neutralize and to prevent the further action of the acid on the tissues.

In poisoning by metallic salts and alkaloids, the same salts, namely, the bicarbonates of the alkalies, may be used, to precipitate the insoluble oxide of the metal or of the alkaloid. Magnesia is generally preferred, as it acts as a slight purgative, and so helps to expels the poison from the intestinal canal.

The substances contained in this group by virtue of their diffusion-power, pass so readily into the blood, that but a small portion of them reaches far into the small intestines. Little is known of their action on the small intestines, and on the organs which pour their secretion into them; yet it seems probable that those secretions having an alkaline reaction may be affected in a double and opposite way, according to the time these drugs are administered acting contrariwise on the stomach. The secretion from the intestinal glands is alkaline; hence, if the general statement made at the beginning of this section is valid, acids applied to the orifices of their ducts should augment their secretion, while alkalies should have the contrary effect. But we have seen that alkalies, given before meals, increase the secretion of the acid gastric juice, and thus augment the acidity of the intestinal canal; and they should likewise increase the biliary and pancreatic secretion. On the other hand, the alkalies, if given after a meal, neutralize the acid in the stomach, and should lessen the secretion from the liver and pancreas. Nothing, however, on these points is known with certainty, the foregoing statements being at present merely conjectural.

The milder alkalies, as bicarbonates of potash, soda, or magnesia, may be used with great benefit in diarrhœa due to excess of acid in the intestines. By neutralizing the excess of acid, these substances arrest the diarrhœa.

Soap is often added to anal injections, to suspend castor oil or turpentine. Soap itself, moreover, may be used as a mild and safe purgative. A piece the size of the thumb, covered

with castor oil or merely wetted with water, and thrust up the rectum as high as the finger will carry it, will, in a short time, produce an easy, copious, and natural evacuation. This plan is especially available for infants and children

On entering the blood, these substances undergo various changes, according to their composition. The acetate or citrate, which has not already undergone a like change in the intestines, becomes converted into the carbonate, the form probably ultimately assumed by the oxide of the alkalies.

The alkalinity of the blood must therefore be increased by these alkalies, not probably to any great extent, as from their high diffusion-power they are rapidly eliminated by the kidneys. On this increase in the alkalinity of the blood much speculation has been built. The alkalies are known to promote oxidation, whence it has been conjectured that, by increasing the alkalinity of the blood, its oxidation, and that of the tissues, may be increased. It has been suggested that alkalies might be profitably employed in diabetes, to promote the oxidation of the sugar. Alkalies have been advocated also for excess of uric acid in the urine, with the expectation of oxidizing this product of the nitrogenous tissues and so converting it into urea or some other substance. And they are sometimes given to fat people to increase oxidation, in order to consume their fat, and so to control unseemly obesity. The solutions of the bicarbonates and especially of the oxides are used for this purpose.

Their action in diabetes appears to be nil, or rather, it should be said, they in no degree lessen the amount of sugar separated by the kidneys, although, if long persisted in, some derangement of the stomach must occur, with diminution in appetite, so that less food being taken, less sugar is excreted.

Nor does it appear that they can oxidise uric acid in the blood; at least there are no experiments in proof of this. It is, however, very useful to give alkalies so as to render the urine weakly acid, or even alkaline, so as to convert the excessive quantity of uric acid into a more soluble urate. This treatment too will prevent the growth of uric acid calculi.

Micturition in young male children not unfrequently causes severe pain, which is found to depend on the existence of uric acid or biurates, in the form of spicular crystals, which in their passage irritate the urethra, by alkalinising the urine. These are dissolved and rendered innocuous.

The citrates having very little action on the mucous membrane of the stomach are the salts best adapted to render the urine less acid, or to make it alkaline.

Next, as to the power of alkalies to increase the oxidation of fats: that the long-continued administration of the more alkaline preparations will induce much wasting of the body, admits of no doubt, but this wasting is effected by their disordering action on the mucous membrane of the stomach. To diminish fatness in this way, so likely to damage the health, and even to endanger life, is surely very injudicious. Some writers of authority, however, maintain that obesity may be thus reduced without any ill effects on the mucous coat of the stomach. Thus, Dr. Neligan states that he has often removed an uncomfortable excess of fat, by the use of liquor potassæ without in any way injuring the patient's general health. This treatment, however, though perhaps occasionally successful, generally fails signally.

