

excites, it is said, eczema and spots like erythema nodosum. The acneform spots may become true boils, and these boils sometimes form large ulcers with conical scabs, looking like rupia. Dr. Weir Mitchell narrates a case of this kind. He found that bromides of potassium, sodium, ammonium, and lithium, produced these ulcers. He tried also bromides of calcium, magnesium, and bromine itself, but as these preparations failed to control the epileptic fits they were not given long enough to determine if they too would produce these rupoid ulcers. Undue administration of the bromide renders a patient low-spirited, easily fatigued and unfitted for work, symptoms which soon subside on the suspension of the medicine.

Acne, and the other evidences of bromism, rarely occur, unless more than one dose, however large, is taken daily.

M. Rabuteau says that bromide of potassium may be detected in the urine and saliva twenty days after the administration of a dose of fifteen grains. Dr. Amory could not detect it more than forty-eight or fifty-two hours after a single dose, but for a much longer time after the drug had been taken several days. Elimination by the urine is less rapid than absorption by the stomach. Traces appear in the urine in ten minutes. Elimination is most active during the first eight or ten hours, and in less than twenty-four hours the greater part disappears.

Bromide of potassium is conveniently administered in beer or milk.

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#### SULPHURIC, HYDROCHLORIC, NITRIC, PHOSPHORIC, AND ACETIC ACID.

The members of this group are powerful acids, and accordingly have a strong affinity for alkalies and bases. Some of them, as sulphuric and phosphoric acids, absorb water with avidity. They all possess a high diffusion-power, and so pass

readily through animal membranes and textures. These are the properties which explain most of their actions on the living body.

These acids, when concentrated, produce decided changes in the skin by their affinity for the bases and water of the tissues, as well as in a minor degree for the organic substances themselves. Their great diffusion-power enables them to penetrate readily and deeply beneath the surface, and to continue their destructive action till they are diluted with water or neutralised by the bases of the animal structures. From their greater affinity for water, sulphuric and phosphoric acids are especially energetic: they withdraw this element from the textures, and thus effect their complete destruction. Applied in adequate quantity, they will destroy the tissues to a considerable depth, and produce a brown or black eschar.

The remaining members of this group, owing to their feebler affinity for water, destroy the tissues less extensively, and their action is much more superficial.

Sulphuric and phosphoric acids are never used undiluted, on account of their physical action on the tissues. Nitric acid, on the other hand, is frequently employed to destroy and remove the surface of foul and unhealthy sloughs and ulcers; and, in virtue of a property of which we shall shortly speak, to change an unhealthy and indolent sore for one more healthy and prone to heal. Thus it is frequently employed in cases of soft chancres, indolent and broken bubo, cancrum labialis, etc.

Nitric, hydrochloric, and especially acetic acid, may produce some vesication. Nitric acid colours the skin characteristically yellow.

They are often used for the purpose of exciting inflammation, and often with the best results. It is now established that two diseased actions cannot co-exist actively in the same part. On this principle, we use one or other of the three acids, nitric, hydrochloric, and acetic. For instance to a patch of herpes circinnatus, we apply an acid, usually acetic,

thus cutting short at once a disease which tends to spread and to continue for a considerable time, and to establish in its place an inflammation which quickly subsides and disappears.

Thus it is that nitric acid induces a healthier action in indolent ulcers, or arrests the spreading of sloughing sores. Acetic acid, and somewhat diluted nitric acid, are frequently applied to warts, which they destroy by withdrawing the bases, and by dissolving the tissues of the warts themselves. But although any of these acids are effectual, in many cases completely removing the warty growths, yet sometimes a fresh and abundant crop springs up in the neighbourhood of those undergoing treatment. Dr. George Bird finds the glacial acetic acid very effectual in removing warty growths.

Small syphilitic warts and condylomata kept constantly moist with a wash of diluted nitric acid are thus removed, certainly and painlessly. A drachm or two of the dilute acid to a pint of water is sufficient.

