, and sometimes extensive sloughing dangerous to life results. Twenty minims of Dilute Hydrochloric or Phosphoric Acid with three or four minims of Dilute Hydrocyanic Acid and five minims of the Tincture of Nux Vomica in an ounce of water twenty minutes before two meals daily is often very useful, and if the stomach is weak a pill containing two grains of Pepsin (Pepsina Porci, Bullock and Co.) may be taken at the same time. Generally it will be found that in cases in which the digestion has been impaired general improvement and gain in weight soon follow a favourable change in the action of the stomach. Cod-liver oil acts beneficially in some cases.

Of Iron in Chronic Renal Disease.—Of all the medicines which have been employed in chronic renal disease, iron is the most advantageous. Of its real value there cannot be any doubt. And many preparations have been thoroughly tried. The reduced Iron, various neutral solutions of Iron, the old Tartrate, the Sulphate, the Citrate, the reduced Iron and Dialysed Iron, Phosphates and Iodides of Iron, the Citrate of Iron and Quinine, and many other preparations of Iron are of undoubted value, but I do not think any preparation of Iron is so generally beneficial as the Solution (Liquor) or the Tincture of Perchloride of Iron, with Tincture or Infusion of Quassia, twice or three times daily between meals.

The influence of iron upon the general health, and indirectly upon the reabsorption of serum, is very remarkable. In one patient (W.S., vol. III, p. 7), each leg measured *eighteen inches* in circumference and the effusion seemed to be increasing. Soon after he was put upon iron the appetite improved, the blood became more healthy, and the effused serum began to disappear. In a month after the treatment had been commenced, the circumference of the legs had diminished to *thirteen inches*, and in this short time several pints of serum must have been removed from the areolar tissue of the body generally. The quantity of urine increased from about twenty to fifty ounces in the twenty-four hours.

After exhausting hæmorrhages, as in low conditions of the system, and after low fevers, every effort must be made to improve the general health, and iron is especially valuable in these cases. I need scarcely say there is no indication for the use of remedies specially influencing the kidney. The improvement consequent upon the use of remedies which are known to affect the general state of the blood is often very remarkable, even when there is long standing structural disease of a serious character.

Digitalis is a remedy which acts favourably as a diuretic in some cases of renal disease, and has been very largely prescribed by some physicians. The infusion (half drachm doses) or the powder (in doses of half a grain three times a day) may be given. The former is by far the most efficacious, and in some cases increases the quantity of water secreted without irritating the kidney. Many diuretics do not act disadvantageously in some forms of renal disease, and I think life is sometimes prolonged by their use. As a general rule, irritating substances, such as cantharides, should be avoided, but citrates, acetates, tartrates, and nitrate of potash may be given.

Treatment of Vomiting in certain forms of Chronic Renal Disease.—In fatty kidney in children and young people and in some other forms of renal disease, frequent vomiting is often very distressing and difficult to deal with. If small pieces of ice are swallowed from time to time it may sometimes be kept under control. Small doses of carbonate of soda with a few drops of Hydrocyanic Acid iced are also useful. A pill containing a drop of creosote with crumb of bread sometimes answers, and although the addition of small doses of opium or morphia may afford relief, such medicines must be used very sparingly, and only while the patient is most carefully watched. Beef tea iced should be given in teaspoonfuls at a time, or iced milk as long as the stomach continues in a very irritable state.

Pericarditis in the course of Renal Disease.—Pericarditis is a very common complication of chronic renal disease. It is probably due to the altered state of the blood and its increased tendency to form fibrinous deposits. The affection does not usually occur until the patient has become very weak. This form of pericarditis may be treated by the application of external warmth, fomentation or a linseed meal poultice, or moderate counter-irritation; but leeches are scarcely ever necessary, and bleeding or lowering remedies would only hasten death. The affection is seldom accompanied by much effusion of serum, and in most cases the pericarditis will run its course without much effusion or serious derangement of the circulation. Its progress is usually slow, and it is better not to carry out any active depletive measures in the treatment of this complication.

Pleurisy and Pneumonia, when they occur in the course of renal

disease, are to be treated on the same principles as when they occur under other circumstances, but no preparations of mercury should be given. It is the exception to meet with very severe forms of pleurisy and pneumonia in those who have long suffered from chronic renal affections, but slight and frequently recurring attacks are not uncommon.

Counter-Irritation.—There is, I think, little doubt that the action of the kidney is affected by counter-irritants, and, as is well known, the afferent nerve fibres distributed to the skin influence the state of the vessels distributed to an organ situated beneath, and even at a considerable distance beneath the surface, by reflex action. Blisters, mustard, turpentine, dry cupping over the region of the kidney, probably act in this manner.

Bleeding is seldom desirable in chronic renal disease. The quantity of blood in the body gradually becomes very much reduced, and in many chronic diseases of the kidney is considerably below what is required by the organism. If there is hæmorrhage from the kidney we should endeavour to check it by the administration of Tincture of Perchloride of Iron, or by Gallic acid in ten or twenty grain doses five or six times a day, by tannin, or by turpentine (*see* page 85).

A well nourished burly man is more likely to die quickly from renal disease than a thin person. If the patient be very stout, appearing to be in rude health, florid, full-blooded when the attack first appears, and especially when dropsy comes on early and is considerable, with nausea, some dyspnœa, quick pulse and irritable weak heart, but without any evidence of the attack being acute—the prognosis is bad, and the case is likely to terminate fatally in a short time. Such cases often end in epileptic renal coma, or uræmia. If, however, the dropsy is only slight, and the patient begins to emaciate and grow pale in consequence of the quantity of blood being reduced, he may get into a state in which the disease progresses very slowly, and he may, with care, be kept alive for many years. The reader would perhaps conclude that if a full blooded patient were bled it would be to his advantage, but such patients do not bear large bleedings, as is proved by the circumstance that rapid prostration and death soon follow a violent attack of hæmorrhage from the bowels or lungs when it occurs in such a case. Sometimes, however, moderate hæmorrhage from the nose seems to do good, or at any rate improvement which was observed has been attributed to this circumstance. So that I am by no means certain that advantage would not result from oft repeated moderate bleedings in well selected cases, although I am unable to speak from actual experience. Such a plan of treatment, if carried out, should be tried cautiously, and the patient very carefully watched.

Of the Treatment of Albuminuria of Advancing Age.—The condition

which gives rise to traces or to more than traces of albumen in the urine during advancing age is very closely allied to that which is so commonly, and one might almost say constantly, met with in the gouty state; and in order to bring those examples which affect the most temperate into the same category it might be suggested that the sufferers, although they have been very careful through life, have nevertheless exceeded as regards the amount of nitrogenous food they have habitually taken. Some organisms require very little meat, and actually flourish upon what would be really starvation diet to others, and if the first live according to a standard which the majority would call very moderate, the diet may for them be excessive as compared with the actual wants of their system. Nothing is more astonishing than the very small amount of food, and especially of flesh, that some healthy persons can live upon without losing weight or appearing to be weaker, or up to less work bodily or mental than their neighbours. To make invalids of all in advancing age whose kidneys are slowly changing, to condemn them to a purely milk diet or other very stringent regimen, to forbid them engaging in their ordinary duties seems to me not only unreasonable, but quite unjustifiable from a medical standpoint—for certainly many will live for ten or fifteen years or more, the albumen in the urine being constant, while some will fail on account of ailments which are in no way directly or indirectly connected with the renal degeneration. Such persons should be careful to avoid taking cold, should not go out to parties in severe weather, and generally should be extremely cautious as regards their health. To lay down minute rules for the hourly guidance of such persons is needless. They may be as sensible as most of us, and as well able to manage themselves as the most learned of the doctors, and if only they can have their condition properly explained to them will be able to preserve themselves in fair health without their lives being made wretched by carrying out a number of minute directions, compared with submission to which penal servitude would be enjoyable liberty. One may freely acknowledge the great importance of impressing sick people concerning the possible serious consequences of running risks of catching cold and disturbing the action of important organs when glands so necessary as the kidneys are damaged, as well as the very silly manner in which many of the well-to-do people of this country live in defiance of science and experience, and the teachings of history and common sense, nay in spite of their own personal experience. But, allowing for all this, and fully recognising the very great difficulty every right minded medical adviser who loves his craft must feel, in steering between the one extreme of making too light of a serious malady, and the other of making too much of a slight one, I cannot help thinking that some very popular amongst us in these days in their desire to avoid the first fall into the last error.

Our clear duty is to caution our patients to avoid needless exposure, to clothe in woollen, to take life as easily as possible, to regulate and simplify diet, and to get as much air as possible when the weather is favourable. Residence in the South for the winter is most desirable, and should be enjoined wherever such a luxury can be enjoyed.

Mild purgatives should be recommended, and a warm bath twice a week is undoubtedly advantageous. Tonics, particularly preparations of iron, are of real use, and almost always improve the state of the blood, and in most cases cause a decided increase in the number of red blood-corpuscles. Patients suffering from this state of kidney should, of course, avoid every kind of strain, particularly of the nervous and vascular system. That some of them live to be very old in spite of advanced renal degeneration is a fact. I have seen cases where albumen was detected between the ages fifty and sixty, and was constantly present —sometimes a mere opalescence only when coagulated by heat or by acid, sometimes amounting to a fifth or even more—the patient nevertheless living to be over eighty. Great care was taken to avoid over fatigue, strain, and taking cold; and in the winter little going out was allowed, but in other respects no special treatment was adopted or needed.

*Further Hints concerning the Diet in Chronic Renal Diseases.**—In treating cases in which the kidneys are prevented from performing their functions with the usual activity, it is above all things necessary to reduce, as far as possible, the quantity of excrementitious substances resulting from the active changes in the various tissues and organs, and to arrange that the nutriment taken shall as nearly as possible balance the loss due to disintegration consequent upon the discharge of function. If the ingesta amount to more than suffices to make up the loss, undue work is thrown upon organs which have been perhaps for long working under grave disadvantages, and this is detrimental to the organism as a whole; it being obviously to the interests of the patient that he should consume only just the amount his tissues and organs use up. By acting upon this important principle we may be instrumental not only in adding months or years to the patient's life, but may enable him to enjoy the highest degree of health which is possible under the adverse circumstances. To fulfil these objects is, however, more difficult in practice than would at first sight appear, because the stomach has often very marked idiosyncracies, and the quantity and quality of nutriment which is considered desirable may not suit that highly sensitive organ, while in not a few instances the patient may be quite unable to digest the food, which theory would suggest as being appropriate, and which experience has shown has yielded the best results in many cases. And it often happens that in this as in many other condi-

* An extract from a clinical lecture delivered at King's College Hospital.

tions, dietaries which have been arranged to the minutest detail, and in accordance with all the supposed requirements of the case completely fail, and cannot be persisted in without the risk of actually starving the patient and doing more harm than would have resulted if ordinary food had been taken.

But even in cases in which it is not possible for the patient to have the advantage of the special system of diet which would seem to be most suitable to his case, it is nevertheless important that the practitioner should be well acquainted with the principles by which, as far as is practicable, he should be guided in his treatment. A little consideration will often enable him to suggest an approach towards the proper diet in cases in which the diet most desirable cannot be borne. For instance, although pure milk cannot be tolerated by some, it will be found that few will object to milk puddings and various dishes which contain milk in large proportion. Some patients may be persuaded to take warm milk, and even if pure milk hot or cold will not suit the stomach, it often happens that the addition of a little lime water will cause the milk to agree, and to digest quickly without producing pain or discomfort.

That the so-called milk treatment is a great advance, and that by it great improvement may be obtained in bad cases of disease, is undoubted, and we ought to feel grateful to Dr. Donkin, who was, I think, the first to carry out this plan of treatment systematically for many months at a time, and those who have advocated and practised the system, not only on account of the good to be obtained in special cases, but also because our knowledge of what may be done in many others has thereby been much increased. Until within the last few years we should have hesitated to have advocated a purely milk diet for many months, but now we know not only that this one fluid may be substituted for the varied diet usually taken, but that people may live on it, gain in strength as well as in weight, and that while taking it pathological changes which were progressing may proceed much more slowly and even cease to progress. The milk treatment, it should be borne in mind, is of great value in many other conditions besides renal disease. Now that we are better informed concerning those subtle degenerative changes which take place slowly and imperceptibly to the patient, undermine the health of some of the most important of his tissues and organs, and slowly or quickly result in impaired action and failure, which can only end in death, we cannot attach too much importance to all suggestions which may reasonably be supposed to be influential in reducing the rate of their progress or in stopping them altogether.

But in treating certain cases of chronic contracting kidney it is altogether inexpedient to put the patient upon a purely milk diet. For years, perhaps, he may have been accustomed, not only to live too well

upon the best of food, but every day has looked forward to his dinner with pleasure, if not as the most important event of the day. Such a person would probably at once rebel against carrying out your advice, or if he did not openly object, there would be little prospect of his carrying it into practice. Moreover, the sudden change recommended would effectually derange the most important and gradually perfected arrangements below stairs over which the cook presides, and if you are to do any good and to be of real use, you must proceed by degrees. Suggest fish, sweetbread, and such harmless things, and in this way gradually bring the patient to content himself with soup, milk puddings, milk, bread, baked and stewed apples, and prunes. First of all reduce to some extent the quantity of his wine, and suggest Hock or Chablis, and so lead him by degrees to give up stimulants altogether. In this way we shall effect our object without offending or disgusting our patient. Time will be gained, and he himself will begin to recognise the reasonableness of our suggestions. He will feel better than he has felt for many months, and perhaps even will have some faith in his doctor, who may then with judgment carry out still further changes towards the simplification of the diet and its restriction as to quantity, so that eventually the patient may be induced to submit to live according to the rational principle that no more is introduced in the way of food than is required to compensate for the waste which results from the action of the tissues and organs and the chemical changes accompanying the development of animal heat.

Of the Treatment of Albuminuria dependent upon Syphilis.—Of all the forms of chronic renal disease, those which are due to syphilis are the most likely to get well. Nay, though the quantity of albumen in the water may have amounted to as much as a third present in every specimen passed during the period of a year or more,—though there be considerable and persistent œdema of the legs extending as high as the waist or higher, and the case in many important respects appears to be grave, improvement may be confidently predicted, and under favourable circumstances complete recovery not uncommonly takes place in the course of a few months. The practitioner will often feel surprised as well as gratified at the change for the better which soon follows the adoption of the proper course of treatment.

In the early stage of renal disease due to syphilis, the patient should be subjected to the usual treatment by purgatives and sudorifics. The warm bath or the hot air bath should be recommended. If there is any indication of uræmia, free purgation should be promptly carried out and followed by free sweating, kept up for an hour or two daily or even twice a day if the patient bears it well. As soon as the quantity of albumen has been reduced to about one-fifth, and the urine flows freely at all periods of the twenty-four hours, iodide of potassium, iodide of

iron, or some other preparation containing iodine should be given, and steadily prescribed for several weeks.

Complete recovery is not infrequent after judicious treatment, steadily kept up for two or three months. I often order iodide of potassium three times daily after meals for a fortnight, and then for a like period of time give syrup of iodide of iron—or Blanchard's pills of iodine of iron, a most convenient and efficacious medicine, which may be persisted in for many months with advantage. It is a good plan to order iodide of iron pills, one or two at 11 and 4 o'clock daily, for a fortnight at a time, at intervals of two or three weeks.

I cannot help thinking that in former days when cases of chronic syphilitic disease were treated with biniodide of mercury (bichloride of mercury and iodide of potassium) the class of morbid changes characterised by chronic deposits in glands and in connection with some of the most important tissues of the body to which syphilitic kidney belongs, was less common than it is now, although on the other hand we do not now see the number of horrible phagedenic sores and dreadful cases of extensive caries and necrosis which used to be by no means uncommon. Not a few facts seem to justify the conclusion that the virulence of many forms of syphilitic poison is less than was the case, but I am inclined to think that the treatment followed out by many practitioners as regards the use of mercury is less pronounced than is wise. My own opinion is that when once well marked secondary symptoms have been manifested, the patient will do well to take mercury and iodides for a fortnight or more at a time, at intervals of a few months for many years. I have never seen harm result from this course, and it alone affords a reasonable prospect of preventing or curing some of those syphilitic deposits which work such havoc later in life in some of the most important glandular organs of the body and in the nerve centres.

When the urgent symptoms have disappeared and the patient has greatly improved in health, albumen being still present in smaller quantity in the urine, it is very important, if the patient's means are sufficient and his circumstances render such a step possible, that he should take a long voyage and reside in a good climate for a year or more, in order that every chance may be afforded for complete recovery—for recovery does take place in some of these cases. The patient not only increases in weight and regains his former health and strength, but the kidneys return to their normal state and secrete healthy urine without any further discharge of albumen.

BILE.

When bile is present in urine, it gives to the secretion a yellow colour, the intensity of which varies according to the quantity of bile

present, and which is more distinct when thin layers are placed upon a perfectly white surface, as on a plate, than when a considerable bulk of urine is examined. The yellow, which is very different from the colour of dark and concentrated urine, is almost of a gamboge tint when thin layers of the urine on a white surface are examined. The colouring matter of the bile (*biliverdin*) may be completely removed from the urine or any solution containing it by filtration through a layer of charcoal.

From pressure upon, or obstruction of, the common gall duct, bile, after it has been secreted, is partly or entirely prevented from escaping into the intestine. The gall-bladder and large and small ducts soon become distended by the accumulation of the secreted bile, which, finding no outlet, is reabsorbed, chiefly perhaps by the numerous lymphatics which are so freely distributed upon the gall-bladder as well as upon the coats of all the large and small gall-ducts. The biliary constituents in a state more or less altered, pass into the blood, and are partly deposited in the tissues and partly carried off in the urine. That scarcely any bile passes into the intestine in many cases of jaundice, is proved by the pale colour, offensive odour, and clay-like consistence of the fæces.

The bile is formed by the cells of the liver and passes directly into the small ducts, and from these into the larger ducts, whence it goes into the gall-bladder or directly into the intestine. In jaundice there are impediments to the escape of the bile from the large ducts outside the liver, or from the smaller ducts within the organ. In either case the bile accumulates, the ducts become stretched, a certain quantity passes through their coats, and is taken up by the blood vessels, or is absorbed by the numerous lymphatic vessels, ramifying in the portal canals, and in the transverse fissure of the liver.

In some cases the jaundice with occasional intermissions lasts for many years. Oftentimes the skin returns to its normal state, and the patient considers himself well, but after a few weeks the jaundice returns, and soon becomes as bad as ever. The yellowness of the skin and fibrous and other tissues which varies in intensity depends upon the staining effected by the yellow serous fluid which transudes from the blood. Variation in the quantity of bile passing into the blood sometimes is due to pressure upon the duct near its orifice, exerted by a small tumour, which changes in volume from time to time, either in consequence of effusion of fluid into its substance, or of alterations occurring in the degree of distension of the vessels which are distributed to it.

