

ric acid, while the zinc unites with the acetic acid, and remains in solution.

The acetate of zinc may be obtained by evaporation, in talcy crystals. It is soluble in water, and is decomposed by heat. It is not poisonous.

When crystallized acetate of lead and sulphate of zinc are triturated together, the mixture presently becomes moist, which is owing to the new compounds combining with less water of crystallization than the original salts, by which means a portion of the water is disengaged in its fluid form.

Medical use.—The solution of acetate of zinc is, with many practitioners, deservedly much esteemed as an astringent collyrium and injection. The solution in spirit of wine of the Dublin college, is stronger and more stimulant than that in water of the Edinburgh.

CHAP. XIV.

ALCOHOL, ETHER, AND ETHEREAL
SPIRITS.

ALCOHOL. *Lond.*
Alcohol.

Take of

Rectified spirit of wine, one gallon;

Subcarbonate of potass, three pounds.

Put one pound of the subcarbonate, previously heated to 300° Fahr. into the spirit, and macerate for twenty-four hours, frequently stirring them; then decant the spirit, and add the remainder of the subcarbonate of potass heated to the same degree; and, lastly, distil off, in a water-bath, the alcohol, which is to be kept in a well-corked bottle.

The specific gravity of alcohol is to that of distilled water as 815 to 1000.

Dub.

Take of

Rectified spirit of wine, one gallon;

Pearl ashes, dried at 300° Fahr. and still warm, one pound;

Caustic kali, in powder, one ounce;
Muriate of lime, dried, half a pound.

Mix the spirit and kali; add the pearl-ashes, previously reduced to powder, and digest the mixture for three days, in a close vessel, frequently agitating it; then pour off the spirit, mix with it the muriate of lime, and distil with a moderate heat, until the residuum begins to grow thick.

The specific gravity of this spirit is to that of distilled water as 815 to 1000.

The muriate of lime may be conveniently obtained from the residuum left in the preparation of water of caustic ammonia.

THE Edinburgh college give no directions for the preparation of a perfectly pure alcohol, as it is never used in pharmacy; but it is perhaps to be regretted, that they have given the title of alcohol to a liquid which is not the alcohol of chemists.

When any ardent spirit is re-distilled to procure alcohol, the water-bath is commonly used, which gives a more equal and temperate heat, and improves the product. Gren says, that the addition of four pounds of well-burnt charcoal and three or four ounces of sulphuric acid, previous to this rectification, destroys entirely the peculiar taste of malt spirit; and that a second rectification, with one pound of charcoal, and two ounces of sulphuric acid, affords an alcohol of very great purity. But the affinity of alcohol for water is so very strong, that it cannot be obtained entirely free from it by simple distillation. We must therefore abstract the water by means of some substance which has a stronger affinity for it than alcohol has. Carbonate of potass was formerly employed; but muriate of lime is preferable, because its affinity for water is not only very great, but by being soluble in alcohol, it comes in contact with every particle of the fluid. For this purpose, one part of muriate of lime, rendered perfectly dry by having been exposed to a red heat, and powdered after it becomes cold, is put into the still. Over this, three parts of highly rectified spirits are to be poured, and the mixture well agitated. By distillation with a very gentle heat, about two-thirds of the spirit will be obtained in the state of perfectly pure alcohol.

ÆTHER SULPHURICUS. *Ed.*

Sulphuric Æther.

Take of

Sulphuric acid,

Alcohol, each thirty-two ounces.

Pour the alcohol into a glass retort, capable of sustaining a sudden heat, and add to it the acid, in an uninterrupted stream. Mix them by degrees, shaking them gently and frequently, and instantly distil from sand, previously heated for the purpose, into a receiver kept cool with water or snow. The heat must also be so managed, that the liquor shall boil as soon as possible, and continue to boil till sixteen ounces are drawn off, when the retort is to be removed from the sand.

To the distilled liquor add two drachms of potass, and distil from a very high retort, with a very gentle heat, into a cool receiver, until ten ounces have been drawn off.

If sixteen ounces of alcohol be poured upon the acid remaining in the retort after the first distillation, and the distillation be repeated, more Ether will be obtained; and this may be repeated several times.

Dub.

Take of

Sulphuric ethereal liquor, twenty ounces, by measure;

Subcarbonate of kali, dried and powdered, two drachms.

Mix them and distil, with a very gentle heat, twelve ounces, by measure, from a very high retort into a cooled receiver.

Its specific gravity is 765, water being 1000.

Lond.

Take of

Rectified spirit,

Sulphuric acid, of each one pound and a half.

Put the spirit into a glass retort, and gradually add to it the acid, shaking them frequently, and taking care that the temperature, during the mixture, do not exceed 120° Fahr.