After the passage of alkalies into the blood, and their conversion into carbonate, the action of these substances on that fluid is at present but little known. Dr. Garrod is of opinion that scurvy is due to deficiency of potash salts with the food, a surmise supported by many facts, but not yet confirmed by exact observation.

The bicarbonate or the citrate of potash is often employed in rheumatism. This disease is supposed to be produced by an excessive formation of lactic acid, which, having an affinity for certain tissues of the body, excites in them the rheumatic inflammation. Alkalies are given to neutralize this acid, and to protect the tissues from its action. But so little is known about the nature of rheumatism, that it is impossible to approach the question of its treatment on the theoretical side. As careful records of exact observations with this treatment are non-existent, we can only be influenced at present by individual impressions. This much, however, must be conceded; that in many cases the rheumatic pain is much relieved as soon as the patient is well under the action of the drug, and the urine has become fairly alkaline.

Many eminent authorities are firmly convinced that the alkaline treatment* renders rheumatic fever both milder and shorter, and diminishes the danger of heart complications. The author has made many careful observations on this question, and he is led to believe that, due attention being paid to the age of the patient, and to the nature of the rheumatism, it will be found that these salts are unavailing to lessen the intensity or the duration of the fever.

Potash salts exist abundantly in the milk, whence it has been suggested that the administration of these salts may promote this secretion. Some recommend them in amenorrhœa, in syphilis, and scrofula.

The sustained administration of the alkalies and their carbonates, renders the blood, it is said, poorer in solids and in red corpuscles, and impairs the nutrition of the body; but these results are probably due to disordered digestion, produced by the long-continued use of alkalies, and are not dependent on an excess of alkalinity of the blood; for such excess must always be slight, on account of the rapid elimina-

* In the fifty-second volume of the *Medico-Chirurgical Transactions*, Drs. Gull and Sutton published a paper on the value of remedies in rheumatic fever. Although not numerous enough to settle this much-vexed question, these cases lead them to the conclusion that alkalies, lemon-juice, or blistering, are inoperative in shortening the course of rheumatic fever, but they do not deny that these remedies may allay pain. They further conclude that neither alkalies, lemon juice, nitrate of potash, nor blisters, prevent the occurrence of heart disease in rheumatic fever. In dealing with statistics relating to the treatment of rheumatism, it is necessary to be specially cautious, for tendency, warranted by observation, is to the conviction that hereafter rheumatism will be discriminated into many varieties. Thus already we have distinctive rheumatic fevers, due not only to weather influence, but to syphilis, lead, etc. Moreover it is often difficult and at first even impossible, to distinguish gonorrhœal rheumatism and acute febrile rheumatoid arthritis from rheumatic fever.

tion of these salts by the kidneys; moreover, it has been shown by Dr. Roberts, of Manchester, that the citrate of potash may be taken for an almost indefinite time, without deranging the general health, yet this drug increases the alkalinity of the blood, while, owing to its neutral reaction, it is harmless to the stomach.

Liquor potassæ bears the reputation of promoting the absorption of inflammatory formations, and is occasionally employed in pleurisy; but its good effects are not conspicuous, and the disorder it produces in the stomach renders its use unadvisable for any length of time.

Carbonate of potash in one or two grain doses, given three or four times daily, with a little syrup to cover the taste, is much used in Philadelphia for whooping cough.

What influence have the alkalies on tissue change? Dr. Parkes has investigated the action of liquor potassæ, and he thinks that it probably increases the disintegration of the nitrogenous substance of the body; and he believes that his experiments justify him in concluding that it disintegrates also the sulphur-holding tissues; for liquor potassæ increases both the urea and sulphuric acid of the urine. The strong reaction of liquor potassæ unfits it to be given in doses sufficiently large to affect in any great degree the reaction of the urine, so that the bicarbonates or citrates must be employed when it is required to alkalinize this fluid.

What action have alkalies on the constituents of the urine? They are all reputed to be diuretic, but as no exact observations have been made with these salts this statement must be regarded as only a probable assumption.