By far the most common cases of jaundice are those which are due to temporary closure of the duct, either in consequence of the accumulation of mucus, which forms a plug and may remain for some time before it softens and is expelled, or from spasm of the muscular fibres

at the lower part of the common duct just where it opens into the duodenum. It is of importance to bear in mind that these cases of temporary jaundice occurring in the young sometimes continue for three months, or even longer, during the whole of which period the jaundice may be intense, the motions colourless, and the urine of a very deep yellow colour.

It was held by Dr. Budd, that jaundice might result:—1. From *obstruction to the escape of bile* after it had been formed, and, 2. From what was termed *suppressed secretion*, in which case it was said that the substances which should have been separated from the blood and converted into bile, remained in the blood. Frerichs has brought forward arguments opposed to this view, and it is very doubtful whether it can be sustained.

Kühne has detected the presence of bile acids in many specimens of icteric urine, by following Dr. Felix Hoppe's method. Although all recent observers who have studied this subject agree that the detection of the biliary acids is most difficult and requires the greatest care, Dr. George Harley seems to consider it a very simple matter, and places implicit reliance upon Pettenkofer's test, applied in the ordinary way, for distinguishing a case of jaundice from obstruction from one depending upon suppression. For full information upon this subject the reader is referred to an abstract of Kühne's observations by Dr. Scott, "Archives," vol. I, p. 342. It seems to me that the view that in certain cases of jaundice there is *suppression* of the action of the liver,—that the liver does not produce bile, and that no biliary acids are formed, is opposed to very many facts, and I have been led to the conclusion that in all cases of jaundice the bile has been formed by the liver cells, and has been reabsorbed after its formation, perhaps much of it being again excreted in an altered form by the intestines, by the kidneys, and other organs. It is easy to conceive that the relative proportion of the biliary acids and colouring matters produced, may be very different in different cases—that the quantity of the acids formed may vary greatly—that their composition may be affected, taurocholic acid being produced instead of glycocholic acid (Kühne)—that the quantity of blood-corpuscles disintegrated by the presence of bile compounds in the blood varies—and that other chemical derangements may be caused, although the action of the liver *cells* is not suspended even for a very short time. It is almost certain that the most important constituents of the bile-colouring matter, resinous acids, &c., cannot be produced in the organism without the agency of the liver cell.

When the bile-forming process is deranged, other disturbances of an important kind, and which affect the urine, occur in the liver. Urea is to some extent formed in the liver, and the proportion varies according to circumstances. In chronic renal disease a less amount of urea is

produced than in health. In congestion of the liver, on the other hand, there is increased secretion. When the hepatic tissue is damaged or destroyed, the quantity of urea formed in the liver is much reduced (Brouardel). The urea in the urine may be reduced, while the amount which is formed in the blood is larger than usual. This, according to Debove, is the case in many affections of the liver, and is to be explained by supposing that the biliary matters in the blood affect the secreting action of the kidneys.

In cases of jaundice depending upon permanent closure of the duct, as from pressure of a tumour, impaction of a gall stone, &c., the jaundice continues, and bile passes off in the urine as long as the liver retains the power of secreting it.

On the Treatment of Cases of Jaundice.—The cases of jaundice, which occur so commonly during the summer months, are not connected with organic disease, and require but very simple treatment. The jaundice usually lasts for a period varying from a fortnight to five or six weeks, but occasionally for a much longer time, and then gradually disappears. In many cases there is scarcely any constitutional disturbance, although the urine is very highly coloured and sometimes contains biliary acids, and the fæces are perfectly colourless. Gentle laxatives and small doses of hydrochloric acid or ammoniacal salts seem to do good, but the remedial measure in which I have the greatest confidence consists in mild counter-irritation over the liver. Even the application of cold wet cloths for half an hour now and then will relieve the pain, sense of fulness, or uneasiness, about the hepatic region; but rags steeped in equal parts of strong hydrochloric acid and water applied for half an hour daily form the best application. This practice, which I learned from Dr. Blakiston, is of great service, not only in actual jaundice, but in cases of temporary biliary derangement generally. The acid may, perhaps, act through the cutaneous nerves, by exciting the biliary ducts and gall-bladder to contract. It also causes action of the colon. Small doses of mercury once a-week seem to give relief in some of these cases. Muriate of ammonia (20 grains three times a-day) and benzoic acid (3 to 6 grains three times a-day) are favourite remedies on the continent. In health, benzoic acid is excreted in the urine in the form of hippuric acid; but in jaundice, Kühne has shown that benzoic acid and benzoates pass unchanged into the urine. I have given podophyllin (½ grain every other day) in several cases, but can offer no opinion as to the advantages of the remedy. In some cases inspissated bile appears to do good. The dose may be enclosed in one of the gelatine capsules now ordinarily used. This useful suggestion was made many years ago by Dr. George Harley. The gelatine generally prevents the bile from being set free before it reaches the duodenum. The inspissated juice of taraxacum, and dandelion coffee, prepared by

Hooper, Pall Mall, seem to benefit some cases, and have been very often prescribed for jaundice and hepatic derangement. Euonymin, Iridin, Baptistin, Juglandin, Phytolaccin, and many more vegetable products have been recommended as cholagogues, but it is very doubtful whether they are as useful as many of the ordinary remedies which have long been prescribed.

SUGAR IN THE URINE—DIABETES.

Sugar in Healthy Urine.—Traces of sugar were discovered in healthy urine, by Brücke, whose observations were confirmed by Dr. Bence Jones. The proportion is, however, not sufficient to be recognised by the tests, until some of the other urinary constituents have been separated. It is possible that the colouring matter in healthy urine may be the source whence the small quantity of sugar present is derived. Schunck has shown that the substance from which indigo is obtained exists in the plant as indican. This indican, when heated with strong acids, splits up into indigo-blue, indigo-red, and a kind of sugar ($C_{12}H_{10}O_{12}$).

There are probably many chemical compounds between the sugar which passes away from the liver and the carbonic acid which is evolved from the lungs. The saccharine material may, under normal conditions, be brought by the blood and taken up by the masses of bioplasm (cells, nuclei) existing in such great number in relation with the capillaries of the lungs, and particles resulting from the death of these bioplasts may become resolved into carbonic acid, among other substances; or it may be taken up by the blood-corpuscles, and the matter of which these bodies are composed resolved into carbonic acid and other matters. Much yet remains to be decided before we shall know precisely how fat, sugar, amyloid, and many other substances, become oxidised in the living organism.

It seems to me that, in the present state of knowledge, the greatest caution ought to be exercised in forming a general conclusion with regard to this most difficult and highly interesting question. But as far as I am able to judge, the evidence is conclusive in favour of the view, that, in health, sugar, or a substance very close to sugar, is produced in the liver, and destroyed after it has passed from this organ into the blood. In the normal state the destruction of the sugar occurs at the same rate as its formation; while in certain lesions of the nervous system, and under other circumstances, more sugar is formed than can be destroyed—or the quantity formed remaining the same, the normal conditions under which its decomposition takes place being absent or modified, it accumulates in the blood, and is excreted by the kidneys and other secreting organs, thus producing diabetes. Whether the excretion of a large quantity of sugar in the urine depends upon

increased activity of the sugar-forming process, or results from the cessation of the destructive changes which occur normally, has not been determined. There can be no doubt that certain parts of the nervous system are seriously implicated in all cases, but whether the nerves exert a direct influence upon the sugar-forming or sugar-destroying processes, or only affect these operations indirectly through the control they exert upon the calibre of the arteries, and therefore upon the quantity of arterial blood distributed to the capillaries, is not known; but there are, I think, many facts which favour the latter view, while it has never been shown that nerves exert any *direct* influence upon the growth or action of any cells or living matter whatever. It is true that Pflüger professes to have traced nerve-fibres into the secreting cells of the salivary glands, but his drawings are alone sufficient to justify us in receiving his statements with the greatest doubt. I cannot admit that any one has yet traced a nerve-fibre into an epithelial cell. We must not lose sight of the fact that highly complex substances are formed in organisms where there are no nerves, and we cannot therefore conclude that secretion is essentially a nerve operation. Nerves influence the processes of growth, formation, and secretion, indirectly by regulating the supply of nutrient material; but the cells probably grow and form new substances independently of the nervous system altogether. The process of disintegration is affected by the quantity of the soluble constituents of blood, rich in oxygen, that is permitted to bathe the cells, and this, like the access of nutrient matter to the growing cells, is regulated by nerve action. The various questions connected with the formation and destruction of sugar are fully discussed by Dr. Pavy, to whose works the reader is referred.

It is not uncommon to meet with specimens of urine from persons apparently in the enjoyment of good health, which exhibit unmistakeable evidence of the presence of diabetic sugar, there being sufficient to estimate quantitatively. I have often found from one to two grains of sugar in 1,000 of urine, in cases where all traces of the presence of this substance have disappeared in a few days, without any of the usual restrictions as to diet; and I have noticed the presence of small quantities of sugar in the urine more frequently during the summer than during the winter months. I know other practitioners have made the same observation, and in such cases there is often much difference of opinion as to whether a patient has "diabetes" or not. I found very positive indications in the urine of a gentleman, who I ascertained, upon enquiry, had been in the habit of eating a large quantity of sugar with fruit tarts. Brown bread and saline medicines soon caused the sugar to disappear from the urine. But in cases of fatty liver, and in that common condition in persons who live too well, where the liver is somewhat wasted as well as fatty, it is very common to find sugar in the urine. The diabetic

condition, in these cases, may persist for weeks or months and then pass off entirely.

The specific gravity of the urine varies enormously in diabetes,—one may almost say from 1,002 to 1,070. The practitioner must never allow himself to conclude that in urine of low specific gravity there is no sugar, for sometimes the percentage in the solid matter of urine of low specific gravity is much higher than in urine of considerable density. Moreover, it will occasionally happen that the urine brought to the doctor for examination has been made after the patient has taken large quantities of water, tea, or other liquid. In such urine there will be very little solid matter, but nearly all of it may consist of sugar.

In every form of diabetes, the quantity of sugar is always much influenced by the quantity and nature of the food, and in some cases the sugar is reduced to a very small quantity indeed if it be properly restricted. The sugar increases shortly after a meal, and it is undoubtedly augmented when much starch is taken. A meat diet, with bran or gluten bread, always causes a diminution of the sugar. Total abstinence from food, and rest, diminish the proportion ; and it is increased by exercise, and by a large quantity of food. As much as two pounds of sugar may be excreted daily ; but about one pound is the more usual quantity. In 1858 I had under my care a girl, aged 19, who excreted daily about one pound and a half of sugar.

The dry harsh skin, with falling off of the old cuticular cells like particles of bran, the intense hunger and thirst, the emaciation, the tendency to the formation of tubercle in the lungs and other organs, are familiar to all who are acquainted with the clinical history of this disease. In many cases, however, I have remarked that the skin is moist, and in some there was excessive perspiration ; nor do we find either intense thirst or hunger in all instances. Dr. Garrod observes, that œdema of the legs is always present in diabetes, and this is undoubtedly the case very commonly, but I have failed to observe it in more than one instance. Diabetes is one of those diseases which runs in certain families, and there is no question that it is hereditary.

The temperature of the body in diabetes is almost always subnormal, and sometimes it is as low as 90° Fahrenheit.

The disease often comes on in the most insidious manner, and with so little derangement of the general health, that it may have existed for many months before it is discovered or even suspected. The first thing to attract attention may be persistent emaciation, associated with perhaps voracious appetite, or the peculiar smell of the water, or the large quantity of urine passed in the twenty-four hours, or the fact of many flies being attracted to it. The quantity of sugar varies much. It may be reduced to an ounce or less in the twenty-four hours, or a pound or more may be excreted during the same period. Any slight febrile or

inflammatory attack will cause a reduction in the amount of sugar secreted within a given time.

The occurrence of diabetes during pregnancy is not uncommon, and is unfortunately often fatal. Sugar may be discovered at any period of pregnancy. When a considerable quantity (5 per cent. or more) has been found in the water towards the end of the period of gestation, the risks attendant on labour seem to be greatly increased, and the practitioner must bear in mind that such a case may end fatally not very long after the birth of the child.

Although it is not possible from the characters of the urine alone or from these considered in connection with the symptoms, to divide cases of diabetes into well-defined classes, it is necessary to bear in mind that the disease exhibits the most marked variation as regards its effects on the action of the tissues and on the duration of life, according as it occurs in the young, in the middle aged, and in the old.

1. *Diabetes in the young.*—Diabetes may occur at an early age. It is often seen between seven and thirty, or thirty-five, and is so very fatal during the earlier period of life that I cannot call to mind a single recovery from the disease occurring in a person under thirty where it had been once thoroughly established. The disease varies, however, greatly in the severity of the symptoms as well as in the rate of its progress. It usually ends fatally in from one to three years after its commencement; although there can be no doubt that by judicious treatment life may be prolonged, and the severity of the symptoms mitigated in a considerable number of cases.

2. *Diabetes in the middle aged.*—The form of the disease which is met with in men between thirty-five and fifty or fifty-five, is often serious but not so constantly fatal as that which occurs at an earlier period of life. It runs a slower course, seems to exert less effect on the general health, is much more under control, and greatly influenced by diet. Some cases of diabetes occurring about this period of life at once improve under proper treatment, the quantity of the urine being not unfrequently reduced to the normal, while the amount of sugar may fall to less than 1 per cent., though if the patient returns to ordinary diet or takes much bread or food containing sugar, the proportion will rise again.

Diabetes during middle life is often associated with enlargement of the liver, and not unfrequently with very decided disturbance of the cerebral functions. It occasionally results in an attack of hæmorrhage and coma or hemiplegia, perhaps succeeded after a time by fatal hæmorrhage on the surface or into the substance of the brain.

Although many cases of diabetes occurring at this period of life respond to careful treatment, some, I regret to say, get rapidly worse from the first, and treatment seems to exert no influence upon the course of

the disease. I have seen such cases in strong men about forty, weighing 14 stone or more, end fatally in a fortnight or three weeks after the patient had been persuaded to apply for advice. Although he considered himself in perfect health up to that time, there can be no doubt that the disease had existed for many months before he was aware of it. It is remarkable that important structural changes may proceed in the kidneys, in the liver, and sometimes in the brain, and progress during many months or even years without the patient being conscious that there is anything wrong, supposing, indeed, during the whole time that the organs in question were all discharging their functions perfectly.

3. *Diabetes in the aged.*—When diabetes occurs after the age of fifty-five, or comes on in old age, it seldom destroys life, and in many cases the general health does not seem to be deranged in any way. At this time of life diabetes may be thoroughly controlled by diet, and in cases where the quantity of water is excessive and the amount of sugar considerable, both may often be reduced to one-half or less in the course of a week or two if the patient is properly dieted. The disease is seldom fatal, and I doubt whether life is shortened when diabetes occurs in the aged.

Diabetes has been of late years considered to depend upon some important change in the nervous system, and undoubtedly many facts may be advanced as being in favour of this view. Bernard discovered that temporary diabetes might be induced by slight injury to the upper part of the medulla oblongata, and it has been shown by him and others that injury to the nervous system in other parts will produce similar effects. Injuries to the head and spine have in man been soon followed by the secretion of saccharine urine, and cases have been referred to by Sir William Gull and Dr. Barlow in which diabetes followed an attack of hemiplegia, a violent shake, actual concussion, an epileptic fit, and over mental work. It is also sometimes associated with a tumour in the brain. But it must be borne in mind that irritation of the peripheral branches of the pneumogastric in the lungs, stomach, or liver, as well as irritation in any part of the trunk of this nerve, will also induce the diabetic state. George Harley showed that if alcohol was injected into the vessels of the liver, diabetes was induced.

Disease of the brain or of cord has been regarded by some as an exciting cause of diabetes, but it would probably be more correct to consider these nervous lesions as concomitants, or consequences of the existence of a state of things which also occasioned the diabetic condition. Diabetes sometimes follows injury to the brain, and Frerichs considers that nearly half the cases are due to nervous shock or lesion or derangement of some part of the nervous system.

Although there is no doubt that in many cases worry has much to do with the establishment of the disease, this cannot be regarded as the

essential or the most common cause, seeing that many cases cannot be attributed to nerve disturbance of any kind, while diabetes is unfortunately seen during childhood,—and even in the case of children placed under the most favourable conditions, who have not been worried or frightened, and whose nervous system had, as far as could be ascertained, never been strained or damaged in any way, or subjected to any kind of shock. Whatever may be the conclusion as to the dependence of the diabetic state upon lesions of the nervous system, there cannot be any doubt concerning the frequent complication of the case by serious affections of the brain and spinal cord.

Coma from effusion of blood into one of the ventricles or extravasation of blood into the brain substance, coma from extreme capillary distension, and coma from degeneration of nerve-tissue, occur in some cases. But there is another form of coma associated with diabetes which does not depend upon any definite brain lesion, and which is much more difficult to explain. This so-called diabetic coma has been attributed by Kussmaul to the presence of acetone in the blood, but all cases cannot be accounted for in this manner. The coma which occurs in diabetes seems to be due to different circumstances. (*See* a paper in which fifty cases are brought forward by Dr. Dreschfield, "British Medical Journal" for 1881, and the discussion on the subject in the fourth edition of Dr. Roberts's work on Urinary and Renal Diseases, p. 273.)

Sugar has been found in the urine in cases of cholera by Dr. Hassall and also by Heintz, but the former observer suggests that, as Heller has shown that in this disease the uroxanthin is in abnormal quantity, it is very probable that the sugar may be derived from this substance from decomposition. The same change may account for the presence of traces of sugar in many cases. Diabetes is a disease which, as far as is shown, does not occur in animals, unless induced by injury to the nervous system, a fact which may be adduced in support of the view that the disease, diabetes, is due to changes to which the higher parts of man's nervous system are alone subject. Dr. Prout regarded diabetes as a form of dyspepsia, characterised by difficulty in assimilating the saccharine alimentary principle.

Diabetes is certainly often associated with pulmonary disease, and tubercle is not unfrequently deposited during its course. Not a few cases of diabetes occurring in the young succumb from the softening of tubercle long before life would have been cut short by the diabetes. But as is well known, many forms of lung disease occur and run their course without any sugar being found in the urine, and it is doubtful whether there is any causal relation between the two pathological conditions.