The members of this group are more generally employed as external applications mixed with water. Thus diluted, they still excite some irritation, and may be used for this purpose with great benefit as lotions in urticaria, controlling the very troublesome itching, even preventing the formation of wheals, and in some cases appearing to be mainly instrumental in the curing of this disease.

Acids, especially nitric and hydrochloric acids, are less employed now than formerly as baths, yet, beyond doubt, they exert a most powerful influence on the skin. A general bath, with two to eight ounces of the strong nitric or hydrochloric acid, is a very powerful exciter of a torpid skin.

What influence, if any, these baths bring to bear on the other organs of the body is at present quite unknown, no experiments having been made to settle this question. It is highly probable, however, that in common with other materials dissolved in baths, these acids remain unabsorbed by the skin, and that any change in the deep parts of the body resulting from their use must be ascribed to the direct action of

these agents on the skin. Profuse sweating can be effectually controlled in some cases by sponging the surface of the body with water weakly acidulated with acids. The sweat is an acid secretion.

To the skin, stripped of its cuticle, they act as stimulants; thus nitric acid is frequently used as a lotion in the treatment of indolent and painful ulcers, for which it is a very valuable application.

Applied to the softer tissues, the dermis, mucous membranes, etc., they act as astringents, causing a direct condensation of the tissues, probably by removing part of the base, by combination with which the albuminous substances were held in the soluble form.

By virtue of their astringency they check profuse secretions from unhealthy sores. Nitric acid is mostly preferred in such cases. Nitric acid is often used as a test for albumen in solution. As we have stated, it precipitates the albumen by abstracting it from the base combined with it, and in setting the albumen free, converts it into an insoluble substance.

These acids, when diluted, very effectually check bleeding from the smaller vessels and capillaries by constringing the tissues, exciting the muscular coat of the arteries to contract, and by coagulating the blood in the ends of the wounded vessels, and so plugging them. Thus vinegar, being always at hand, is valuable when diluted in checking bleeding from leech-bites, piles, cuts, etc.

Before speaking in detail of the action of acids on the various parts of the alimentary canal, it will save much repetition and render our course far clearer, if we make a few general preliminary remarks on the action of acids on the secretion of the various glands opening into the alimentary canal.

Repeated and careful experiments have established the fact that dilute acids taken into the stomach check its secretion; while, on the other hand, alkalis stand prominent among the most powerful exciters of the secretion of the gastric juice. From these facts the more general law is inferred, that acids applied topically check the production of acid se-

cretions from glands, while they increase the flow of alkaline secretions; the very reverse being the case with alkalies, which are inferred to check alkaline, but to increase acid secretions. This general law gains support by interpreting fully the effects, substantiated by experience, of acids on the secretions of the alimentary canal in disease. (See Alkalies, page 124).

Acids are powerful stimulants of salivary secretion and act through the cerebro-spinal nerves, supplying the salivary glands; and if these are divided, acids cease to augment the salivary secretion.

These acids produce the same effect on the mucous membrane of the mouth as on the skin, and for the most part are used for the same purposes. Thus, strong nitric acid is often applied to foul and sloughing ulcers of the mucous membrane to change their character and to check their progress.

Acids are in part neutralized by the alkaline secretion from the salivary glands, while any acid remaining free precipitates the mucus, coating the mucous membrane, and, if in sufficient quantity, attacks the mucous membrane itself. They act beneficially as astringents, when the lining membrane of the mouth is relaxed or ulcerated, as in ulcerative stomatitis, salivation, etc.; but other astringents are to be preferred. As these acids are apt to dissolve the earthy constituents of the teeth, they should, therefore, be taken through a quill, a glass tube, or a reed.

But nitric acid exerts a further action on the mucous membrane of the mouth, and may be given in small medicinal doses with conspicuous benefit when in various ways this membrane is inflamed or diseased, as in ulcerative stomatitis, apthæ, salivation from mercury, or when reddened, inflamed, and glazed, a condition not unfrequently met with in great irritation of the digestive organs.