Before referring to the presumed diuretic properties of these substances it will be as well to digress for a short space to speak in general terms of diuretics.

By diuretics, we understand medicines which act as eliminators of the urine; and we must distinguish diuretics from those medicines which, by promoting tissue change, cause an increase in any of the constituents of the urine. Diuretics merely separate from the system already-existing products.

As the urine is a complex fluid, containing, besides water, many salts and other ingredients, we may have medicines which will eliminate one or more of these, but leave the rest unaffected. We may therefore have diuretics of water, or of urea, or of uric acid, etc. Again, the retention in the blood of materials which should be eliminated by the kidneys, may be due to a variety of conditions. The physical state of the kidneys may be altered, and these organs disabled, by disease of distant organs, as of the heart. Or, on the other hand, through insufficient oxidation and combustion of the effete products of disintegration, refuse materials may remain in a form unexcretable by the kidneys; and, lastly, the retention of the urinary ingredients in the blood may be dependent on organic disease of the kidneys themselves.

Thus, in one instance a medicine acting on some organ at a distance from the kidneys, as the heart or lungs, will be a diuretic; while in another, those means which promote oxidation in the blood will prove diuretic; and, lastly, diuretics may act immediately on the kidneys by removing or altering those physical conditions which hinder the action of these organs.

How far do the members of this group act as diuretics? and in which of the foregoing ways? We cannot give very satisfactory answers to these questions.

First as to their diuretic action.

It is generally held that all these substances are diuretic, and, under certain circumstances, they may possibly become so. Acetate of potash and acetate of soda enjoy the highest repute in this respect. Some careful observations have been made with these substances on persons in health, which have led to unexpected results. Thus it was found by Böcker (quoted by Parkes), "that so far from acting as a diuretic in health, the acetate of potash diminished the water, the urea, the extractives, and, in a remarkable manner, the earthy salts." Some valuable observations concerning the action of citrate of potash and acetate of potash, as diuretics in health, have been made by Dr. Nunneley on himself. He

took daily, for twelve days, three to five drachms of citrate of potash. On an average, the daily excretion of water was increased by two ounces and a half; but the urea was lessened by eighty-four grains, and the solids by sixty grains. The acetate of potash, in daily doses of two and a half to three and a half drachms, exerted a similar influence in a somewhat less degree.

But should we expect medicines to act as diuretics or eliminators in healthy persons? In their blood there should be but little urea or uric acid to be eliminated, and we must be careful, therefore, how far we allow physiological experiments to guide us as to the action of diuretics in disease. That such caution is highly necessary is shown by an observation by Ranke, who, after giving acetate of potash, noticed a very considerable increase in the quantity of urine voided soon after, showing that this salt will sometimes act as a diuretic of water.

Having spoken of their properties as diuretics, we will endeavour to answer the second part of the foregoing question:—In what way do they act as diuretics?

It is not supposed that any members of this group act on organs remote from the kidneys. They may possibly act by promoting oxidation in the blood, and so reducing effete products to urea, in which form they are separated by the kidneys.

Some of these medicines are considered to be febrifuge, as the citrates and acetates. If so, they would act as eliminators of water, as on the decline of fever an increase takes place of the urinary water, previously held back in the system during the febrile state, and an increase in the solids of the urine often occurs simultaneously. If, therefore, these substances will check fever, this increase of water and solids must, in some measure, be due to their action.

These alkalies are generally reputed to act as diuretics when the kidneys are diseased. Thus the citrates and acetates are given in acute and chronic Bright's disease. Some consider that, by making the urine alkaline, it is enabled to

dissolve the organic, but diseased, matters which block up the uriniferous tubes in Bright's disease, and hinder the secretion of the kidneys.

It has already been mentioned that the members of this group render the urine less acid, or even alkaline; but we may here add that, strange to say, the amount of acid excreted with the urine is actually increased, although, being neutralized by the alkalies, it gives no acid reaction.

Of these remedies, the citrates and bicarbonates are constantly employed to make the urine alkaline, when the urinary organs are irritated or inflamed. They are used in cystitis and gonorrhœa. If in cystitis the urine, before it is passed, is already alkaline from decomposition of the urea, alkalies must be intermitted; for they would, of course, increase the alkalinity of the urine, and so promote still further the decomposition of urea, and the formation of carbonate of ammonia, as alkaline, decomposes much more readily than acid urine.