Sugar has been detected in pneumonia and bronchitis. In extreme

cases of phthisis sugar is occasionally detected in the urine, and towards the close of many exhausting diseases, a meal of starch is followed by the excretion of saccharine urine. I have shown the presence of a considerable quantity of sugar in the sputum in a case of acute pneumonia, just before the patient's death. It has been asserted by some observers, that sugar can always be detected in the urine after anæsthesia produced by chloroform, and in cases of bronchitis and emphysema. I have carefully tested for sugar in the urine of several patients who had taken chloroform, but did not succeed in detecting it in a single instance. The presence of sugar is accounted for on the supposition that the sugar is not further oxidised, and carried off as carbonic acid. Bernard has, however, shown that this theory cannot be sustained. He has proved that the temporary diabetes produced by irritation of the floor of the fourth ventricle, close to the origin of the pneumogastric nerves, is not due to the impaired action of the respiratory organs, as Reynoso and others have supposed.

I have myself found sugar in the urine in pneumonia and phthisis, and have frequently met with it in cases of gradual contraction of the liver, accompanied with a corresponding condition of the kidneys, with albuminous urine. In one case the sugar and albumen seemed to alternate. Sugar would be present for a few days, while no albumen could be detected, and then albumen would appear and the sugar would cease for a time.

Some have contended that the state of the pancreas has something to do with the development of the diabetic condition, but it must be borne in mind that various departures from the normal state of that gland are frequently met with without the presence of sugar in the urine.

Diabetes is generally accompanied with emaciation, but I have seen cases in which the patient was not only well nourished but corpulent and increased in weight during the diabetic condition. Not long since, I was consulted by a very robust and healthy-looking man, a farmer, weighing 13 stone 6 lbs., who appeared to be suffering from dyspepsia. It was, however, found, upon examination, that the urine was of specific gravity 1,028, contained a considerable quantity of sugar (38 grains in 1,000), and was loaded with albumen. There were no casts of the uriniferous tubes or other indications of renal disease. This case gradually became worse, although the proportion of sugar in the urine became reduced, when he was put upon a properly regulated diet.

In cases of carbuncle, sugar sometimes appears in the urine, and towards the close of chronic exhausting diseases it has been detected. We should always examine the urine of patients suffering from a succession of boils, as in many of them sugar will be found. When diabetes occurs in old people, it is usually quite under control, and not

unfrequently partial recovery occurs. The specific gravity is often 1,030 or 1,040, but not more than from three to five pints may be secreted. There is no ground for anxiety, even if the urine contains very much sugar, provided the quantity of urine passed is not excessive.

Injudicious living, and especially very frequent indulgence in good dinners, unquestionably favour the development of the diabetic state. The disease, like gout, is hereditary, and, unless those who are predisposed exercise great care in diet, they are very likely to suffer from the disease in middle life.

In diabetes wounds do not always heal satisfactorily, and surgical operations should, if possible, be avoided. Slight injuries are not unfrequently fatal, and life is sometimes cut short by the exhaustion consequent upon abscesses or mortification of a portion of tissue.

This disease, like many other serious maladies, has been attributed to the influence of stimulants, but it need scarcely be said that thousands indulge but too freely in alcohol without contracting diabetes, for one who suffers in this way. And on the other hand, it will be found that comparatively few diabetics have indulged in excess of alcohol. It is unreasonable to attribute a disease which occurs in the young, which affects both sexes, and which is remarkable for hereditary transmission, to the direct effects of alcohol, and it need scarcely be said that the fact of the increase of sugar in the urine after the administration of alcohol to a diabetic, cannot be fairly advanced in favour of the above view, since many other things, and even injury to nerves, direct and indirect, will act in precisely the same way.

The occurrence of this remarkable disease is not due to some peculiarity in diet or in the mode of life. Up to the present time we are unable to say why sugar is not present in healthy urine, and what conditions lead to the excretion of so large a quantity as we meet with in many cases of diabetes; neither can we tell why one case dies in a very short time while another lives for many years and passes very much sugar during the whole time. The liver of a patient who has died of diabetes is often much heavier than the healthy organ and contains much blood, but such changes may be secondary and not causal. No constant anatomical alterations have been shown to be present in the liver in diabetes.

The practitioner will meet with cases in which diabetic urine also contains a considerable quantity of albumen. This complication, which adds to the gravity of the case, is usually met with in men of middle age, who have lived too well for many years. Great anxiety about business matters, or family trouble, or some sudden loss, has prostrated the patient, and when the case is carefully investigated, besides much nervous derangement and symptoms attributed to a gouty tendency, the

practitioner discovers that the liver is large with a rounded edge, that the arteries are thickened, that perhaps there is slight œdema of the ankles and about the inner edge of the tibia, that the urine is of high specific gravity, about 1,030, and contains both sugar and albumen, and sometimes uric acid is present in decided quantity.

The sugar varies greatly in quantity during the course of diabetes, and the variation sometimes occurs quite independently of any changes in the nature or quantity of the food. Now and then the diminution is so marked for some days, that the practitioner begins to think the case less serious than he had at first supposed. If the patient catches cold or gets any febrile attack, the sugar is much reduced in amount, and it is important to bear in mind that towards the close of a bad case the practitioner may be misled by this circumstance of the reduction in quantity or even total disappearance of the sugar, and induced to express a more favourable opinion of the case, possibly only a short time before the patient actually dies. Too much caution cannot be exercised as regards giving an opinion as to the probable duration of life at any period of a case of diabetes. There is no state less certain, and although the patient may have been for months in the same general condition as regards strength, sudden failure may occur at any time and be followed by death in a few hours.

Impaired Sight and Cataract in Diabetes.—The dimness of sight, Amblyopia (ἀμβλυς, dulled), which not unfrequently affects patients who have been suffering from the diabetic condition, seems in some cases to be dependent upon changes in the vitreous humour, in others upon alterations in the lens (cataract) and probably in a larger class upon structural changes in the retina or optic nerve or both. A form of retinitis is not uncommon, and in some cases hæmorrhages from capillary vessels have been observed. It is well known that cataract is very frequently observed in diabetes, probably in from 5 to 10 per cent. of the cases, and sometimes at an early stage of the disease. Sir William Bowman often diagnosed diabetes from the presence of cataract. The form of the disease is "soft cataract," and the results of operation are not generally satisfactory. Dr. G. Weir Mitchell and Dr. Richardson showed that cataract was caused in the frog, if syrup was injected under the skin, and they arrived at the conclusion that the opacity of the lens depended only upon the increase in the density of the fluids which bathed and permeated it, an inference, however, scarcely justified by the facts. It has not been shown that in cases of cataract the density of the serum of the blood is invariably increased, and it is improbable that cataract, as it occurs in diabetic patients, is due solely to this cause, seeing that it is not present in some of the worst cases, while it is sometimes well marked in persons who are suffering from a very mild form of the disease. The experiments of

Dr. Bence Jones and M. Dupré, showing the great rapidity with which saline substances pass into the crystalline lens, have been too hastily advanced in favour of the notion that the lens is the seat of active *nutritive* changes. The phenomena in question have probably nothing whatever to do with the nutritive process, and are illustrations of simple diffusion. Were it not for the determination on the part of some persons to prove, in face of a vast array of facts pointing to a very different conclusion, that cataract and other diseases result from physical changes only, the mere circumstance of the very slow and gradual progress of the opacity would alone be regarded as conclusive evidence against such a doctrine.

The large Quantity of Urea in Diabetes.—There can be no doubt whatever that, in many cases of diabetes, the sugar excreted in the urine is not derived solely from the starchy matters taken in the food; for although the patient may be restricted to a diet consisting entirely of proteine and fatty substances, sugar is nevertheless formed. The observations of the Rev. S. Haughton certainly confirmed this conclusion. He showed, in some cases which he investigated with the greatest care, that the sugar excreted had a double origin, having been in part derived from the starch in the food, and partly from the decomposition of proteine substance. He considered that the proteine compounds resolved themselves into glucose and urea without giving out work, the total work done in the body in diabetes being at a minimum. The large excretion of urea depends not upon *the work done in the body*, as in health, but results merely from decomposition. In this way the large excretion of urea in diabetes is explained; and the fact cannot be accounted for upon the usual theory, that the urea is derived solely from the disintegration of tissue. ("On the Phenomena of Diabetes Mellitus." Dublin, 1861.)

Ringer draws the following conclusions on this subject, "On the Relative Amount of Sugar and Urea in the Urine of Diabetes Mellitus," Trans. Med.-Chir. Soc., 1860, p. 323. 1. After the influence of food on the urine has entirely disappeared, a constant ratio is maintained between the sugar and urea. 2. After a purely non-amylaceous and non-saccharine meal, both the sugar and urea are increased, but that during this increase the same ratio between them is observed, this ratio being 1 of urea to 2·2 of sugar. 3. Under both these circumstances the sugar could only be derived from the nitrogenous elements of the body, and therefore some ratio might on *à priori* grounds have been expected.

The highly important and interesting observations lately made by M. Hohl, in a case of diabetes where inosite was passed in large quantities, and seemed to take the place of the urea and sugar, must not be passed over.

Analyses A, B, C, represent the composition of the urine in a case

of diabetes, a healthy-looking girl, only eighteen years of age. She had been suffering from the disease for about three months. Various plans of treatment were tried, without any marked results. She remained under treatment for six weeks, and then left the hospital. She drank from four to six pints of fluid daily; and, when living on a moderate meat diet, with a small quantity of bread, passed rather under a gallon of urine. The urine was analysed from day to day; and I select three specimens for illustration. When the last was obtained, her diet was restricted to bran-biscuits and milk. The results are expressed in grains, and represent the quantities passed in twenty-four hours.

ANALYSIS	A.		B.		C.	
	March 20th.	In 100 of solid matter.	April 2nd.	In 100 of solid matter.	April 23rd.	In 100 of solid matter.
Quantity of fluid drank in 24 hours	64708·75		36968·75		36968·75	
Specific gravity of Urine ...	1,037		1,043		1,043	
Reaction	Acid.		Acid.		Acid.	
Water	78653·75		69364·50		50857·625	
Solid matter ...	8846·25		8510·50		6017·375	
Urea			512·30	5·430	455·000	7·561
Sugar	8750·00	98·910	7549·12	88·703	4889·326	81·253
Organic matter..			141·07	2·447	501·287	8·333
Fixed salts ...			308·11	3·620	171·762	2·853

THE TREATMENT OF DIABETES.

In the treatment of a case of diabetes, the diet must be carefully regulated. That starchy and saccharine substances taken in the food, cause an increased quantity of sugar in the urine, is proved beyond question, while, on the other hand, every practitioner is familiar with the improvement that invariably takes place in the condition of the diabetic patient, even a very short time after the allowance of these and allied substances has been reduced.

There are many cases where the urine contains small quantities of sugar, which recover if starchy and saccharine matters are withheld in quantity or avoided. In such cases it would seem that the sugar had been derived from these substances only, while, in severe cases, the excretion of sugar continues although the patient is restricted to a diet consisting of albuminous matters and bran. In many cases the diabetic condition passes off, and after an interval reappears. The disease may

continue for many years, or it may carry off the patient in a few months. It is rare for a *confirmed case* under forty to recover completely.

Except in very severe forms of the disease, it is neither expedient nor necessary to insist too strongly upon a very strict diet immediately the patient comes under treatment, for many rebel if this is attempted at once, who might have been induced to submit to a fully restricted diet if the system had been introduced gradually. The quantity of wheaten bread may, at first, be reduced, and the proportion of meat may be increased, and brown substituted for white bread. Then some of the bran food may be tried. By employing a little ingenuity in using bran, eggs, cream, and glycerine, a perfectly restricted diet may be gradually enforced without distress to the patient. To put every one upon a rigid diet, because there is sugar in the urine, would be useless and cruel, and it is even probable that some cases would live much longer upon an ordinary diet than upon a rigidly exclusive one.

The diabetic may be allowed to take his tea and coffee with cream instead of milk. Cream diluted with water is far better for the diabetic than milk which contains milk-sugar. It is of the first importance that all persons suffering from diabetes should be warmly clad. They should wear woollen next the skin all the year round. Many feel chilly and clothe warmly by their own desire, but some patients are so much opposed to flannel that it is necessary to explain to them how essential it is to protect themselves from cold. We are not, however, compelled to deny even sweet flavours to the diabetic, for he may use glycerine; the preparation now made so largely by Price and Co. (Price's glycerine) is so pure, and its taste is so perfectly sweet, that it can hardly be distinguished from sugar.

The terrible thirst which often causes such distress to the diabetic patient and the full gratification of which increases his peril, is, I think, more effectually assuaged by acid drinks than by ordinary water. Lemon-juice in the proportion of one or two tablespoonfuls to a pint of water, may be allowed, and if the patient objects to the sourness, a tablespoonful of glycerine may be added. Cream of Tartar (Potassæ Tartras Acida) may also be used to make an acid drink in the proportion of two or three drachms to a pint of water, with or without lemon-juice.

Glycerine may be used for sweetening tea, coffee, and cocoa; it may be introduced in custards; and with eggs and gluten bread well softened, a very palatable kind of pudding may be prepared; glycerine, eggs, and bran may also be made into a light sort of cake or pudding, which may serve to vary the monotony of a strict diet.

The diabetic patient may take a moderate quantity of milk, but it should be borne in mind that milk contains a form of sugar, and, therefore, is not to form a staple article of food in this disease. Various

kinds of meat and white fish may be taken. Oil, fat, cream, and butter are advantageous in some cases. Eggs may be taken if they agree with the patient, but sometimes they upset the stomach. Soups of various kinds—but not containing flour. Cheese, cream cheese, ham, and bacon may be eaten by diabetic patients.

The best vegetables are cabbage, broccoli, mustard and cress, endive, lettuce, and watercresses. Asparagus should not be taken, as, according to Dr. Harley, when eaten in quantity, temporary diabetes may be induced. Potatoes and all vegetables containing much starch, and fruits, both fresh and dried, as they contain sugar, must not be eaten.

It is scarcely necessary to particularise the individual articles of food which may be taken by the diabetic patient. Long lists have been given in many works, but some of these bills of fare are more amusing than useful. The most curious of any that I have seen is the carte of Prof. Bouchardat, Paris, 1859, which was translated many years ago by Dr. Bence Jones, and strongly recommended by him. I cannot, however, help thinking that a number of the dishes enumerated for diabetics would derange the strongest stomachs. The complete list would extend over six or seven pages, and I shall therefore content myself with giving as examples a few of the strange compounds which are not likely to be very popular in this country. "Pickled pork, with cabbage, also sour-kraut. These should be washed in much water, and well dried. Black pudding, ham, and spinach. Fresh herrings, with butter, or with sauce piquante. Black beetles (!), with butter, garlic, and other herbs. Sardines, pickled in oil. Salt herrings, with olive oil. Mesentery of the calf, in oil (very good). Calves' ears, plain. Calves' brains, with butter, à la poulette, or fried with gluten flour. Slices of goose, with olives. Fried oysters. Carp's roe. Fried legs of frogs. Fried crabs' tails. Pike, with caper sauce and oil. Herring, with butter or oil, or mustard sauce. Ray, with butter or caper sauce. Sea eel, with oil or butter. Cod, with oil or butter. Mussels, à la poulette or pickled. Frogs. Lobster salad. Crabs. Prawns; or beetles or crab sausages. Young green walnuts, in salt water without vinegar; the same dried." *See* "Medical Times and Gazette," Jan. 28, 1865.

Instead of eating crumb of bread, the patient should be instructed to eat well baked crust only, or thin slices of bread should be well toasted in the usual way. By this process much of the starch is converted into matters which do not yield sugar when acted upon by the saliva or pancreatic fluid. The practitioner will generally find that in cases in which it is absolutely necessary to insist upon a very restricted diet it is desirable to begin with toast, before advising bran cakes or gluten bread. Some patients who cannot manage the latter substances do not object to toast soaked in soup or otherwise softened, and very often

the proportion of sugar excreted becomes so much reduced that a highly restricted diet is not needed.

Substitutes for Bread.—Some of the best substitutes for wheaten bread are *Bouchardat's gluten bread*, or *M. Durand's Toulouse gluten bread* (Callard's English gluten), but the *bran biscuits*, prepared as Dr. Camplin directs, are far superior to either. The first contains about 25, and the Toulouse bread 26 per cent. of starch, while the last contains only traces of this material when properly prepared.

Formula for making Bran Cakes.—Dr. Camplin, who himself suffered from diabetes, proposed a most valuable kind of food made from bran. The bran is ground fine in a mill, sifted, and can then be made into a kind of cake. The directions Dr. Camplin gives are as follows:—"Take a sufficient quantity (say a quart) of wheat bran, boil it in two successive waters for a quarter of an hour, each time straining it through a sieve, then wash it well with cold water (on the sieve) until the water runs off perfectly clear; squeeze the bran in a cloth as dry as you can, then spread it thinly on a dish, and place it in a slow oven; if put in at night let it remain until the morning, when, if perfectly dry and crisp, it will be fit for grinding. The bran thus prepared must be ground in a fine mill, and sifted through a wire sieve of such fineness as to require the use of a brush to pass it through; that which remains in the sieve must be ground again until it becomes quite soft and fine, a precaution especially necessary if, as sometimes happens, the mucous membrane of the bowels is in an irritable state. Take of this bran powder 3 ounces (some patients use 4 ounces, the other ingredients as follows), three new-laid eggs, 1½ ounce (or two ounces, if desired) of butter, about half a pint of milk; mix the eggs with a little of the milk, and warm the butter with the other portion; then stir the whole well together, adding a little nutmeg and ginger, or any other agreeable spice. Bake in small tins (pattipans), which must be well buttered, in a rather quick oven for about half an hour. The cakes, when baked, should be a little thicker than a captain's biscuit; they may be eaten with meat or cheese, for breakfast, dinner, and supper; at tea they require rather a free allowance of butter, or may be eaten with *curd* or any of the soft cheeses. It is important that the above directions as to washing and drying should be exactly followed, in order that it may be freed from starch, and rendered more friable." ("On Diabetes," p. 86.) The mill may be obtained from Mr. Gollop, 149, Cheapside. The bran powder and biscuits cost 1*s.* 6*d.* a-pound. The gluten biscuits cost 2*s.* 6*d.* a-pound.

An excellent form of bran, very finely powdered, has been recently introduced by Messrs. Chapman and Co., of the St. James' Mills, Hatcham, S.E. This is to be obtained retail of Mr. Bonthron, baker, Regent Street, and is sold in small tins.

The same firm also prepares a capital kind of flour for making ordinary bread. This is called whole meal flour, in consequence of the bran being ground up with other parts of the grain. The bread is, of course, more nutritious than ordinary baker's bread. The price of this flour is the same as that of the best white flour.