These, with other acids, as citric, tartaric, etc., quell the thirst of fever patients much more effectually than plain water, especially if the drink is made rather bitter with some agreeable-tasting substance, as orange-peel or cascarilla. Much

of the troublesome thirst of fevers is not the expression of the wants of the general system, but is owing to dryness of the mouth and throat. This disagreeable local sensation is very liable to lead fever patients to drink more water than is really good for them, producing loss of appetite, indigestion, and even diarrhœa and flatulence.

The action of acids in lessening this thirst has already been explained. Acids, as we have seen, probably increase alkaline secretions, and thus the acid drinks used by fever patients promote an increased secretion in the salivary glands. Bitters, as we shall subsequently see, possess the same power, and hence it is that acid and bitter drinks, by their action on the salivary glands, keep the mouth and throat comfortably moist, and quench the thirst. By lessening the harassing thirst they quiet the patient, quell irritability of temper, favour sleep, quiet the pulse, and diminish the heat of the body; hence these medicines, especially the organic acids, are largely employed as fever medicines. They are applied to the throat for the same purpose as to the mouth. Thus, undiluted nitric acid acts beneficially as a topical application, on the foul sloughs or ulcers occurring in the course of scarlet fever or other diseases.

Bretonneau has strongly recommended the application of strong hydrochloric acid to the throat in diphtheria. The acid may be used undiluted, or it may be mixed with an equal part of honey, which gives the mixture consistence, and makes it cling for some time about the parts on which it is painted. It should be applied to those spots only of the mucous membrane attacked by the diphtheritic inflammation, not to the neighbouring healthy tissues, where it would produce active inflammation. The diphtheritic membrane being very prone to implant itself on inflamed surfaces, the application of the acid to the sound tissues might, by exciting inflammation, favour the spread of the disease. This treatment, however, is of little, if any, service, and in the author's experience fails utterly to check the progress of the inflammation.

Nitric acid, in small medicinal doses, may be given with

benefit when the throat presents the same appearances as those of the mouth previously described [*vide* p. 110].

The albuminous constituents of food are digested and rendered soluble mainly by the agency of acids: all acids are not equally efficient. Lactic and hydrochloric acids far outstrip all others in this respect, while sulphuric acid hinders rather than promotes digestion, by precipitating the albumens in an insoluble form. The action of acids on nitrogenous substances is greatly heightened by the addition of pepsin.

Thus, in scanty secretion of gastric juice, dilute hydrochloric acid may be employed to assist digestion. The considerations developed at the beginning of this section concerning the action of acids on acid secretions render it obvious that the time of its administration, in respect to the meals, is all important. If given before the meal, acids check the secretion of the acid gastric juice, and so hinder, instead of aid, digestion. When the secretion is scanty, the acid must be given after the meal, when the secretion from the membrane of the stomach is completed; then the additional acid will assist the action of that secreted naturally, but too scantily. In many cases of atonic dyspepsia, alkalies are preferable to acids; but they must, of course, be given a short time before a meal, because then they stimulate abundantly the secretion of the gastric juice. In most cases of atonic dyspepsia, alkalies, with the precautions noted, are superior to acids given after the meal, although, as is well known, certain cases occur wherein acids answer better than alkalies. In cases like these, the mucous membrane is presumably considerably damaged by excesses in eating or drinking, and owing to degeneration of the glands of the stomach, no stimulant could excite a sufficient flow of gastric juice.