When excess of uric acid occurs in the urine, it should be kept for a time alkaline; and Dr. Roberts, of Manchester, by many careful and ingenious experiments, has shown that uric acid calculi may probably be dissolved in the bladder, if the urine is maintained alkaline for some weeks. This treatment is probably useful in renal calculus which is generally composed of uric acid only. It is reasonable to expect that the alkaline urine would, in time, reduce the calculus sufficiently to pass down the ureter. We certainly meet with patients complaining of much pain in the back, passing bloody urine containing a large quantity of uric acid crystals, and a little pus, who are curable with large doses of citrate of potash.

We may here introduce a short account of some interesting experiments made by Dr. Paul Guttmann on the action of potash and soda salts. He confirms many of the conclusions arrived at by Claude Bernard and others. The results are singular, and scarcely in accordance with the experience of medical men of the action of these substances on the human body. We give a short summary of his paper:—

Potash Salts are all far more poisonous than soda salts.

Potash salts are all equally poisonous and fatal in the same space of time, if applied in the same way.

Chloride of potassium, carbonate of potash, and nitrate of potash, in identical doses, are equally powerful to destroy life, and in the same period of time, even when the salt, previous to injection, is mixed with a solution of albumen.

The acid of the salt plays no part in the fatal result.

In poisonous doses great muscular weakness sets in, first appearing in the hinder extremities; while in warm-blooded animals dyspnœa and convulsions take place. They lessen the frequency and force of the heart's beats, and sometimes make them irregular. This holds good with all potash salts.

Large doses at once arrest the action of the heart, which always ceases to act in the diastole.

Traube asserts that the action on the heart is effected through the vagi nerves. This view Guttmann considers erroneous, as, after the vagi were both divided, and the medulla removed, the potash salts still affected the heart as before, and even when the vagi was paralyzed by woorali, the potash salts still acted as usual on this organ. Whether their effect on the heart is owing to their action on the heart's substance, or on its ganglia, Guttmann cannot say. He states that these salts lowered the temperature of the body; but certainly to a very insignificant extent.

These salts act but slightly on the muscles, and not at all on the peripheral nerves, unless applied directly to them in a strong form. The loss of sensibility and motion is due to their paralyzing action on the spinal cord, an action first evidenced and most expressed on the posterior part of the cord.

Soda Salts, in twice or three times the quantity which proves fatal in the case of the potash salt, produce no effect on the system, except a passing weakness.

Even in larger doses, soda salts exert no action on the heart, cause no diminution in the temperature, and produce no apparent effect on the cord, brain, nerves, or muscles.

The heart of a frog suspended in a solution of potash

quickly ceases to contract, while a solution of soda of similar strength required a much longer time to produce that effect.

Many soda salts produce an opacity of the lens in frogs but this is not noticed to occur with the sulphate of soda. Guttmann shows that the opacity is not due to mere abstraction of water from the lens. This opacity does not take place in mammiferous animals; it is removed by immersing the opaque lens in water.

SOLUTION OF AMMONIA.
CARBONATE OF AMMONIA.
SPIRITS OF AMMONIA.

These preparations have many properties in common with the alkaline potash and soda group. They possess a strong alkaline reaction, are freely soluble in water, have a high diffusion-power, and dissolve the animal textures; but they differ from the potash and soda preparations in their volatility, and in being more powerful local irritants of the living animal tissues, exciting in them very active inflammation.

Their action on the skin is in many respects similar to that of the alkaline potash and soda preparations. Liquid ammonia, owing to the water in its composition, manifests but little attraction for that of the tissues; and since its solvent action on the textures is less than that of the soda or potash salts, it physically destroys these much less quickly and extensively. Owing, however, to its high diffusion-power, it readily penetrates the cuticular covering of the body, and excites a degree of active inflammation, sufficient to destroy the tissues, and so produce, first a slough, then an ulcer. The preparations of the members of this group are never purposely employed to produce formidable destructive changes in the tissues, but, in the form of liniment or the