Almond Cake.—Dr. Pavy ("On Diabetes," p. 154), has added another substitute for wheaten bread—almond cake and bread. A very palatable kind of biscuit has been prepared with egg and blanched almond powder, according to Dr. Pavy's suggestions, by Mr. Hill, of Bishopsgate Street.

Glycerine Sponge Cake.—It occurred to me, some time since, that the bran, with eggs and glycerine, might be made into a form of sponge cake, and I tried some experiments with this view. Glycerine sponge cake is not only palatable, but really nice. When freshly made, the cakes are as soft as ordinary sponge cake. They may be dried, and will keep for any length of time. In the dry state they can be readily softened in soup, tea, or coffee. They can be flavoured with lemon, or other flavour, according to taste. A similar kind of food can be made with savoury gravy; and in cases where the digestive powers of the stomach are impaired, a few grains of pepsin can be added with advantage. Food made on a similar principle, with ordinary flour, concentrated extract of meat, and pepsin, is valuable in many cases when the stomach is very weak and irritable.

Patients often desire to change their diet from time to time, and they may be allowed to try one substitute for bread after another.

Manufacturers of Gluten Bread, &c., for Diabetic Patients.—The various substances required for diabetic patients may be obtained of the following firms, which are arranged alphabetically:—

Van Abbott, G., and Co., Howford Buildings, 148½, Fenchurch Street, and 5, Princes Street, Cavendish Square—Gluten Bread—Toulouse Gluten Bread, &c.

Bell and Co., 338, Oxford Street—Gluten Bread, &c.

Bewley and Evans, 3 and 4, Lower Sackville Street, Dublin—Gluten Bread, &c.

Blatchley, E., 362, Oxford Street—Bran and Gluten—Bran and Gluten Cake and Biscuit.

Bonthron, J., baker, 106, Regent Street.

Bullock and Reynolds, 3, Hanover Street, W.

Gollop, 149, Cheapside—Maker of Mills for Grinding Bran.

Hill, W., 60 and 61, Bishopsgate Street, E.C.—Almond Cakes, Biscuits and Rusks.

Smith, baker, Gower Street, W.C.—Bran Biscuits, &c.

Wines.—Of wines containing little sugar, amontillado, mansanilla,

and Manilla, may be taken, and good claret may be recommended. In dry sherry and Madeira there is comparatively little sugar, from 4 to 20 grains in an ounce. Champagne contains, according to Dr. Bence Jones' estimate, from 6 to 28 grains in the same quantity. Claret, Burgundy (Beaune or Macon to be obtained very good for about 18*s.* a dozen), and Moselle may be obtained without sugar. Brandy and whiskey are the best spirits. Alcohol is said to increase the sugar, but moderate quantities of brandy or whiskey seem to be of service in some cases. I sometimes order two or three ounces of whiskey daily, if the patient is weak. I have never seen any bad effects resulting, and many cases have improved while taking this stimulant. Vichy, or other alkaline water, may be taken in moderate quantity, but it is well to restrain the diabetic patient from taking too much liquid. Lime, potash, soda, and lithia water may be given with the stimulant.

The skim-milk treatment of Dr. Donkin seems to have suited some cases, but it does not answer for all patients. Some get worse under it, while buttermilk, koumiss, whey, and other milk beverages, disagree with so many patients that these should only be recommended as an experiment, and the patient should be instructed to discontinue such beverages if he finds they do not suit him. Dr. Donkin recommended 6 to 8 pints of skimmed milk daily. ("On the Milk treatment of Diabetes and Bright's Disease," 1871.) Dr. Roberts expresses a very decided opinion against the skim-milk treatment. "Three months of the skimmed-milk treatment brought the case to a fatal termination;" but I do not quite see why he concludes that the death was due to the treatment only, as the patient might have died at the same time had a different system been adopted or the case left without treatment.

If the diet is too restricted, the patient may continue to lose in weight, in which case a little more licence must be permitted, for it is obviously wrong to insist that the patient should only eat this or that if in point of fact he cannot eat, and may really soon be in a condition worse than that which would have resulted if no restrictions whatever as to diet had been imposed. The diet is altered for the patient's benefit, but if the alteration is found to be to his detriment it would be against all principles of rational medicine to insist upon its being carried out.

The diabetic patient should be weighed as soon as he is placed under treatment, and again at intervals of a fortnight.

Medicines.—Benefit often results from the use of ordinary tonics The mineral acids are sometimes of service. Dilute phosphoric acid will allay the thirst. A very agreeable drink may be made as follows:— Acid phosph. dil. a drachm, glycerine an ounce, water half a pint; mix. A few tablespoonfuls of this may be taken occasionally during the day.

Various bitter infusions, and citrate of potash and ammonia, sometimes do good. Of all the tonic remedies I have tried, the old tincture of perchloride of iron has, I think, been of the most use. I generally order from ten minims to half a drachm, two or three times a-day, in infusion of quassia, or sometimes with one or two grains of quinine, and advise the patient to continue taking the medicine for months. Under its use the strength has improved, and the patient has gained in weight. Sulphate of zinc has been recommended. Hydrocyanic acid is valuable in cases when there is irritability of stomach. Cod liver oil is very serviceable.

Sugar has been given in large quantity in diabetes, and, as would be supposed, has been found worse than useless.

Rennet and Pepsin have been given in diabetes. Dr. James Gray ("Glasgow Medical Journal," vol. IV) states that, of twenty-eight persons treated by rennet, seven "completely recovered," but they were also placed upon a restricted diet. Dr. Roberts tried rennet, but although the patient improved while taking it, he had been improving quite as rapidly before he commenced taking the remedy. ("Brit. Med. Journ.," Nov. 17, 1860.) According to Leubuscher, the quantity of urea, chloride of sodium, and sugar were increased by the administration of pepsin, but Dr. Parkes thought that this substance increased the sugar. On the other hand, in one case in which I tried it, benefit resulted, but then there was some dyspepsia, and I thought that the diet was imperfectly assimilated. In a very bad case of diabetes pepsin will be of little use, but in various conditions in which the digestive power of the stomach is impaired, either temporarily or permanently in this or indeed any disease, pepsin will be found to be a very valuable remedy. Really good pepsin has not yet been fairly tried. The powdered pepsin may be kept in a well-stoppered bottle for three years without its active powers being in any way impaired. Four-fifths of a grain with ten drops of dilute hydrochloric acid and an ounce of water dissolve 100 grains of hard-boiled white of egg. ("Archives of Medicine," 1856, vol. I, pp. 269, 316.) It is prepared by Messrs. Bullock & Co., 3, Hanover Street, Hanover Square, W., and costs a shilling a drachm, which may be divided into twenty or thirty doses. *See* p. 197.

It is curious with what confidence some writers pass a general condemnation upon certain remedies and remedial measures. Their statements get repeated again and again, notwithstanding that hundreds of people use the remedy in question and are quite convinced of its potency. Such authoritative statements as "Parkes and Leubuscher found pepsin useless" go for very little, and must not deter practitioners from prescribing pepsin in cases where the digestive power of the stomach is impaired. This remedy is not only of real service but it gives comfort to the patient, and not unfrequently relieves pain and distress.

Alkaline remedies are of advantage if given from time to time. They probably promote the removal of the sugar already formed in the blood, and perhaps help assimilation. Small doses of liquor potassæ (ten drops to an ounce of water), or ten-grain doses of bicarbonate of potash or soda after food, or two or three tumblers of Vals or Vichy water with the meals daily for a week or ten days at a time, may be given in cases where the urine is very acid or the patient troubled with flatulence and discomfort, lasting for some time after a meal.

Constipation is often very troublesome in diabetes, and even in those cases in which the appetite is not inordinate, the quantity of material excreted into the large intestine is very considerable. The formation of sugar is associated with the formation and accumulation in the blood of considerable quantities of those substances which constitute the chief constituents of the fæces, and which are separated by the glands of the lower part of the small intestine and the large bowel. In cases of diabetes the separation by the kidneys of an undue amount of water promotes active absorption by the mucous membrane of the colon and cæcum. Consequently the fæcal matter quickly becomes inspissated, and not unfrequently hard and almost dry. Far too little fluid is secreted by the glands of the large bowel. The nerves and nerve centres being also sluggish, accumulation goes on to a great extent in some cases without any reflex action being excited. Sometimes frequent injections are required before any relief can be obtained. It is necessary in managing a case of diabetes to guard against this contingency by frequently giving purgative medicines. Aloes, scammony, colocynth, or compound rhubarb pill generally answer, but it is necessary to change the purgative from time to time. The tincture of Cascara sagrada, or the so-called Cascara cordial, seems to be a valuable addition to our purgative remedies. It usually operates gently without producing pain. From fifteen to twenty or thirty drops in a tablespoonful of water may be taken over night, and the dose is generally followed on the following morning by a pretty free action of the bowels. A syrup of the cascara bark is now prepared, the taste of which is not unpleasant.

Of the usefulness of opium in the treatment of diabetes there is no doubt. It not only causes a reduction in the daily secretion of sugar, but the quantity of water passed is lessened. If the patient is restless and irritable he is benefited by the soothing effects of the drug upon the nervous system. In many cases, so far from increasing the constipation which is so frequently troublesome, opium seems to have an opposite effect. It must, however, be admitted that now and then a patient for whom opium is prescribed finds that he cannot take it in consequence of the headache that is occasioned by its use, while sometimes it seems to have little effect upon the water, but seriously disturbs the stomach and increases the dryness of the mouth which is so distress-

ing to the patient. If opium acts favourably it may be given in half grain or grain doses once or twice a day. The dose should be only increased very gradually. If the patient improves, the quantity may be reduced or the drug withheld for a time. It has been recommended that opium should be given at once in doses sufficient to occasion its physiological effects, but I cannot agree with this advice. Sometimes so little influence is observable that to produce contraction of the pupils we might have to prescribe a quantity of the drug so considerable that there would be danger of its toxic effect suddenly being manifested, and great danger to life might result.

Codeia is preferred by Dr. Pavy, who prescribes this alkaloid in gradually increasing doses, beginning with half a grain twice or three times daily, until in the course of a fortnight or so the dose reaches two or three grains.

Cinchonine, quinine, and strychnine are unquestionably beneficial in cases in which the disease has not reached a very serious state of development. Such medicines improve the general health and strength, and I have no doubt by their administration the duration of life in many cases may be prolonged and the distressing feeling of lassitude and exhaustion experienced by many may be mitigated or removed.

I have found carbonate of ammonia (five to ten grains in an ounce or two ounces of water every two or three hours) and liquor ammonia of use in checking the feeling of depression and exhaustion from which people often suffer in this disease. The ordinary compound spirits of ammonia or sal volatile may also be given in drachm or half drachm doses in a wineglassful of water once in three or four hours. In those cases of diabetes which are not uncommon in well-nourished, nervous, over-energetic men of from forty to fifty, who have worked too hard and been over-anxious, and have perhaps indulged in eating and drinking,—with possibly enlarged liver and perhaps albumen in the urine, very great advantage has sometimes resulted from the washing-out system. Such cases often greatly improve, if, before the condition has existed for a considerable time, they spend two months in Carlsbad. At times of the year when that watering-place could not be visited, good effects may be obtained by carrying out a similar system at Bath, some sulphate of soda being added to the Bath waters. Of all the forms of diabetes, these cases, if treated during the early period of the condition, receive the greatest benefit from judicious treatment. If we cannot render the water free from sugar, we may greatly prolong the patient's life if only he will allow himself to be kept to a rational system of diet for a sufficient time. Not only so, but I feel confident that some of these cases which, if left alone, would end fatally in two or three years, may be so far relieved that life may go on to the ordinary period.

Alkapton.—Bödecker found in the urine of a patient a substance

which possessed many of the reactions of sugar. Alkapton is of a pale yellow colour, and does not crystallise. It contains a large quantity of nitrogen. It reduces copper, like sugar, but does not reduce oxide of bismuth, nor is fermentation excited in it by yeast. Urine containing it becomes of a brown colour upon exposure to the air, if an alkali be present, without the application of heat. This change occurs if potash be added. *Sugar and potash* change colour only when the solution is boiled. Alkapton was separated by Bödecker from the urine by the following process:—After precipitation with acetate of lead, the mixture was filtered, and the solution mixed with tribasic acetate of lead, excess being avoided. The precipitate was washed, suspended in water, and decomposed by sulphuretted hydrogen. The solution filtered from the sulphuret of lead was evaporated to dryness over the water bath, and the residue extracted with ether. The alkapton remained after the ether had evaporated. (Bödecker: "Zeitschrift. f. rat. Med." VII, 128; "Ann. Ch. Pharm." Jan. 1861; Bowman's "Medical Chemistry," edited by Prof. Bloxam, p. 51.) Alkapton was found in the urine of an infant by Dr. Johnson, his attention being called to it by the brown stain on the linen (quoted in Bowman's "Med. Chem.," by Bloxam, p. 52).

ON URINARY CALCULI AND CALCULOUS DISORDERS.

THERE are several substances in healthy urine which are only slightly soluble in water. In certain derangements of the physiological actions, some of these are produced in much larger proportion than in health, while other matters not present in healthy urine, and not readily soluble in water, are sometimes formed. It is not therefore surprising that, from time to time, some of these not very soluble substances should be slowly deposited in the insoluble form from the urine while it yet remains in the bladder, or even before it reaches that organ. It is interesting to consider the various conditions which are likely to lead to the deposition of calculous material, and it is instructive to study the general state of the system which is associated with each particular form of insoluble matter deposited. If we were accurately acquainted with the mode of deposition of calculous matter, it is very possible that we might lay down such rules for the guidance of patients in whom the tendency existed as would prevent the formation of the stone, or retard its increase if already formed.

The deposition of a calculus does not always depend upon the state of the urine, for it is possible that the urine may be healthy while a stone is forming; the changes taking place on the surface of the stone itself having much to do with the precipitation of insoluble matter. These changes are different in different cases, sometimes resulting in the setting free of an acid and sometimes of an alkali. Bacteria are intimately concerned in the initiation and maintenance of these changes. It will often be found that the tendency to calculous disorder is explained by deranged chemical changes, which may perhaps sometimes be materially modified by giving attention to the action of the alimentary canal and skin, altering the mode of living, and administering the salts of the vegetable acids, alkalies, mineral acids, or even mere diluents in large quantity, according to the nature of the case.

In those cases in which the deposition of the calculous matter mainly depends upon the urine being in a state unfavourable for holding certain slightly soluble matters in solution, it follows that the tendency

to deposit may be averted, if the condition of the urine can be altered. It is possible that at one time an acid state of urine may favour the precipitation of uric acid; while, after a short interval, its characters may become so altered that it becomes alkaline. Not only does the precipitation of uric acid cease, but phosphates, which are insoluble in an alkali, are deposited. Phosphatic salts are soon precipitated on the outer surface of the uric acid, and the stone thus becomes most effectually protected from the further solvent action of an alkali.

In such a state of urine, however, a stone may increase rapidly in size, for there is always a certain amount of earthy phosphate in solution which, if the urine becomes alkaline, is precipitated in the form of ammoniaco-magnesian phosphate and phosphate of lime, both of which salts are insoluble in fluids of alkaline reaction, whether the alkali be due to the decomposition of the urea and the formation of carbonate of ammonia or to the presence of fixed alkali.

Calculi are usually composed of many different constituents; but one generally predominates greatly over the rest, and the calculus is named accordingly. Even the purest calculi composed of earthy salts contain, nevertheless, a certain proportion of organic matter; and those which seem to consist of organic material only, contain a proportion of earthy salts. A certain amount of animal matter is deposited with the hard material, and in many cases serves to agglutinate the particles together.

It was shown by Mr. Rainey that, when saline matter crystallised in a viscid substance like gum or mucus, it took the form of a spherical mass instead of assuming its usual crystalline characters. (*See* Mr. Rainey's "Observations on the Formation of Shell," &c.) After the hard matter of a stone has been dissolved, this animal matter remains in the form of a translucent, granular, mucus-like mass. Upon microscopical examination, the remains of delicate fungi can often be detected in this matrix, and very frequently dumb-bells of oxalate of lime, or fragments of them, are found. The fungi were formed during the formation of the calculus; and it is probable that the reaction developed in the fluid in contact with them during their growth, occasioned the continued precipitation of the insoluble calculous matter. Were it not for the viscid organic matter, the hard crystalline substance would be deposited in its characteristic crystals. In some calculi, however, the material does exhibit its ordinary crystalline character.

The hard calculous matter may consist of substances which exist in healthy urine, like *phosphates* and *uric acid*, slowly deposited from their weak solution in the secretion; or of materials which are not present in perfectly normal urine, such as *oxalate of lime*, *cystine*, *blood*, *carbonate of lime*, *&c.*

The insoluble material is deposited in distinct layers, which can

often be easily detached and separately examined. These layers are easily demonstrated by making a section of the calculus, which, except in the case of the hardest and most brittle calculi, may be readily effected as follows. The calculus is to be sawn through with a fine sharp saw. The cut surface is next to be ground smooth, by being rubbed down upon a smooth flat hone with water. When it is perfectly even, it may be washed and allowed to dry. Lastly, the cut surface is to be varnished. All the different layers will now be seen very distinctly. If the calculus be brittle and hard, unless it be sawn through with a diamond wheel, it is better to grind away one half without using the saw. Small calculi are very easily ground and polished, and often furnish very instructive specimens.

The concentric layers are often of different colours and of different degrees of hardness, often contain varying proportions of organic base, and are of different chemical composition. Each ring forms the section of a layer, and a portion of each may be detached and separately subjected to chemical examination. Some of these layers are deposited quickly, others more slowly; and they therefore vary considerably in hardness. In examining a calculus, it will be necessary to subject a small portion of several layers to examination. Concentric layers are very conspicuous in the most minute calculi, even in those microscopic calculi which require to be examined under a power of 250 diameters ("100 Urinary Deposits," pl. VIII, figs. 101, 104).

Seldom can any definite crystalline form be made out, except upon the surface of the concretion; and upon examining small portions of a calculus in the microscope, nothing but a great number of fragments, exhibiting concentric layers, can usually be distinguished. Sometimes the material is at first deposited in separate little spherical masses, which become aggregated, and at length become incorporated together. Upon the surface of some calculi beautiful and well-formed crystals are, however, sometimes formed. Well marked crystals of triple phosphate, oxalate of lime, and cystine are occasionally found on the surface of a calculus so large and distinct that they may be seen and identified by the unaided eye.

Calculi may be arranged in two classes, according to the relative proportion of the organic matter and inorganic matter present. The *combustible*, or *almost entirely combustible* calculi, are those which consist almost entirely of organic matter, and leave very little residue after exposure to the action of a red heat on platinum foil; while the *partially combustible* or *incombustible* calculi, consisting mainly of inorganic material, leave a considerable proportion of fixed residue.