Acids, as we have seen, will check or lessen the secretion of gastric juice. In many stomach diseases, or from sympathy with distant organs, the follicles pour an excess of acid into the stomach, which undue secretion may be checked by the administration of acids shortly before food is taken. But acidity of the stomach is often owing to excessive or irregular

fermentation leading to the production of a large quantity of various acids, as acetic, butyric, and lactic. This excessive or irregular fermentation of acids is itself checked by acids; and as either undue secretion of the gastric juice, or excessive formation of acids by fermentation, are the two causes of acidity, we have in acids themselves remedies able to control and check the acidity of the stomach, and relieve the distressing symptoms accompanying this condition, whether due to pregnancy,\* uterine disease, calculus of the kidneys, the various dyspepsia, or more serious diseases of the stomach.

Practical men indeed know well that the administration of acid checks acidity, removing the acid eructations, the heartburn, and the sense of discomfort at the chest and epigastrium, arising from excess of acid in the stomach. Hydrochloric or nitric acid is generally preferred, and small medicinal doses, separately or combined, are ordinarily sufficient, provided the prescribed conditions are complied with.

Patients are sometimes greatly annoyed by eructations of an offensive gas, with the odour and flavour of rotten eggs—a gas evidently consisting largely of sulphuretted hydrogen gas. The late Dr. Day, of St. Andrew's, noticed that in such cases the urine is loaded with oxalic acid, for which condition he strongly recommends the employment of the mineral acids. Nitric acid is likewise of great use in the treatment of dyspeptics with oxalic acid in the urine but who are free from sulphuretted hydrogen eructations, and who suffer from great mental depression.

In the treatment of dyspepsias, a clue to the administration of acids on the one hand, or of alkalies on the other, is sometimes to be obtained by testing the reaction of the fluids ejected from the stomach. Not unfrequently, soon after a meal, a fluid regurgitates almost unconsciously into the mouth, sometimes so strongly acid that it sets the patient's

\* The acidity of pregnancy is often prevented by two or three drops of tincture of *nux vomica*, taken a few minutes before meals; sometimes it is controlled by *ipecacuanha*.

teeth on edge. The exhibition of nitric or hydrochloric acid shortly before each meal, almost immediately removes this acid pyrosis. Sometimes the fluid of pyrosis has an alkaline reaction, often accompanied with much distress, with nausea and vomiting of the just-eaten food; the rejected contents of the stomach generally show a strong alkaline reaction. Here the nausea, the vomiting, and all distressing symptoms, may be removed by the use of an acid immediately after a meal. On theoretical grounds, we should expect an alkali administered shortly before the food would yield even more satisfactory results, but the author has had no experience of the use of alkalies in such cases.

It need hardly be said that acids given soon after a meal to patients troubled with acidity and heartburn, greatly aggravate their sufferings. It is adding fuel to fire. These remedies should not be continued too long, lest they should not merely check undue acidity of the stomach, but exceed this office, and by lessening the secretion of gastric juice to an undue extent, actually induce the very opposite condition to that for which they were, in the first instance, employed. To those who have watched the action of acids on the stomach, it is well known that, if too long continued, the improvement first following their use, lessens, ceases, then fresh symptoms arise, which, with apparent strangeness, are relieved by the very opposite treatment which had previously benefited.

If their administration is long continued they excite a catarrhal inflammation of the mucous coat of the stomach and intestines, accompanied often by diarrhoea, and even general wasting. This damaging action of acids explains the occasional effects of vinegar, when taken for a long time, in reducing the stoutness of fat people. Vinegar is sometimes taken surreptitiously in wineglassfuls several times a day to reduce obesity. It may reduce the stoutness, but it does so at the expense of serious injury to the body, and is a foolish practice which cannot be too strongly condemned.

It has been ascertained that these acids are inoperative to

check the growth of *sarcinæ* in the stomach. They often fail even to check the acidity accompanying these growths. It is a common practice with drunken soldiers to drink a wine-glassful of vinegar in a tumbler of water, with the view to remove the intoxication. Whether it does sober a drunkard is not quite certain, but it seems to steady and enable a tipsy soldier to pass muster on presenting himself at barracks.

They are useful in bleeding from the stomach by virtue of their astringent action, and their power of coagulating the blood. Sulphuric acid is generally preferred to the other members of this group. Many other astringents are surer.