1. The first class includes calculi composed of *uric acid*, *urates of ammonia*, *soda*, *lime*, and *magnesia*, *cystine*, and the rare forms of *uric* or *xanthic oxide calculi*, *mucus*, *fibrinous* and *blood calculi*.

II. The second class comprehends the *oxalate of lime* or *mulberry* calculus; calculi composed of various *phosphatic deposits;* that consisting of *carbonate of lime*, which is very rare in the human subject but not uncommon among the lower animals; and the *silicic acid* calculus.

Class I.—*Calculi which leave only a Trace of Fixed Residue after Exposure to a Red Heat.*

Uric Acid Calculi.—Nearly two thirds of the calculi in the museums in this country consist in great part of uric acid. They vary very much in size. Small uric acid calculi are sometimes formed in considerable number in the kidney. For the most part, the deposition of the uric acid commences in the kidney itself; and not unfrequently the small concretion becomes impacted in the lower part of the uriniferous tubes or in the infundibula, and gives rise to great irritation and pain, lasting it may be for many years, until at last it becomes released, and passes down the ureter into the bladder. It may now escape from the ureter or remain in the bladder, when layer after layer is added. If it be not removed, the calculus may attain a considerable size.

The uric acid calculus is usually of an oval form, but somewhat flattened on two of its surfaces. Occasionally the calculus is perfectly spherical. Uric acid calculi are sometimes quite smooth externally, sometimes rough, or covered with a number of rounded projections. They are generally of a brownish hue, varying from a pale fawn colour to a dark brownish red. Dr. Rees met with one specimen in which the nucleus was quite white, and was composed of pure uric acid destitute of colouring matter. The consistence of the uric acid calculus is usually hard, and its texture compact, but rarely it is soft, and can be broken down between the finger and thumb. If fractured, it usually breaks up into small angular pieces.

I have examined many small uric acid calculi, and in several instances have found that the nucleus consisted of matter insoluble in potash, which polarised readily; and, in some specimens, well-defined dumb-bell crystals of oxalate of lime were discovered. In a few the nucleus consisted originally of mucus or some soft matter, which after a time shrank and nearly dried up, leaving a space or cavity in the centre of the calculus; but, even in these instances, matter insoluble in potash and acetic acid was generally detected. Dumb-bell crystals of oxalate of lime in small collections generally form the nucleus of uric acid calculi.

The uric calculus is often coated with phosphates. The irritation of the calculus Dr. G. O. Rees thought excited the secretion of an abnormal quantity of alkaline fluid from the mucous membrane of the bladder, which caused the earthy phosphates to be precipitated from their solu-

tion in the urine. If ammonia were set free by the decomposition of the urine, it is possible that a little of the uric acid calculus might even be dissolved; but this would soon be prevented by the deposition of earthy phosphate upon its surface. The phosphates are not, however, *secreted* in increased quantity by the mucous membrane of the bladder, as was formerly taught, but are merely precipitated from their solution in the urine.

Calculi composed of Urates.—These calculi usually contain urates of soda, ammonia, and lime; and very commonly small quantities of oxalate of lime are deposited with the urates. This calculus is in great part soluble in boiling water, and gives off ammonia when heated with a strong solution of bicarbonate of potash. In Prout's time this calculus was the one generally met with in children; it is usually small in size, of a pale brown colour, and is softer than the uric acid calculus. Layers of urate are often found in uric acid calculi.

Uric Oxide, Xanthic Oxide, Xanthine.—These names have been given to a rare form of calculus, which has only been found in man on three occasions. It is not soluble in water; it is hard, of a yellowish brown colour, and the surface can be polished by friction. Scherer has found xanthine in the liver and spleen, in muscle, and in blood. It is closely allied to uric acid, and also to hypoxanthine, which only differs from it in containing two atoms more of oxygen.

Cystic Oxide—Cystine.—This form of calculus is of a pale greenish colour; its surface is smooth, and there are no indications of concentric layers. The fracture is glistening, and the structure is semi-transparent. Cystine is referred to on page 69. (*See* also "100 Urinary Deposits," pl. VII, figs. 92, 93, 94.)

Fibrinous Calculus.—This form was first noticed by Dr. Marcet, and it appears to consist entirely of an elastic organic substance closely allied to fibrine. It is said to resemble yellow wax in its appearance. It dissolved in potash, but was precipitated by excess of acid. It was insoluble in water, alcohol, and ether; but was dissolved by acetic acid, with the aid of heat. In this solution, ferrocyanide of potassium produced a precipitate. It left very little fixed residue after exposure to a red heat.

Blood-Calculi.—Dr. Scott Alison furnishes the following interesting remarks with reference to some blood-calculi in the kidney. ("Archives of Medicine," vol. I, p. 245.) Upon examining the body of a man named William Solly, who was admitted into the Consumption Hospital, Brompton, under the care of Dr. Cursham, on August 23, and who died on the 30th of the same month, the left kidney was found by Dr. Alison to be greatly wasted and changed in structure. The infundibula and pelvis were stuffed with hard bodies, most of which were of a coal-black colour. "The black calculi occupied the pelvis, while the infundibula

were tenanted with a few calculi of a whitish-grey colour, with one exception small in size, about the magnitude of pear-seeds, and wanting the ordinary physical characters of phosphate of lime. One calculus, which occupied an infundibulum, is the size of a horse-bean, looks somewhat worn and disintegrated, and at one point resembles a piece of decayed wood. At one side it is black, from the presence of altered blood. It is very light in weight, and is composed of blood and phosphate of lime. The black calculi, which form the chief point of interest in the case, were about six in number, and ranged from the size of a coriander-seed to that of a small horse-bean. When found, these black calculi were tolerably hard; but, being friable, they partly broke asunder in handling. The fractured surface varied a little in colour, in some parts presenting a dark rusty tint." Liquor ammoniæ dissolved these calculi, and they were capable of partial combustion. The microscope revealed only amorphous particles; but Dr. Owen Rees, with the assistance of a neutral saline solution, discovered forms which he considered to be the remains of blood corpuscles. The kidney was remarkably altered. It was very small, but retained somewhat of the normal shape. It weighed only an ounce and a half, and was only two inches in length. Its colour was drab; its consistence was firm and fibrous. At one extremity only could any natural cortical or tubular structure be found. The kidney in fact resembled a sac with thin irregular walls. The lining membrane appeared healthy. The renal artery was small, thickened, and scarcely admitted a common probe. The ureter was small, but less out of proportion than the artery. The investing membrane could not be separated from the other parts with which it was connected.

The atrophy of the kidney in this case was probably brought about by the production of inflammatory action, set up, perhaps, by the presence of small calculi of phosphate of lime. Blood was probably effused in consequence, and remained in the infundibula and pelvis, failing to be washed down the ureter in consequence of the suppression of the flow of urine. This blood, hardening, would form the calculi which were discovered. After the abatement of the supposed inflammatory action, degenerative processes would supervene, and lead to the remarkable atrophy and change which the altered kidney presented. The duties of this wasted organ would be thrown upon the other kidney: but, as the system was much wasted by disease, no increase in size resulted.

"Only a very imperfect history of the patient could be obtained, he being very exhausted when he came into hospital. Since his death, inquiries have been made for information, but with little success. He was fifty-two years old, and by trade a painter. He had been ill with cough two years, and his feet and legs became œdematous only two weeks previous to his decease. No information could be obtained

respecting his having suffered from calculi in the bladder, or from hæmaturia; but it is right to mention that no member of the family of the deceased could be found."

Fatty Concretions.—Specimens of urine which contain large lumps of hard fatty matter will sometimes be brought for examination. Quite lately I have seen two such specimens, which were said to be cases in which concrete fatty matter had been passed in the urine. In these, however, the fat was ordinary suet, as was proved by the presence of the fat-vesicle, white and yellow fibrous tissue, and fragments of vessels. Three pieces of suet, it was afterwards ascertained, had been introduced by the patient.

Class II.—*Calculi which leave a considerable quantity of fixed residue after exposure to a red heat.*

Oxalate of Lime Calculi.—I have seen an oxalate of lime calculus not larger than the 1-500th of an inch, and have traced the formation of such a stone through the several stages of aggregation. I believe that the dumb-bell crystals formed in the kidney, in the first place become aggregated together, forming small collections, crystalline matter is then deposited in the interstices, and gradually a microscopic calculus results. Microscopic oxalate of lime calculi are represented in figs. 97, 98, 101, pl. VIII, "100 Urinary Deposits."

Microscopic calculi may remain for some time in the kidney, and slowly increase until they form the concretions known as the hemp-seed calculi. Not unfrequently a number of them are formed in the kidney, and pass down the ureter one after the other at varying intervals of time. Sometimes one becomes impacted, and gives rise to the most serious and distressing symptoms. Having arrived at the bladder, the slow deposition of the oxalate may continue, or layers of uric acid or phosphate may be deposited, according to the state of the urine.

In cases where the oxalate increases, the surface becomes tuberculated, in consequence of the irregular deposition of the salt; the colour varies from a pale brown to a dark brown purple. When these have increased to the size of a nut or larger they are often called mulberry calculi. Such stones often attain a large size. They are very heavy and hard. On section, the laminæ are well seen, and it is often noticed that the calculous matter has been deposited most unequally.

Occasionally the oxalate of lime is deposited almost colourless and crystalline. Dr. Prout figures one of these calculi. I have a beautiful specimen, which was given me by Dr. Gibb, and was obtained from the horse. Large octahedral crystals of oxalate of lime can be seen all over the surface. The small hemp-seed calculi, which are white on the surface, also exhibit numerous beautiful crystals, although they are smaller than those referred to in the last specimen.

Occasionally, in *post-mortem* examinations, we are somewhat surprised to find these slowly increasing calculi in the kidney, although the patient never suffered from the slightest symptom during life. I have an oxalate of lime calculus the size of an almond, which I found very firmly fixed in one of the ureters of a man who died of an acute malady. Although its surface is rough, and it is half-an-inch in diameter, it seems to have caused scarcely any uneasiness, and there was no suspicion of its existence before the patient died.

Mr. McCormick sent me the following history of a case of a large mulberry calculus removed from a patient by Mr. James Ceely of Aylesbury. It is not a little remarkable that this rough calculus, weighing twelve drachms, should have been present without causing great pain and uneasiness :—"At the age of fifteen years the patient (now forty-five) suffered from pain in the hypogastric region, extending along the urethra to the glans penis. At intervals during the succeeding twelve months the pain was very violent, and was at each attack followed by the evacuation of bloody urine. Occasionally since then he experienced pain in these situations, while taking horse exercise, or during unusual exertion, *but never to any great extent, and he was never compelled to seek advice.* With these exceptions his general health, although delicate, had been good till June (1858), when he had an accession of symptoms resembling those mentioned, but greatly aggravated. The urine, in addition to blood, contained 'gravel.' At this time he consulted Mr. Reynolds, of Thame, who detected a vesical calculus, and on the 20th September, Mr. J. H. Ceely performed the lateral operation and removed a rough, irregular, mulberry calculus, weighing twelve drachms. During the first ten days subsequent to the operation, the urine contained considerable quantities of pus and blood, after which time all abnormal characters disappeared, and the patient was discharged from the Bucks Infirmary perfectly well on the 8th of October, and had suffered little pain or inconvenience. This patient had enjoyed excellent general health during a period of twenty-nine years, notwithstanding the presence of a calculus probably during the whole period."

A calculus of very curious shape, the nucleus of which consisted of oxalate of lime, is described by Mr. Price in the eleventh volume of the "Transactions of the Pathological Society." Mr. Price removed fourteen calculi from the bladder of an old man by the lateral operation of lithotomy. Two of the calculi were peculiar in possessing several spine-like projections. The largest of these was about the size of a chestnut, and from its surface projected from eight or ten spines, two of which were upwards of half-an-inch in length. Surrounding the oxalate of lime nucleus were several layers of uric acid and urates, with some earthy phosphate. The spines were formed of the latter salts alone, and there was no projection of the oxalate of lime nucleus into them. The cause

of their peculiar shape could not be ascertained. The stone was not in any pouch in the bladder, but was free in its cavity, and the absence of any spines projecting from the nucleus militates against the idea of the peculiar form having been given to it while in the kidney. No *post-mortem* was allowed. It seems possible that the formation of the spines might have depended upon the more rapid deposition of calculous matter on those parts opposite to the intervals between the smaller calculi, than over the part of the surface in immediate contact with them, as only the two largest calculi exhibited this peculiarity.

Calculi in Patients who have had Cholera.—The circumstances under which oxalate of lime is deposited in the form of the dumb-bell crystals have been already alluded to. It is interesting to find that both Drs. Prout and Kletzinsky have noticed deposits of oxalate of lime in patients who had had cholera, in which disease the fluids are in a high state of concentration. In *two* cases of this disease *dumb-bells of oxalate of lime* were found in the urine by myself. Dr. Prout also alludes to the frequency of cases of *calculous disease* in those who had suffered from cholera. These are important facts in favour of the view I entertain with reference to the formation of the nucleus of the calculus, which I have, in fact, shown to be in many cases a microscopic calculus. I have found numerous dumb-bell crystals and collections of these impacted in the uriniferous tubes of patients who have died of cholera. The remarkable concentration of the fluids which occurs in this disease is no doubt very favourable to the deposition of a substance so slightly soluble as oxalate of lime, in a solid form.

Passage of Oxalate of Lime Calculi from the Kidney.—Oxalate of lime calculi often give rise to extreme pain when impacted in the kidney, and while passing down the ureter, or lodged in the bladder. In the kidney the pain is often of the most violent character, and frequently the patient suffers from many attacks before the stone is dislodged. Very frequently hæmorrhage occurs, and sometimes inflammation is excited, which terminates in the suppuration of the tissues contiguous to the stone. On the other hand, as already remarked, calculi may pass without giving rise to the least inconvenience; indeed, I have known many instances where a calculus has been for years impacted in the kidney, and has at last passed down the ureter without the patient having been aware of its passage.

Calculi composed of Earthy Phosphate.—Both phosphate of lime and ammoniaco-magnesian phosphate enter into the composition of calculi. Dr. Prout showed that the phosphates were very often deposited upon other calculi, while there were very few instances in which uric acid, urate, or oxalate of lime, was deposited upon the phosphate. These two earthy salts enter into the composition of the *fusible calculus;* its degree of fusibility varying according to the proportion of triple phos-

phate present. The latter substance is easily fused in the blowpipe flame, while the phosphate of lime is quite infusible.

When the calculus contains but a mere trace of triple phosphate its structure is dense and even, it is heavy, and its surface is smooth and polished; but large calculi of this kind are exceedingly rare. A small quantity of triple phosphate is almost always present in the large calculi. Portions of the laminæ of these calculi are easily broken off. Phosphate of lime calculi are often found in the kidney. In some cases the whole of the pelvis is filled with them, varying in size and shape, and mixed with a considerable quantity of pulverulent matter like fine sand. Each particle of this is found, upon microscopical examination, to consist of a minute calculus, containing a certain quantity of organic matter, probably mucus and disintegrated epithelium, for its nucleus. Occasionally a phosphatic calculus, lodged in the pelvis of the kidney, gradually increases until a large mass is formed by the deposition of earthy salts, layer after layer, the whole pelvis of the kidney being occupied by it, while its prolongations extend into the infundibula and calyces.

The calculus, which consists almost entirely of triple phosphate, has a very porous structure; it is light, easily broken down by pressure, and perfectly white. Its surface is rough, and large crystals of triple phosphate can often be discerned upon the surface with an ordinary lens.

Mr. Charles Hawkins sent me several small calculi which had been passed by a patient, to the very large number of 600, in a fortnight or three weeks. They were all about the size of a small pea. The surface exhibited several flattened sides, evidently caused by so many lying in juxtaposition. They looked very like small biliary calculi which had been packed together in the gall bladder. The matter of which they were composed consisted of phosphate of lime and ammoniaco-magnesian phosphate, with a considerable quantity of organic matter. Although these calculi were, in many respects, like prostatic calculi, it is almost certain that they came from the pelvis of one kidney.

Carbonate of Lime Calculi, though common among herbivorous animals, have rarely been met with in man. They are friable, and sometimes perfectly white. Mr. Smith has described some which are very like the mulberry calculi ("Med.-Chir. Trans.," vol. IX, p. 14). There are specimens of this form in the Oxford Museum, among Mr. Hitchings' collection, but, unfortunately, no history is attached to them. Dr. Thudichum states that he has examined prostatic concretions which consisted almost entirely of carbonate of lime. A small quantity of carbonate of lime is usually deposited with the earthy phosphates. This calculus effervesces freely when exposed to the action of acids previous to incineration; white oxalate of lime yields carbonate only after having been exposed to a red heat.

Mr. Wagstaffe showed at the Pathological Society, December 17, 1867, a specimen of renal calculus consisting almost entirely of carbonate of lime, removed from a patient aged forty-two, who was admitted into St. Thomas's Hospital with heart-disease, and died thirteen days after admission. The urine was slightly albuminous, but otherwise healthy. At the *post-mortem* examination, besides atheroma of the aortic valves and aorta, with hypertrophy and dilatation of the left side of the heart, the upper half of the right kidney was found greatly dilated; and the pelvis contained a large calculus, which branched very freely into the calyces. There were also several loose rounded calculi, and a quantity of fine calculus grit. The minute structure of the kidney appeared healthy under the microscope. The main part of the calculus was lying in the pelvis, and appeared exactly like uric acid. The small loose rounded calculi were of about the size of peas, white, laminated, smooth, and hard. A fine dry, soft, opaque white powder, very much resembling phosphate of lime was also present. The small calculous grit when examined under the microscope, resembled diminutive uric acid calculi. On examining each of these separately and with great care, it was found that *carbonate of lime formed the almost sole constituent*, a small trace of triple phosphate being discernible. Mr. Wagstaffe did not know of any specimen in which carbonate of lime was proved to be the constituent of a renal calculus, but he was inclined to think it not so uncommon a form of deposit as represented.

Prostatic Calculi.—These calculi vary very much in size. The small ones are roundish, but often the sides are more or less flattened when many have been lying in apposition. Small prostatic calculi are represented in "100 Urinary Deposits," pl. VIII, fig. 104. They are generally hard and white, like porcelain or alabaster, but occasionally have a soft porous structure. The surface is generally perfectly smooth. They consist of organic material, with phosphate of lime and a trace of carbonate; but it is seldom that triple phosphate is to be detected. The earthy matter may vary from 50 to 90 per cent.

These calculi are formed in the follicles of the prostate gland, and commence as minute very transparent concretions, composed principally of albuminoid matter, and which contain scarcely any hard calcareous material, and at this early period of their formation, therefore, are not entitled to the name of calculi. Microscopic concretions have been detected in the follicles of the prostate during the periods of youth and early manhood by Sir H. Thompson, who states that he found them in every one of a series of fifty prostates which he subjected to examination. In old age, as is well known, they are often found of considerable size. When small, they do not give rise to any symptoms, but they may increase in size and number, and cause the greatest inconvenience and distress.

In sections of the prostate which I have made from a man of about forty years of age, who died from pneumonia, the various stages of growth through which these concretions passed were well illustrated. The specimen has been preserved in glycerine in order to increase its transparency. Each follicle of the gland is seen to be occupied by many small roundish bodies, and a considerable number of epithelial particles. Many of the follicles are distended by a number of transparent microscopic concretions, varying from a pale yellow colour to a dark reddish brown. Some of the smallest are not more than the one two-thousandth of an inch in diameter, and yet these are seen to be composed of *several concentric layers*. In the centre of almost all the concretions no one can fail to notice a quantity of minute globules, and in some, one or more roundish cells may be distinctly seen. These, in fact, constitute the "nucleus" of the concretion. The concretions under consideration up to an advanced period of their growth, consist almost entirely of organic matter, which resists the action of moderately strong solution of potash and acetic acid. It is a firm transparent albuminoid material, which, in its chemical characters, agrees with the substance of which the outer part of the cell is composed. The walls of hydatid cysts, and some of the elastic albuminoid concretions occasionally found in the peritoneal cavity, and in other situations, are composed of a substance closely allied to this. These bodies, I believe, are formed by the slow deposition of albuminous matter round a nucleus consisting principally of epithelial cells and *débris*. The material which is deposited in successive layers has probably been formed by the cells of the gland, and is of nearly the same composition as the matter of which the outer part of the cells themselves consists. It is sometimes colourless, but more commonly of a yellowish tint, and sometimes reddish. A small concretion having been once formed, new matter is deposited upon it, and gradually becomes hardened by the absorption of its fluid constituents.

Up to this period of its formation there is very little earthy matter in the concretion, but gradually a change takes place, and granules of phosphate of lime are precipitated in the substance of the transparent organic matter. This change having commenced, the further deposition of calcareous matter goes on. The particles already formed increase, more phosphate being precipitated from the surrounding fluid in which it was held in solution. As the concretion enlarges, the proportion of phosphatic salts to the organic matter becomes greater, and a *prostatic calculus* at last results. The calculus may attain a very large size, and may even extend forwards, into the urethra, and backwards, into the bladder.

The characters of these concretions are well described by Sir Henry Thompson, whose remarks are illustrated by careful drawings ("The Enlarged Prostate," pls. IV and V). Sir Henry Thompson thinks that

the concretions are first formed by the coalescence of the small yellow bodies or granules, which afterwards coalesce and form a larger mass. Professor Quekett considered that they commenced by a deposit of earthy matter in the secreting cells of the gland, while Dr. Handfield Jones believed that the concretions originated in a vesicle, which increased by endogenous growth. In various parts of many sections of the prostate gland which I have prepared, concretions, the nucleus of which appears to consist of granular matter, may be observed. There are others in which concentric layers may be traced quite to a central point or granule. Some have a perfectly transparent centre. And not a few exist, in which the nucleus is composed of small granular cells, varying in number from one to twenty, or more. The so-called nucleus of the calculi is not of uniform structure and composition, but it is different in different specimens.

If when the urine is alkaline any particles of solid matter, either epithelial cells or grit, or crystals of any kind be present, they soon become encrusted. Sometimes solid bodies of various kinds have been introduced from without, and now and then instruments, used in the course of surgical examination or operation, have broken, or pieces of them have been left behind in the bladder, or particles of solid matter accidentally attached to them, such as particles of sand or other foreign matter, have been detached when the instruments were withdrawn. In these cases the foreign substance, whatever its nature, and however minute it may be, usually becomes covered by phosphate which is deposited, layer after layer, until a considerable thickness is attained, and, what is practically a stone—it may be of considerable size—is at last formed, which possibly can be removed only by the operation of lithotomy, because some of the foreign bodies around which calculous matter has been deposited are not to be crushed. Some very remarkable stones of the kind alluded to will be found in the Museum of the Royal College of Surgeons.

On the Origin and Formation of Urinary Calculi.—This subject has been already referred to incidentally. Whenever there is a tendency to the precipitation of any of the slightly soluble constituents of the urine in an insoluble form before the urine has left the organism, in the uriniferous tubes, in the pelvis of the kidney, or in the bladder, one of the conditions most essential to the formation of calculus is present; or, if an unusual quantity of any such substance should be formed, so that the urine contains a stronger solution of it than in health, very slight changes will lead to its deposition before the urine has left the bladder, and thus an insoluble deposit will result. Each little mass of deposit, a few grains of urate, or a crystal of triple phosphate or uric acid, may form a nucleus, around which new matter will collect. As a general rule, however, the deposit escapes with the urine. Often it would

appear that on the surface, and in the interstices, of rough stones more especially, small quantities of urine are retained, and prevented from mixing with the general mass. Chemical changes soon occur, the immediate result of which is the further precipitation of insoluble material. If the urine alters in its character from time to time, different substances may be deposited; thus oxalate of lime may form the nucleus of the calculus; and, after this has reached a certain size, the deposition of the oxalate may give place to that of uric acid. Again, the precipitation of this substance may cease, and several successive layers of phosphate may afterwards be formed. In some calculi these layers alternate in a very remarkable manner.

But the most interesting part of the whole process is the formation of the nucleus of the stone, and it is most important that we should study this part of the question very carefully, for if we could ascertain the existence of calculi at a very early period of their formation, we could in many cases no doubt effect their expulsion before they attained a size too large to pass down the uriniferous tubes where they were formed, and thus distressing and in but too many cases very prolonged suffering would be prevented, all contingent accidents avoided, and perhaps the necessity for a severe operation removed.

Any solid matter may form the nucleus of a calculous concretion. Inspissated mucus from any part of the urinary organs—crystals which have been deposited from the urine during its formation—cells of epithelium—ova of entozoa—pieces of fibrine and small clots of blood—and, lastly, foreign bodies which have been introduced from without, such as peas, portions of slate pencil, or tobacco-pipe, pins and needles, pieces of thread, hair, and silk, and other substances which have been occasionally forced into the bladder by silly persons. Pieces of a catheter and of a bougie have also been found in the centre of a stone. *See* preparations in the Museum of the Royal College of Surgeons. My friend, Mr. Charles Hawkins, gave me, a short time ago, some very curious concretions. They were about half-an-inch in length, and about the tenth of an inch in diameter. The surface was rough. They were of a whitish colour, and the calcareous matter of which they consisted was composed of triple phosphate and phosphate of lime. Upon breaking several with care pieces of an undoubted hair were found in the centre. The patient from whom they were obtained suffered from an ovarian cyst, which had opened into the bladder. These concretions were, in fact, composed of earthy phosphates, which had been deposited from the urine upon the hairs, which had been formed in the ovarian tumour, and had passed into the bladder. Hair and teeth, as is well known, are not unfrequently developed in ovarian tumours.

Large calculi are often formed by the aggregation of very small ones, just as a microscopic calculus may be formed by the aggregation of

microscopic dumb-bells. Mr. Haynes Walton showed me a calculus of an oval form and whitish colour, with a very smooth external surface, about an inch and a half long by an inch wide, which he had removed from the urethra, directly behind the scrotum, of a gentleman of eighty years of age. It had been impacted in this situation for years. There was distinct evidence of the presence of this calculus fifty years before it was removed! On making a section, no concretic layers nor central nucleus were seen, but, upon examination with a low power, sections of very small calculi were observed in every part of the cut surface. In each of these a central nucleus and several concentric lines were clearly distinguishable. The small calculi were connected together by a certain quantity of whitish matter, probably consisting of phosphate of lime and triple phosphate.

The Formation of Microscopic Calculi.—Microscopic calculi are often formed in the same way by the aggregation of excessively minute particles. For some time I have had my attention very forcibly directed to the formation of the nucleus of urinary calculi, in consequence of having met with many specimens of *microscopic calculi* of various kinds in different specimens of urine. It is not uncommon to find microscopic uric acid calculi—aggregations consisting of uric acid crystals, which, if retained, would receive deposits of fresh material on the outside, until the small calculi, familiar to all observers, and varying in size from a mustard-seed to that of a pea, or larger, were formed. Microscopic calculi of phosphate of lime are by no means uncommon, and I have found them in the kidney in several instances. In some cases, as is well known, renal phosphatic calculi grow to an enormous size, and occupy the entire pelvis, leading in some instances to the destruction of the secreting structure of the kidney.

But it is in the uriniferous tubes themselves that the nucleus of the great majority of urinary calculi, be their general components what they may, is formed. Here is produced that microscopic granule which is the solid around which the further aggregation of hard calculous material takes place. Many microscopic calculi are composed of crystalline matter which is prevented from assuming its ordinary crystalline form by the organic matters, most likely viscid mucus, in which the crystalline material is deposited, and by which, as was shown by Mr. Rainey, it was caused to assume a spherical, oval, or some allied form, instead of exhibiting its usual sharp and well-defined angles and faces.

Until a few years since, I had never had an opportunity of watching the formation of calculi composed of oxalate of lime. The nucleus of these calculi does not consist of mucus or epithelium, as in the phosphatic calculus, but is of the same composition as the exterior. Figs. 97, 98, 101, "100 Urinary Deposits," pl. VIII, represent dumb-bell crystals. In the two first figures are small masses of dumb-bells, hun-

dreds of such collections having been found in a single specimen of urine. Although each mass is seen to consist of a number of distinct crystals, these are firmly attached, so that the whole mass could be rolled over and over without the individual crystals being separated from one another.

Such collections I have many times seen in the uriniferous tubes in kidneys obtained from *post-mortem* examinations. There can, therefore, be no doubt as to the precise seat of formation of these bodies. I have seen such in the kidney of the fœtus, and have detected dumb-bells in the urine of children under two years of age. Gradually the interstices between individual dumb-bell crystals become filled up, and at the same time a few of the larger crystals increase in size at the expense of the smaller ones. At length a small crystalline mass, of an oval form, results, which clearly consists of a microscopic mulberry calculus, two of which have been figured in "Kidney Diseases, Urinary Deposits, and Calculous Disorders." If retained, the calculus will gradually increase in size. When such calculi reach the pelvis of the kidney, a few sometimes increase gradually by the deposition of oxalate of lime upon their exterior; while no doubt, the greater number escape with the urine, and give no trouble. Such small bodies would easily become entangled in the mucus of the mucous membrane, and might remain in the pelvis of the kidney without exciting any disturbance until they had grown so large as to cause considerable inconvenience. If some of them passed down the ureter into the bladder, and happened to be retained for some time in this viscus, in a case where the urine contained much oxalate, they might increase in size until a mass too large to escape by the urethra had been formed. It is, therefore, of great importance that cases in which these dumb-bell crystals are found in the urinary deposit should be very carefully watched.

As I have before stated, many small uric acid calculi, which appear to be composed entirely of this substance, will be found upon careful examination to have a nucleus consisting of oxalate of lime, and not unfrequently well-defined dumb-bell crystals may be obtained after the uric acid has been dissolved by liquor potassæ. These are insoluble in potash, and also in acetic acid. From analyses I have made, I have been led to conclude that the dumb-bell crystals almost invariably form the nucleus around which the uric acid is deposited. I have not detected oxalate of lime in the centre of the small renal calculi composed of phosphate of lime. The phosphate is probably usually deposited around masses of epithelium or in and upon pieces of mucus.

Frequency of Occurrence of different kinds of Calculi.—It is often very difficult to ascertain why certain varieties of calculi should be found in greater proportion in some parts of the country than in others. The question is one of great interest in connection with the consideration of conditions under which the formation of urinary calculi occurs.

In the collection of calculi at Guy's Hospital the proportion composed of phosphate of lime is as 1 : 29 ; at Bartholomew's as 1 : 32¼ ; while in Norwich it is as 1 : 132⅜ ; and in Bristol as 1 : 155. Of 230 pure uric acid calculi in different hospitals in England and on the continent, as many as 164 are contained in the Norwich collection. (*See* the tables in the appendix to Dr. Prout's work on "Stomach and Urinary Diseases.") In the collection of urinary calculi in the museum of Guy's Hospital, it appears, from the statement of Dr. Golding Bird, that out of 208 calculi the *nucleus* consisted of uric acid in 127, of oxalate of lime in 47, of phosphates in 22, and of cystine in 11 ; or, of uric acid in 60 per cent., of oxalate of lime in 22 per cent., of phosphates in 10 per cent., and of cystine in 5 per cent. These figures are somewhat different from those given by Dr. Golding Bird, because I have thought it more correct to reckon in this calculation 142 calculi, which were obtained from one individual, as one.

Dr. Carter's observations on the composition of the calculi in the Grant Medical College, Bombay, proved that very few *nuclei* were composed of uric acid, while a large number consisted of oxalate of lime. The following table from Dr. Carter's paper, shows the percentage of calculi in India and in England entirely composed of uric acid, urate of ammonia, and oxalate of lime :—

	Grant Med. College. Per Cent.	College of Surgeons. Per Cent.	Guy's Hospital. Per Cent.	Norwich Hospital. Per Cent.
Uric acid	3·3	32·92	15·38	24·73
Urate of ammonia	5·0	2·15	3·84	8·29
Oxalate of lime	14·0	5·12	9·13	3·16

The following are the conclusions to which Dr. Carter has been led :—"1. That, in the Bombay Presidency, the proportion of calculi having oxalate of lime for their nucleus, or wholly composed of it, is about twice as great as in England, taking for comparison certain standard collections there. 2. That the proportion of calculi having uric acid or a urate for their nucleus or entire substance, is considerably less in India than in England ; in the former, urate of ammonia calculi are somewhat more frequent than uric acid calculi ; the opposite is the case in England. 3. That the number of calculi wholly composed of earthy phosphates, or having them for a nucleus, is proportionately much fewer in India than in England, the difference being chiefly owing to the rarity of the mixed phosphate in the former." ("An Account of the Calculi contained in the Grant Medical College Museum, with some General Remarks on Calculi in India." By H. V.

Carter, M.D., Lond., Assistant-Surgeon, Acting Curator of the Museum, August, 1859.)

Formation of a Calculus composed of Phosphate, Uric Acid, and Oxalate of Lime.—It is important to bear in mind that the central part of the calculus which is visible to the unaided eye and which is spoken of as the nucleus, may have a real nucleus which is microscopic, and of a different composition to the material which immediately surrounds it. I have shown that the nucleus of many a calculus which apparently consists of uric acid, is really composed of oxalate of lime. A phosphatic calculus may have a nucleus of uric acid about the size of an almond, while the latter contains in its centre a smaller nucleus, consisting of oxalate, which can only be demonstrated by microscopic observation. Now the history of the formation of this is, probably, as follows :—A number of dumb-bell crystals of oxalate of lime, formed in the uriniferous tubes, become aggregated together, and around this small mass uric acid is deposited as it lies in the tubes or in the pelvis of the kidney. The stone passes down the ureter into the bladder, where the phosphate is deposited around it, and where the calculus attains its present size. Now, the deposition of the phosphatic salts on the uric acid is not more dependent on the presence of the latter than the precipitation of the uric acid was consequent upon the presence of the oxalate. In all probability neither the phosphate nor the uric acid would have been precipitated had not the oxalate been present in the first instance. It is not too much to say that, if the latter had not remained for some time in the uriniferous tubes, and gradually increased in size, no calculus would have been formed in the present case ; if, therefore, the collection of dumb-bell crystals had been washed out of the kidney by diluents, soon after its formation, the further precipitation of calculous matter there is good reason for thinking would have been entirely prevented.

Of the Influence of Considerable Quantities of Fluid in Preventing and Relieving Calculous Disorders.—In considering the general points of importance with reference to the diet and regimen in the case of those who suffer from a tendency to the formation of urinary calculus and those who having already formed stones are most anxious to avoid the production of more, I may limit the discussion to uric acid and oxalate of lime, for not only are these the most common forms of calculi that we meet with, but they form the nuclei of most. Although the uric acid calculus is much more common than the oxalate of lime, it must be borne in mind that oxalate of lime usually forms the insoluble nucleus around which uric acid is deposited, and there is no doubt that in many cases if the formation of oxalate of lime could have been prevented, many a uric acid calculus that brings misery to its producer would not have been formed.

I have already adverted to the importance of increasing the quantity of fluid taken by persons who suffer from certain varieties of urinary deposits. This principle has been fully recognised by Prout and many practical physicians who have had experience in treating cases of this class, and it has been found to be the proper treatment by many who had no knowledge concerning the way in which relief might be brought about. The remedy, perhaps from its very simplicity, has certainly not received the attention at the hands of many practitioners that it deserves. Certain conditions of the system are determined or modified by the dilution of the blood, and many of the chemical decompositions going on are promoted by an increase in the quantity of fluid. Some changes will not take place unless the solutions of the substances be very dilute. Many comparatively insoluble matters are slowly dissolved away by the frequent renewal of the fluid in contact with them. A substance so very slightly soluble as silica is capable of being dissolved in water; and it is from a solution containing so slight a trace that the substance can only be detected at all by operating upon very large quantities, that the whole of the silicious matter contributing in so important a degree to give firmness to the stems of many of the grasses, is deposited. The amount of water that must pass through the tissues of the plant during its growth and give up its silicious matter, must be enormous, since the quantity dissolved in each pint of fluid taken up by the roots is so very small.

By causing much liquid to traverse the tissues of a living animal, comparatively insoluble substances will be washed out; while, on the other hand, if little fluid, especially if it contains a considerable proportion of solid matter dissolved in it, permeates the tissues, the state of things will be favourable rather to increased deposition than to the solution and removal of matters already deposited. It is doubtful if that abundant deposition of urate of soda which is from time to time met with in almost all parts of the body, in certain cases of gout, would have occurred at all, if the fluids had been constantly maintained in a proper state of dilution. When such crystals have been formed, we may endeavour to remove them, and to prevent further deposition by maintaining the fluids of the body for some time in a state of dilution, and by increasing the solvent properties of the serum for the urate by giving frequently repeated small doses of alkali.