Their high diffusion-power enables these acids to pass readily from the stomach into the blood. The acids which pass into the intestines must, to a great extent, become neutralized by the alkalies of the bile and pancreatic juice, and as acids, can affect to a very small extent, by direct contact, the middle and lower part of the intestinal tract. But in becoming neutralized, some of the biliary and weaker acids are set free, heightening in some degree the acidity of the contents of the intestines.

Dilute acids are used as antidotes in poisoning by the alkalies.

The influence exerted by acids on the pancreas or liver is unknown. The secretions from these two organs being alkaline, has led to the suggestion that the acids may increase the glandular secretion; but on this point nothing is known with certainty. It has long been held that nitric acid acts in some way beneficially on long-standing diseases of the liver, as in chronic congestion and cirrhosis, and that this drug will augment the flow of bile after the liver has struck work from the excessive use of mercury.

There can be no doubt that sulphuric acid is highly useful in checking summer and choleraic diarrhoea, although, as it is generally administered with opium and warm carminatives, it is difficult to distribute to each remedy its exact share of merit. Its mode of action is less obvious than its efficacy. It may control the formation of acid in the intestines, or it may

act as an astringent, and so check diarrhoea. If as an astringent, then, as the acid is soon neutralized and converted into a sulphate in the upper part of the small intestines, losing its astringency at once, its influence on the lower and middle part of the small intestine must be exerted through nervous sympathy between one part of this canal and another. Sulphuric acid is considered to act often capriciously, giving rise to much uncertainty in its administration; but this lack of uniformity in its results can be accounted for, in many instances, by the dose. A small medicinal dose often benefits, whilst a full one, by increasing the acidity of the canal, may even aggravate the diarrhoea. Dr. Neligan and other authorities, recommend it in chronic diarrhoea, and to control the "profuse sweating and colliquative diarrhoea of hectic."

In small medicinal doses, nitric acid is of great use in many diarrhoeas. Thus it often acts admirably in the straining diarrhoea of children, when the motions are green, curded, and mixed with mucus. This form of diarrhoea yields speedily to acids which counteract the acidity of the intestinal canal, on which this flux depends. Yet, on the whole, other remedies are to be preferred to acids. Nitric acid may sometimes be used with great benefit, especially when given with pepsin, in that chronic diarrhoea of children when the pale and pasty motions smell sour and very disagreeable.

The application of strong nitric acid is an efficient remedy for internal piles; two, or at the most three, applications to the enlarged and dilated vessel are sufficient; nor need the acid be applied to the whole surface, but only to one or two points; it is useful in granular or ulcerated piles. A superficial slough follows. It produces little or no pain. After the separation of the slough the contraction of the sore diminishes the swelling. A drachm or half a drachm of the dilute nitric acid to half a pint of water, is an excellent lotion for bleeding piles. It stays the hæmorrhage, constricts the swollen and inflamed tumour, and eases the heavy, tensive, wearying pain.

Acids are reputed to heighten the action of purgative medicines, and sulphuric acid is sometimes employed for this purpose. They are usually added to purgative salts, as Epsom salts, when a tonic and bracing action on the mucous membrane is desired, as in many cases of anæmia of young women.

If not already neutralized on their passage into the blood, these acids must at once become so, and it would appear that thenceforth their history must be that of the salts they form. Yet the received action of these acids on the organs of the body is so different from that of any of their salts, that the behaviour of the acids must be spoken of separately from that of their salts.

On combining with the alkalies of the blood, the acids must set free some weaker acids, and so to a slight extent lessen the alkalinity of that fluid, as is evidenced by the increased acid reaction of the urine following the use of these mineral acids. What further effects they may have on the blood is at present quite unknown. They are reputed to be tonic and bracing, but the improvement in the general health may be more safely attributed to their action in the intestinal canal. Still, they do produce certain changes in the fluids and solids of the body, since acids, especially vinegar, are beneficial as preventives of scurvy in the absence of lime-juice or fresh vegetables.