Patients who have passed renal calculi, or who have suffered from symptoms indicating their presence, will do well to get into the habit of taking a sufficient quantity of fluid during each period of twenty-four hours. It is not possible to state what is the proper quantity. In health not only should the proportion of liquid vary with the quantity of food taken, but the amount should be greater in hot than in cold weather. More should be taken when the person takes very con-

siderable exercise than when he is quiet. Those who ride long distances on bicycle or tricycle require considerable quantities of fluid. Free perspiration causes all the tissues to be quickly permeated by fluid, and it might be fairly argued that if in hot climates the tissues are not too freely bathed by fresh quantities of fluid, it must be certain that in cold and temperate climates where the action of the skin is reduced to a minimum, this washing out and removal of slightly insoluble substances must be very imperfectly performed, and we have at once an explanation of the frequency of cases of gout and other conditions depending upon the accumulation in the interstices of the tissues of imperfectly soluble substances which impede their action and occasion degenerative changes which result in irremediable damage and disease, by which life is cut short at a comparatively early age.

Other things being equal, those who habitually take large quantities of liquid in proportion to the food they consume will be less likely to be the subjects of calculous disorders than those who take comparatively little. It is advantageous for every one now and then to take from three to four pints or more of water in the four and twenty hours, in order that his tissues may be washed out from time to time, and his uriniferous tubes flushed. In this way that concentration of the fluids, which favours the production of gravel and the formation of calculus, is prevented.

Even in health it is important to regulate the amount of liquid according to the solid matter of the diet. Many object to take much fluid. They are not thirsty. Liquid they say blows them out. They detest water, milk, lemonade, and all the beverages which contain no ingredients more deleterious than those present in good water. They will appeal to the directions of high medical authorities, to the dietaries which have been arranged after the fullest consideration, to the experience of thousands, to their own feelings, against the advice given them to considerably increase the quantity of liquid they consume. But although you may find it impossible to persuade them to increase the liquid to three or four pints daily for a month or two, you may get them to submit to the *régime* of a German bath, where they will imbibe a larger quantity of fluid than you have advised them to take.

That a large quantity of liquid disagrees with many persons is certain, but nevertheless those who are the subjects of rheumatism or gout, or of uric acid deposits, or of calculous formations, will do well to gradually bring themselves to the habit of taking considerable quantities of fluid, though they may find at first that the new practice does not suit them. Such persons, taking freely of liquid will require less food, and will gain in health thereby, as well as from the free dilution of the intertextural fluids and the consequent assistance afforded to the free action of the secreting organs in every part of the body. A wide-spread

prejudice against the imbibition of liquid has been fostered by bad arguments, and by the fear of introducing disease-germs into the organism. This latter danger can always be guarded against by simply having all water used for drinking boiled for a quarter of an hour or longer and allowed to become cold in a clean pitcher before it is taken.

Notwithstanding all that has been said to the contrary, there is no doubt that in the cases we are considering the most important part of the treatment—and that for which no alternative or substitute can be found—is the administration of plenty of water—boiled water, toast-and-water, mineral waters, lemonade, effervescing citrate of magnesia (potash), or soda, tea, weak coffee, or cocoa, barley-water, linseed-tea—as may be preferred—but water to the amount of at least two pints during each period of twenty-four hours should be taken by those who have exhibited tendencies to the frequent deposition of the imperfectly soluble constituents of the urine or to the formation of actual calculi; neither beer nor wine—however diluted—will do; spirits will do harm, even if diluted with very considerable quantities of water—unless the patient is restricted to very small quantities, say from one to two ounces only.

We are, perhaps, too apt, in many chronic cases, to put invalids upon a plan of treatment for only a few days or weeks; and our patients are often unreasonable enough to expect that the remedies we prescribe will remove, in a week, matter which has been slowly accumulating, perhaps, for years. It is difficult to impress upon those who suffer, the immense importance of allowing time for the beneficial operation of the therapeutic system to which they are subjected.

Little benefit can result from adopting a special diet and medicinal system for a month or even a few months in cases where the derangements to be counteracted have persisted for years, and the tendency to the formation of the deposit in abnormal quantity has been transmitted perhaps through several generations. It is chronic cases of the kind under consideration, which receive such real benefit from the comparatively prolonged course to which they are subjected in a German bath or hydropathic establishment; and it too often happens that, in endeavouring to perform quickly, by remedies, that which it is only possible to effect by giving large quantities of fluid during a considerable period of time, we disappoint ourselves and our patients. Exercise, when it can be taken, is of the utmost importance. Hot baths, Turkish baths, &c., are beneficial, because they promote sweating and excite thirst. Thus more fluid is ingested, which is soon got rid of by various emunctories and carries out with it insoluble substances. The fluid which is removed is soon replaced by a fresh quantity. In the frequent repetition of these processes from time to time a vast quantity of fluid is made to pass through the body, with the most beneficial results.

We seldom find difficulty in prevailing on patients to take Seltzer, Vichy, or other alkaline waters daily, or a few doses of the effervescing citrate of magnesia now sold so largely, although it would be useless to recommend them to take *pure water*. They may take the waters with their wine at dinner, the last thing at night, and in some cases it is desirable that the patient should take the water the first thing in the morning. People who live well every day, or rather *too* well, will find great advantage from continuing this plan, and now and then taking small doses of alkalies. It is quite superfluous for me to enter into the minute details applicable to individual cases; but I cannot too strongly recommend a careful enquiry into the general mode of life of patients of this class; for permanent relief may be afforded if we can but convince them of the importance of constantly attending to simple rules based on the principles to which I have directed attention.

We must not forget in the treatment of cases of renal calculus, the very great importance of keeping the patient's general health as good as possible. Many forms of chronic disease cause suffering in proportion to the degree of weakness which prevails, and a pain easily borne and, perhaps, scarcely to be noticed when the patient is well, becomes of a most severe character if his health fails. The very remedies we employ to mitigate his suffering too often disturb his digestive organs, and though for a time a little relief is given, little or no real advantage is gained.

It is of consequence to attend to the action of the bowels, for, although by purging we cannot cause a stone to be removed from the kidney, we shall invariably find that the pain and suffering are much increased whenever the bowels become torpid. We observe the same fact in cases of neuralgic pain, and, not unfrequently, severe toothache ceases as soon as a purgative—particularly a mercurial—begins to act. Saline purgatives often act well. They not only empty the large intestine, but a part is absorbed and acts as a diuretic—the stone being moved a little, or at any rate a passage between it and the walls of the ureter in which it is impacted being made by the washing away of mucus and *débris* which had accumulated, and which with the stone caused for a time complete obstruction.

On Dissolving Urinary Calculi.—Many of the observations which I have made with reference to the prevention and removal of the conditions upon which the formation of urinary deposits depend, are also applicable to calculi of allied composition. When uric acid or urate of ammonia calculous matter, for instance, has been deposited, it may be dissolved, or its increase may be prevented, by producing alterations in the chemical composition of the urine; and such alterations may be effected partly by diet, and partly by the administration of various remedies, especially alkalies and the salts of the vegetable acids.

Mere dilution of the urine will sometimes exert a considerable influence upon a calculus; and it is probable that many soft or porous calculi have been entirely dissolved in this manner. An acid state of urine would tend gradually to dissolve a phosphatic calculus; and it is very likely that, if a feebly alkaline condition of the urine be maintained for a considerable time, an impression would be made upon some forms of urate and uric acid calculi. The irregularities often seen upon the surfaces of such calculi have been very properly termed "water-worn," and clearly indicate that the urine has exerted, for a time at least, a solvent action. Although in certain cases it would undoubtedly be right to adopt for a time treatment of this kind, we must not look forward to a favourable result with very great confidence; at best, such changes are tedious and uncertain, and in some cases cannot be effected at all. Although in the laboratory we succeed in dissolving many deposits and calculi, it is in fact comparatively seldom we are able so to alter the composition of the urine and maintain the changed characters for a sufficient length of time to effect solution, except in very rare instances.

Many attempts have been made to dissolve the calculus by injecting fluids, which exert a solvent power upon the stone, into the bladder. The most convenient plan is to inject the fluid, heated to a temperature of 100° Fahrenheit, through a double catheter for half an hour every two or three days or more frequently. Dr. Willis recommended that the fluid should be placed in a reservoir at a sufficient height above the patient, and connected with the catheter by a tube provided with a stop-cock, by which means the flow of the solvent could be carefully regulated. In carrying out this plan, it is very important that the solution should be so weak as to prevent all chance of the mucous membrane of the bladder being injured. Sir Benjamin Brodie showed that phosphatic calculi might be greatly reduced in size, or entirely dissolved, by injecting a weak solution of nitric acid (2 to 2½ minims of strong nitric acid to two ounces of distilled water). Such a solution would also act very favourably in removing the sharp edges of some phosphate stones and small fragments remaining in the bladder after the operation of lithotrity.

The objection to the use of alkalies in attempting to effect the solution of uric acid or urates is, that phosphates are precipitated from the urine, and the calculus soon becomes not only protected from the further action of the solvent, but its size increased. A very ingenious plan for dissolving calculi was proposed some years since by Dr. Hoskins, who employed a weak solution of acetate of lead (one grain to the ounce) with a mere trace of free acetic acid. With a phosphatic stone, double decomposition occurs. Phosphate of lead, in the form of a fine granular precipitate, and an acetate of lime and magnesia, are formed.

The solution, it need hardly be said, does not produce any irritation or unfavourable action upon the bladder.

In many cases all our attempts to remove the stone by effecting its solution will be ineffectual, and we shall have to call in the assistance of the surgeon, who may remove it entire by lithotomy, or crush it with the lithotrite into several small pieces, which escape by the ordinary channel.

Experiments concerning the Solvent Action of Alkaline Carbonates.—Dr. Roberts demonstrated "that very weak solutions of the alkaline carbonates dissolved uric acid calculi with considerable rapidity, while stronger ones altogether failed. In order to decide what strength of solution had the most solvent power, fragments of uric acid, weighing from 40 to 112 grains, were placed in 10-oz. phials, and solutions of carbonate of potash and soda of various strengths were passed over them at blood heat. The experiments were continued day and night; and the daily flow of solvent varied from 6 to 15 pints.

"Operating in this way, it was found that above a strength of 120 grains to the pint no solvent action was exerted: and even with 80 grains to the pint there was only a little; but solutions of 50 and 60 grains to the pint dissolved the fragments freely. A coat or crust of white matter invariably invested the stone in the stronger solutions, and prevented further action. At and above 120 grains to the pint this coat was dense and tough, and could not be wholly detached from the subjacent surface. With 80 grains to the pint it was brittle, and easily detached like a layer of whitewash. With 60 grains to the pint, and under, either no crust formed at all and the stone dissolved clean with a water-worn appearance, or it was only represented by a few loose flakes, scattered here and there over the surface, and offering no impediment to dissolution. This coating or crust was found essentially to consist of bi-urate of potash or soda, and its formation depended on the fact that the alkaline bi-urates are almost insoluble in any but very weak solutions of the alkaline carbonates. In the strong solutions the bi-urate remains undissolved and encases the stone in an insoluble investment; while in weaker ones it is dissolved as fast as it is formed, the surface of the stone remains clean, and dissolution proceeds without impediment" ("Archives of Medicine," vol. III).

The following table represents the result of experiments performed by Dr. Roberts, and continued for forty-eight days:—

TABLE II.—*Uric Acid and Carbonate of Potash.*

Strength of Solution.	Flow per 24 hours.	No. of Obs.	Daily Average Loss of Weight Per Cent.		REMARKS.
Grs. per Pint.	Pints.				
240	6	1		0	Covered with a tenacious white coat, as if of paint.
120	6	3		0	Covered with a less dense coating. After detaching this and wiping, there was a mean loss of weight of 7·1 per cent.
80	6	2		9·8	Covered with a loose detachable white crust.
60	14	2	19·0	... 22·2	Surface clean.
60	6	5	21·4	...	Loose flakes in spots.
40	6	3		15·6	Sometimes a few loose flakes where the fragment rested.
30	15	4	13·0		
30	8	2	15·0	11·9	Dissolved clean; occasionally a few loose flakes.
30	4	2	9·5		
30	6	4	80·2		
20	6	3		11·0	Dissolved clean.
10	6	3		6·5	Ditto.

On Dissolving Calculi by Electrolysis.—Attempts have been made to disintegrate and effect the solution of calculi in the living body by the aid of galvanism. MM. Prevost and Dumas ("Annales de Chimie," vol. XXIII, p. 202, 1823) employed electricity for the purpose of disintegrating phosphatic calculi, by the mechanical action of the gases set free in the electrolysis of water; but only a grain per hour was thus removed. The *solution* of the calculus was not attempted in those experiments. Dr. Ludwig Melicher ("Oesterreich. Medicin. Jahrbuch," 1848, vol. I, p. 154) tried to dissolve a calculus by the aid of electricity. It is said that two experiments on the living body were successful. (Quoted by Dr. Bence Jones.)

Further efforts to effect the object were made by Bence Jones, who employed a solution of nitrate of potash, and decomposed this by the aid of a powerful galvanic battery. The nitric acid set free at the positive electrode would decompose the uric acid exposed to its influence, and the potassa evolved at the negative electrode would dissolve it, so that an uric acid calculus placed between them would be disintegrated at both points. The battery employed was from five to twenty pairs of Grove's plates. From 2 to 9 grains of uric acid calculus were

dissolved per hour at the temperature of the body. Of oxalate of lime ½ grain to 2 grains per hour only were dissolved. Of oxalate of lime and uric acid, in alternating layers, 4½ to 5 grains were dissolved per hour. Of phosphatic calculi upwards of 25 grains were dissolved per hour.

Treatment of Renal Calculus.—Concerning the treatment of calculus of the kidney, I would remark that we have to consider how to relieve the suffering, the means by which the stone may be caused to pass, or assisted in its passage from the kidney, and how the further formation of renal calculi may be prevented or discouraged.

The most valuable remedial measure for the relief of the pain or uneasiness in the region of the kidney is the application of warmth, and the best manner of applying it is the hot bottle. Patients who suffer in this way should always have at hand one of the thick vulcanised india-rubber hot-water bottles, covered with flannel or some woollen material. The bottle is filled with hot water and flannel interposed until the heat is found to be easily borne. As the water cools down some of the intervening layers of flannel may be removed. The application may be continued for hours if necessary. Hot fomentations, or a poultice upon which laudanum has been sprinkled, may be tried.

Sedatives are most efficient remedies in these cases, and even the most severe cases may be greatly alleviated by opium or morphia.

In not very severe cases of renal calculus a suppository made of extract of hyoscyamus or extract of conium will answer very well. I often order from two to five grains of each extract to be made into a pill of oval form, which the patient can introduce for himself, or with the aid of a suppository tube. When a more powerful sedative is required, a grain or two of opium may be introduced, or you may order ten or fifteen grains of the morphia suppository of the London Pharmacopœia (suppositoria morphiæ—20 grains contain ½ grain of morphia). For an injection, from five to twenty minims of laudanum (tinctura opii), or less than half that quantity of black drop (liquor opii sedativus), mixed with a tablespoonful of boiled starch (mucilago amyli) may be introduced with the aid of one of the small india-rubber clyster bottles. If the pain is intense we may resort to the hypodermic injection of morphia. The pain is sometimes relieved by cupping, or the artificial leech may be used.

The violent pain which often, but not invariably, results from the passage of a calculus down the ureter, is relieved by hot fomentations or a warm bath. Diluents and sudorifics should be taken internally by those who suffer from renal calculus. About a quart should be given during twenty-four hours for two or three days' running. In one case, referred to by Dr. Prout, the intolerable burning sensation was relieved by the application of pounded ice to the region of the kidney. If there

is violent hæmorrhage, the patient must be kept in the recumbent position. Purgatives, cupping over the loins, and alkaline diuretics, with small doses of opium or henbane, are required, if the descent of the calculus is very slow, or if the stone is impacted in the kidney; often there is violent sickness, but this is of short duration. In some cases the calculus has been washed out by giving the patient a large quantity of fluid during six or eight hours. Moderate exercise, or even the violent jolting of riding, when the suffering is not very great, will often promote the descent of a calculus from the kidney. I know of several cases in which a calculus has passed down the ureter without causing any pain whatever, and the patient was not conscious of its existence until he had passed it.

Sometimes a stone will remain impacted in the lower part of the ureter, obstructing or entirely preventing the entrance of urine into the bladder on that side, and finally making its way by ulceration into the cavity of the bladder. Such cases are usually attended with atrophy and cystic degeneration of the corresponding kidney. The presence of pus in the urine, succeeding to pains in the loins and the usual signs of the passage of a calculus by the ureter, and accompanied by many of the signs of stone in the bladder characterise these cases. The sound passed into the bladder fails to recognise the stone or to give the metallic chink which the surgeon likes to hear before proceeding to an operation for the removal of a stone from the bladder. Patience and palliative treatment for the relief of suffering are the only remedies for such a state of things. After a time the stone makes its way into the bladder and then its more evident signs are distinctly manifested, while all pain and discomfort cease.

Of the Treatment of Renal Calculus by Complete Rest.—Some authorities have recommended complete rest for a considerable period of time, in order that a calculus in the kidney may become encysted. But although this practice seems in some instances to have been followed by success, it is not certain enough in its results to justify us in recommending it very generally. To some persons rest in the recumbent posture for six months means complete sacrifice of prospects, or even ruin. Such had better take their chance. While on the one hand a calculus may remain in the kidney for many years without much change, on the other the probability of renal calculus coming away under ordinary circumstances is greater than of its becoming encysted if the patient rests absolutely for six months or a year.

Catheterism.—For the practical remarks upon this important subject I am indebted to my friend and colleague Professor John Wood. The performance of the simple operation of passing a catheter, sound, or bougie into the bladder may be rendered both difficult and painful by many circumstances. A want of skill or of the proper delicacy of touch

in manipulating the instrument, or a want of attention to the natural curves of the urethra, and to the position of the triangular ligament and neck of the bladder will often cause much inconvenience and delay. A silver catheter of the proper curve is usually more easily passed than an elastic or straight one. If an elastic catheter is used it should have the proper curve impressed upon its stilette, which should be so far stiff and resisting as to retain its curve under some degree of pressure. The instrument should be well cleaned, both inside and outside, and its channel carefully examined for and freed from obstructions of hardened mucus or blood. It should then be rubbed briskly with a soft cloth or silk handkerchief to warm it to the temperature of the urethra, and well oiled. In introducing it the operator should always have the umbilicus exposed to his view, as a guide and indication of the median line of the body in which the urethra lies. The ring end of the catheter should be kept strictly in this median line ; any deviation of the instrument when held with its point in the direction of the bladder indicates a departure from the proper line of the urethra. A similar twist of the point of the instrument out of its course is shown by a want of level in the rings on each side of the open end of a silver catheter. During introduction it is better to stand on the left side of the patient. The penis should be held between the finger and thumb of the left hand and the meatus opened by pressure above and below it. If a bougie or straight catheter be used a firm yet gentle traction upon the penis should be made so as to bring the front and more moveable curve of the urethra in a straight line.