Dr. Rees recommends large doses of lime-juice to the extent of eight ounces daily, in acute rheumatism. Dr. Inman speaks highly of this treatment, and finds that tartaric and citric acids cannot be substituted for lime-juice, and that lemon-juice is inferior to it.

Nitric acid is recommended in secondary syphilis. Salivation, it is said, has been caused by its administration; if so, salivation may have been due to the direct action of the acid on the mucous membrane by increasing the alkaline secretion of the salivary glands.

Acids are sometimes observed to abate the rapidity of the pulse in fevers; a result not due probably to the direct ac-

tion of the acid on the heart or nervous centres, but ascribable with more likelihood to the diminished restlessness, arising from diminished thirst.

Sulphuric acid, especially in conjunction with sulphate of zinc, is considered to check the profuse sweating of phthisis and other exhausting diseases; and Dr. Graves ascribed a similar action to vinegar. The following was his favourite recipe: Distilled vinegar, ℥ij. Laurel-water, ℥ij. Syrup, ʒvj. Aqua, ℥v. An ounce or two ounces to be taken every third or fourth hour. Further, sulphuric acid appears to possess a decided power of checking bleeding from the lungs or womb. It is difficult, indeed, to understand how an ordinary dose of sulphuric acid can exercise such an influence after becoming so greatly diluted by admixture with the blood, and the difficulty is enhanced by the consideration that these acids, either before or immediately after their entrance into the blood, are converted into salts, as sulphates, nitrates, and phosphates. Whatever influence, therefore, is exerted on distant organs must be effected through these combinations; yet we cannot ascribe to any salts of these acids properties similar to those ascribed to the acids themselves.

In questions like these, experience is a safer guide than speculation. For the subtle influence of even small doses on distant organs of the body is well exemplified, by the influence of these medicines on the mother's milk; for after taking acids for some time, they induce sickness, diarrhoea, and colicky pains in the child.

Phosphoric acid has been recommended in diabetes. Griesinger, who has carefully studied the action of this medicine, considers that it does more harm than good. He pushed the acid to the extent of an ounce daily, and found that this dose increased the sugar. The members of this group augment the acidity of the urine, whence it has been proposed to dissolve phosphatic calculi by artificially acidifying the urine; but the objections to this method of treating calculi are insuperable, owing to the action of acids on the mucous membrane of the stomach and intestines precluding their persistent

administration; whilst, as the acidity of the urine can be but slightly heightened by their administration, they must be taken for a considerable time to effect any notable change in the size of a stone.

The injection of nitric acid, sufficiently diluted, has been employed with success by some eminent surgeons, and is a far more effectual treatment for phosphatic calculi. From his experiments on the solvent power of dilute solutions of this acid on calculi after their removal from the body, Dr. Roberts of Manchester considers this treatment worthy of much wider application than at present obtains: moreover, by neutralizing the urine, if alkaline, and preventing its decomposition, nitric acid injections protect the mucous membrane of the bladder from the irritation of the alkaline urine.

The further influence of sulphuric, nitric, and hydrochloric acids on the urine is unknown. Of the influence of acetic and phosphoric acids we shall speak in another place.

Before closing our remarks on the action of these acids on the body, it is right to add that phosphoric acid may possess many other properties than those specified above; but these will be referred to in speaking of the phosphates, in which form this acid exists in the blood, and manifests many of its good effects on the diseased body.

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#### SULPHUROUS ACID.

#### SULPHITES.

#### HYPOSULPHITES.

SULPHUROUS acid is commonly used as a deodorizer and disinfectant. It is a deodorizer by virtue of its power to arrest putrefaction; hence it may be used to prevent bad smells, but it possesses little or no power to decompose offensive gases; consequently it is of little service in destroying foul odours. It arrests fermentation by destroying the minute organisms which determine this process. It is ranked among disinfect-