In using the silver catheter while the patient is standing up, a dexterous manipulator will often employ the "tour de maître," which is thus performed. The instrument is held with its concavity directed down and backwards, and the penis is left to hang in its normal curve. The end of the catheter being placed in the meatus, it is then made to slide gently along the lower wall of the curve until the point reaches the front layer of the triangular ligament at the sinus of the bulb. A half turn round to the patient's left groin is then given to the end of the instrument with a sweeping and at the same time onward motion. This brings the point of the instrument into the upward curve of the vesical end of the urethra, pressing gently against the upper wall, and places it in the position for entering the bladder, at right angles to the level of the perineum. The shaft being kept strictly in the median line, its own weight will then be sufficient to urge the end into the cavity of the bladder. The advantage of the "tour de maître," when cleverly performed, is a greater ease of the passage and much less pain to the patient.

In the healthy urethra there are several points which might form a difficulty by obstructing the point of the catheter or bougie. Normally, the narrowest parts of the urethra, and pathologically, the most common

strictures are at the external orifice, and at the anterior layer of the triangular ligament—where the inner or upper curve of the ∫ meets the outer or lower bend; any instrument which passes these easily should pass through the whole canal. Below the size of No. 4, the point may become entangled in the "lacuna magna," a "cul de sac" or follicle which is placed in the upper wall of the urethra about 1½ inches from the meatus. Next it may be arrested in the sinus of the bulb by pressing against the triangular ligament below and behind the orifice of the membranous portion. It is here that the major part of false passages are made by urging the catheter too much backwards towards the rectum instead of upwards into the bladder. Next the point of a small catheter may be entangled in the "sinus pocularis" of the "verumontanum" or in one of the prostatic sinuses on each side. All these are to be avoided by keeping the point of the catheter against the upper or front wall of the urethra in the median line. But even this direction must not be carried to excess. In cases of difficulty from stricture in the membranous portion of the urethra, a false passage is sometimes made through the upper or anterior wall, bringing the point of the catheter either between or behind the layers of the triangular ligament, and in front of or into the anterior part of the prostate. When false passages have been made there is great danger of urinary infiltration into the pelvic fascia, and of subsequent peritonitis, which is frequently fatal.

It cannot be too strongly impressed upon the mind of the operator that forcible catheterism is under almost any circumstances of difficulty a very dangerous proceeding. A great many cases of death resulting from the shock following careless and violent operations have happened both in healthy and debilitated constitutions. It is much better to try again and again with patience and gentleness than to endanger the patient's life by injuring the passage.

If retention of urine be pressing and the bladder much distended the comparatively safe operation of tapping the bladder from the rectum should be performed in case of failing to pass the catheter. Afterwards, when the congestion and spasm of the urethra have subsided and the abnormal traction upon the urethra by a distended bladder has been removed, persevering efforts to pass a catheter and subsequent slow dilatation can in a great majority of cases be safely accomplished.

On Washing out the Bladder.—There are many conditions in which great benefit results from washing out the bladder. Sometimes pure water is required, but sometimes a very dilute solution of an acid or alkali is preferable, according to the character of the deposit or the condition of the mucous membrane. Weak solutions of antiseptics (1 of carbolic acid to 500 of water, or 10 drops of Condy's fluid to a pint of water, or a 1 per cent. solution of tincture of perchloride of iron) are often useful. In some cases the bladder does not empty itself,

and the urine which always remains behind in small quantity may become decomposed, and set up decomposition in the fresh urine as it flows from the ureters and mixes with the fluid in the bladder. This state of things, which may have continued for many months and already occasioned damage to the mucous membrane, may sometimes be permanently altered by washing out the bladder occasionally with pure tepid water, introducing small quantities (an ounce or two) at a time through a catheter, and then drawing off the contaminated water and throwing up another ounce or two of fresh, and so on until the water returns clear and free from smell. This washing out of the bladder and the surface of the mucous membrane is sometimes required to be performed very frequently if the mucous membrane is to be kept in a fairly healthy state. Many patients easily learn to perform the operation for themselves, and become adepts in passing the flexible catheter. To wash out the bladder, the nozzle of a small India-rubber ball syringe holding not more than two ounces is made to fit into the opening. After being filled with tepid water the ball is gently compressed with the hand, and the water slowly injected. After waiting a few minutes the water may be allowed to pass off in the usual way through the catheter after removing the ball syringe, or the contaminated water may be drawn into the syringe and removed, and the operation can be repeated if the quantity of decomposing urine be considerable. The patient if skilful may wash out his bladder twice or three times daily without risk.

In order to facilitate this operation many ingenious contrivances have been introduced. The catheter has been divided so that a continuous stream of water in and out could be obtained, but it is doubtful whether in ordinary cases any advantage is gained by this method, and in experienced hands harm might result.

In February, 1884, Dr. Wm. Job Collins described a two-way tap which could be introduced easily enough by the least experienced into the catheter, the tube of an ordinary Higginson's enema syringe being connected with the flow tube, the tap of the outflow is closed while the water is being injected. When two ounces or less had been introduced, the latter was turned on and the water and urine allowed to flow out. A great improvement upon this nozzle was suggested by Mr. Buckston Browne in which taps are quite done away with. This much simplified apparatus leaves little to be desired, and it can be carried into use by any one without the slightest difficulty, and without disturbing the catheter in the least degree. The new tube is fully described by Mr. Buckston Browne in the "Lancet" of October 18, 1884. It is made by Messrs. Weiss and Son, Strand.

Patients who perform the operation for themselves should in all cases be carefully taught by the practitioner in the first instance, and the great importance of care and gentleness, and of introducing only a

small quantity of water at a time and at the proper temperature should be fully explained to them.

Lithotomy.—This part of the subject I am not competent to discuss, but there are one or two recent modifications to which I may be very briefly permitted to advert. The operation of lithotomy, which is performed by most surgeons in the present day, is the lateral one. For a discussion of the various important points connected with this operation, I may refer to Bryant's "Practice of Surgery," and Erichson's, and other treatises on Surgery.

Some time since, the median operation was performed with considerable success by Mr. Allarton. Its principal advantage seems to be, that the levator ani and prostatic capsule and plexus escape injury, while the course into the bladder is most direct. There is also the advantage that the knife is not used either to notch the prostate or to open the bladder. On the other hand, there seems to be considerable chance of injuring the ejaculatory ducts, and a surgical friend tells me that there is a want of space in manipulating with the forceps, and in seizing and extracting the stone, and that there is also some risk, especially in children, of injuring the bulb of the urethra or the rectum. The operation is described in the "Lancet," 1859, vol. I, p. 122. (*See* also Mr. Allarton's work on "Lithotomy Simplified." London: Ash and Flint. 1854.)

In connection with the subject of lithotomy, I may remark that, by an improvement in the manner of carrying out the operation, adopted by Mr. Wood, the injurious effects which sometimes result from a free division of the prostate, pelvic fascia, and levator ani with the knife are altogether avoided. Mr. Wood employs a staff composed of two blades, which can be separated from each other while the instrument is held in position. Dilatation of the urethra is readily effected by allowing the finger to slide in between the blades. In the single case in which this operation has been performed in the living subject, it certainly succeeded admirably. ("Medical Times and Gazette," December 22, 1860.) The principal advantages of this over the ordinary lateral and median operations respectively are that, as the knife does not enter the bladder at all, neither the prostatic veins nor the fascial capsule are injured, nor can the ejaculatory ducts be cut. The levator ani cannot be divided, and all chance of the extravasation of urine into the pelvic areolar tissue is avoided. The form of the external incision is such that more room is given than in the ordinary operation, while injury to all important vessels and other structures is avoided. By this proceeding the dilatation necessary for the extraction of the stone is much more easily effected than in the median operation.

In some cases a stone becomes encysted or impacted in some part of the bladder. This may occur in two ways. First, by the previous

formation of sacculi of the mucous membrane protruding between the separated meshes of the dilated muscular coat, into one of which a calculus has been known to pass occasionally and to remain permanently. 2ndly, by a totally different process, viz., ulceration by pressure, a stone making its way through some part of the wall of the bladder, usually the neck. In an interesting case of this kind in a male adult recorded in the "Transactions of the Pathological Society," 1867, vol. XVIII, p. 171, by Mr. Wood, a uric acid stone, weighing upwards of 4 oz., had lodged for many years in the neck of the bladder, —bridging across the orifice of the urethra. Much difficulty was experienced in dislodging this stone during the operation of lithotomy which Mr. Wood performed for its removal. It was afterwards found to have formed for each of its ends a pouch in the walls of the bladder, which on the right side had obliterated the orifice of the ureter, and completely perforated the proper vesical wall, which was closed by dense adventitious tissue. An enormous distension and hypertrophy of both ureters and dilatation of the right kidney into a mere sac with corresponding hypertrophy of the left kidney had been the result of this abnormal position of the stone.

Sometimes a small stone will either form or become impacted in the prostatic portion of the urethra. When formed there it is usually composed of phosphate of lime. If it affords an obstacle to micturition it should, if possible, be extracted by the urethral forceps. If the effort to do this fail, it may be pushed back into the bladder by the use of a full-sized bougie, and then be crushed with the lithotrite. If this cannot be done, the surgeon must cut down to it from the perineum by a median operation, as if it were in the bladder. In such a case Mr. Wood removed a small stone by means of a long-handled small scoop manipulated upon the finger introduced into the rectum, used to steady and press forward the prostate against the point of the instrument.

Lithotrity. Litholapaxy.—Of late years lithotrity has been carried out very successfully in numerous cases in which the operation of lithotomy would have been practised formerly. The operation has been so much improved that it may almost be said to have replaced the operation for removing the stone entire from the bladder. The number of fatal cases resulting from lithotomy was considerably greater than that obtained from an analysis of cases of lithotrity. And experience has proved that stones of very large size may be crushed with safety. So far as I can learn, setting aside a few exceptional cases, it would seem that lithotomy afforded but a poor chance of safety where lithotrity could not be confidently recommended. These remarks apply only to adults. In children, lithotomy is so safe an operation, while the small size of the urethra and other circumstances are unfavourable to lithotrity, that some surgeons I believe still prefer the cutting operation.

The experience especially of Sir Benjamin Brodie, Mr. Charles Hawkins, Sir Prescott Hewett, and Sir Henry Thompson, has proved that, when performed with care, lithotrity is a most successful operation. Cases have been operated on with success in spite of stricture and irritable bladder, and lithotrity has been performed where lithotomy could not have been undertaken. (*See* a case reported in the "Transactions" of the Royal Medical and Chirurgical Society for 1859.) In the twentieth volume of the "Transactions" of the Royal Medical and Chirurgical Society, Sir Benjamin Brodie concluded his paper with the following sentence :—"My own experience has certainly led me to the conclusion that lithotrity, if prudently and carefully performed, with a due attention to minute circumstances, is liable to a smaller objection than almost any other of the capital operations of surgery." (1859.)

About five years ago one of the greatest improvements ever introduced in operative surgery was effected by Professor Bigelow of Harvard College, U.S. This consisted not only in crushing the entire stone at once, but in removing immediately all the resulting fragments, in fact, completing the operation at one sitting. After the stone had been thoroughly crushed, and the fragments taken one after the other and crushed into very small pieces, a large thin-walled catheter was introduced and connected with a most ingenious apparatus for injecting and withdrawing water from the bladder. The organ was thus washed out, and the fragments carried by the stream of water were collected in a small glass reservoir connected with the apparatus until all had been completely removed, when the instrument was withdrawn and the patient left quietly in bed. The success of this new operation has been most complete. Improvements have been made in some parts of the apparatus, but the principle and practice of the operation remain much as when they were first laid down by their distinguished author. Many surgeons have confirmed all that Dr. Bigelow has said concerning the great advantages of his new operation of litholapaxy. For example, Dr. Freyer, surgeon, Her Majesty's Bengal Army, lost only four cases out of one hundred and eleven operations performed in India in the civil hospitals at Moradabad and Bareilly. Several of his patients were very old, but nevertheless made successful recoveries. The ages of Dr. Freyer's patients are given approximately in the following table in which the cases have been classed in decennial periods :—

96	1
80 to 90	8
70 „ 80	3
60 „ 70	19
50 „ 60	23
40 „ 50	22
30 „ 40	20

20 to 30	4
10 ,, 20	8
Under 5	3

The four fatal cases occurred in persons respectively 65, 48, 45, and 26. ("One Hundred and Eleven Cases of Litholapaxy," by P. J. Freyer, M.A., M.Ch., Surgeon, Her Majesty's Bengal Army, Civil Surgeon, Bareilly, North-West Provinces.—"Lancet," February 28, 1885, p. 375.)

On the Spontaneous Fracture of Urinary Calculi in the Bladder.—But few cases of this uncommon accident have been recorded. When three or four phosphatic calculi exist in the bladder, it sometimes happens that one or two are broken. The fragments may be discharged by the urethra. A stone has been fractured in the bladder by direct violence. Mr. Southam brought forward three interesting cases in which single calculi had undergone fracture in the bladder. *See* a paper read before the British Medical Association at Dublin, 1867, and printed in the "British Medical Journal," January 4, 1868. In two of the cases, the calculus consisted respectively of uric acid and oxalate of lime. Mr. Southam thinks that the fracture must have resulted from the development of gas within the calculus itself, possibly in consequence of the decomposition of the animal matter of the calculus. This view is supported by specimens in the Dupuytren Museum, in which the fracture is limited to the *internal* portion of the stones, the outer layers being intact. Mr. Southam has kindly allowed me to have copies taken of his drawings, and to publish them in "Kidney Diseases, Urinary Deposits, and Calculous Disorders," pl. III, figs. 16 to 20.

Of the Removal of a Stone from the Kidney by Operation and of the Removal of One Kidney—Nephrotomy and Nephrectomy.—A stone may be removed from the kidney by operation without extirpation of the kidney itself. Some of the cases in which this operation of nephrotomy has been performed have done remarkably well, and there can be no doubt that the antiseptic treatment has been the means of establishing this amongst a considerable number of serious operations, which could not have been undertaken by the surgeon before he had the advantage of the new proceeding without such serious risk to life as to render them unjustifiable.

During the last few years many operations on the kidney have been performed here and on the Continent. A number of these have been successful, and the operation is now included, I believe, by many distinguished surgeons in the ever-increasing list of operations which ought to be performed for the relief of sufferers. It is, however, obvious that so formidable an operation as cutting down upon the kidney from the loin, or from the anterior surface of the abdomen, should not be thought of unless the evidence of the presence of a stone is very con-

clusive, and the probability of relief by operation great. The wearing character of the pain, and its effects upon the general health, and the misery the unfortunate patient may have had to endure, perhaps for half his life, possibly have had the effect in many instances of making him assent, and look forward with delight to this, or, indeed, any proposal that would seem to afford him but a moderate prospect of relief, though there might not only be considerable risk of failure, but the consequences of the operation might very soon destroy life. But the desire on the part of an anxious sufferer to be relieved, and our desire to cure him, must not be allowed to have undue weight in determining our decision to interfere, and we ought to sanction operative interference only in those cases in which a favourable result may reasonably be anticipated. At the same time it must, I think, be admitted that we have been taught by experience that the danger to life is really less than the very serious character of the operation and the necessarily extensive damage to nerve plexuses and ganglia would have led us to expect.

The whole kidney has been removed in several instances, and recovery has taken place without a bad symptom. Moreover, when we bear in mind the very favourable statistics of the operation for ovarian dropsy, and the frequently successful removal of the entire uterus, we shall not be surprised that many cases of nephrotomy recover without a bad symptom, and that the kidney may be probed in various directions for the purpose of ascertaining the presence and exact position of a stone without very great risk to life.

Of 132 cases of extirpation of the kidney referred to by Billroth in a clinical lecture delivered early in 1884, 70 recovered and 62 died ("Medical Times," July 5th, 1884).

Mr. Bryant, in his work on the "Practice of Surgery," fourth Edition, 1884, advocates the operation of nephrectomy when that of nephrotomy is inapplicable, or has proved unsuccessful. He states that more than half the cases operated upon have been successful, and that the result turns more upon the nature of the disease for which the operation has been undertaken than the operation itself. My friend advocates strongly the lumbar in preference to the abdominal operation when it can be performed.

In some cases relief from pain which has existed for many years has been obtained by simply cutting down upon the kidney without injuring it in any way. Needles have been passed in different directions into the substance of the organ for the purpose of ascertaining the position of the stone without detriment to the patient. In some of these, although no stone was found, the pain was relieved, and the patient made a good recovery. However, looking from the medical side, I should say that these operations of nephrotomy and nephrectomy were not to be recommended in as many as 5 per cent. of the cases of renal calculus

that come under our observation. Considering the extreme difficulty in forming a judgment—1, as to the size and position of the stone in cases generally; and 2, as to the quantity of the renal tissue remaining in the affected kidney, and 3, whether the other kidney is in a thoroughly sound condition; it is only rarely that the operation is suggested to the mind as a wise expedient, even when there has been long-continued suffering, and the patient may be desirous of accepting almost any chance of changing the monotonous life of suffering to which for many years he has been condemned. With regard to this operation, I cannot do better than place before the reader the remarks of Billroth in an address delivered by him "On Extirpation of the Kidney:" "It is now the task of the present day to recognise and define still more clearly the class of cases in which surgical measures are of use. If we have here and there pushed the limits of surgical benevolence somewhat too widely, we may, without discredit, retract them a little as our experience extends, but at the same time fix them upon a still firmer basis. If the surgeons of to-day will not fancy themselves to be such all-powerful fellows, but will be content to follow with modesty the example of their brethren the physicians, indefatigably investigating and combining, we may yet succeed in bringing cure, or at least temporary relief of their troubles, to still more unfortunate sufferers. This is, and always will be, the ultimate aim of our common scientific and humane endeavours, and the real end and object of our noble calling."

It is of course very important that persons who have had one kidney removed should thoroughly understand the physiological action of the organ and the circumstances most likely to derange it, so that they may make the best of the one that remains, and expose it to as few risks as possible. They should bear in mind that slight disturbance when there is but one organ may be attended with physiological changes that may have a serious effect on the organism, and it is therefore important that they should understand how to reduce the work of the kidney to the most moderate amount consistent with health, more especially when any tendency to derangement may be manifested. In short, every care should be taken to protect the organ from strain, and as little work should be thrown on it as possible, especially during the first few months after the removal of its fellow, while it is adapting itself to the double work which it has to discharge, and perhaps growing in size, and preparing more efficiently to perform the increased physiological requirements demanded of it.

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