Then cautiously place the retort in a sand-bath, previously heated to 200°, so that the liquor may boil as quickly as possible, and the ether may be distilled over into a tubulated receiver, to which a vessel, cooled with snow or ice, is fitted. Continue the distillation until a heavier fluid begin to come over, which is seen in the bottom of the receiver, below the ether.

Pour twelve ounces more of rectified spirit upon the liquor remaining in the retort, and repeat the distillation of ether in the same manner.

ÆTHER RECTIFICATUS. *Lond.*
Rectified Ether.

Take of

Sulphuric ether, fourteen fluidounces;
 Fused potass, half an ounce;
 Distilled water, two fluidounces.

Dissolve the potass first in the water, and add the ether to it, shaking them constantly until they are mixed. Lastly, with a heat of about 120°, distil from a large retort into a cold receiver, twelve fluidounces of rectified ether.

ÆTHER SULPHURICUS CUM ALCOHOLE. *Ed.*
Sulphuric Ether with Alcohol.

Take of

Sulphuric ether, one part;
 Alcohol, two parts.

Mix them.

SPIRITUS ÆTHERIS SULPHURICI. *Lond.*
Spirit of Sulphuric Ether.

Take of

Sulphuric ether, half a pint;
 Rectified spirit, a pint.

Mix them.

LIQUOR ÆTHEREUS SULPHURICUS. *Dub.*
Sulphuric Ethereal Liquor.

Take of

Rectified spirit of wine,
 Sulphuric acid, each thirty-two ounces, by weight.

Put the spirit heated to 120°, into a glass retort, capable of supporting a sudden heat, and pour upon it the acid, in a continued stream. Mix them gradually, and distil into a cooled receiver twenty ounces of liquor, by measure, with a sufficient and quick heat.

If sixteen ounces of rectified spirit of wine be poured upon the acid residuum in the retort, it will again afford, by distillation, sulphuric ethereal liquor.

OLEUM ÆTHEREUM. *Lond.*
Ethereal Oil.

After the distillation of sulphuric ether, continue the distillation with a reduced heat, until a black froth swell up. Immediately remove the retort from the fire, and pour water upon the liquor which remains in the retort. Skim off the

oily matter which swims upon the top of the water, and mix it with as much lime-water as will saturate the acid in it. Shake them together; and, lastly, collect the ethereal oil after it has separated.

SPIRITUS ÆTHERIS SULPHURICI COMPOSITUS. *Lond.*
Compound Spirit of Sulphuric Ether.

Take of

Spirit of sulphuric ether, one pint;

Ethereal oil, two fluidrachms.

Mix them.

LIQUOR ÆTHEREUS OLEOSUS. *Dub.*
Oily Etheral Liquor.

Take what remains in the retort after the distillation of the vitriolic ether.

Distil to one half, with a moderate heat.

The products arising from the decomposition of alcohol by the action of the acids are extremely curious and interesting. The theory of their formation was not understood until it was very ingeniously attempted by Fourcroy and Vauquelin, who endeavour to shew that the acid remains unchanged, and that the alcohol is converted into ether, water, and charcoal.

The most convenient way of mixing the ingredients, is to put the alcohol previously heated, into a tubulated retort, and with a long-tubed funnel, reaching down to the bottom of the retort, to pour in the acid. By cautious agitation, the two fluids unite, and heat is produced, which may be taken advantage of in the distillation, if we have a sand-bath previously heated to the same degree, to set the retort into immediately after the mixture is completed; nor is there any occasion for a tubulated receiver, if we immerse the ordinary receiver, which ought to be large, in water, or bury it in broken ice.

The distillation is directed to be performed with an equal and very gentle, but quick heat; but Mr Phillips says erroneously, for when the distillation of 10 ounces of product was completed in three hours, its sp. gr. was 0.791; but when it occupied almost nine hours, its sp. gr. was only 0.782. The juncture of the retort and recipient is to be luted with a paste made of lintseed meal, and further secured by a piece of wet bladder.

Immediately on mixing the acid with the alcohol, there is a considerable increase of temperature, and a slight disengage-

ment of alcohol, somewhat altered, and having an aromatic odour. On placing the retort in the sand-bath, a portion of pure alcohol first comes over; and when the mixture in the retort boils, the ether rises, and is condensed in thin, broad, straight streaks, having the appearance of oil. Until the liquor which passes over into the receiver amounts to about half, or somewhat more than half, of the alcohol operated on, it consists almost entirely of alcohol and ether, and there has been no disengagement of any permanently elastic fluid: but now the production of ether ceases, and sulphureous vapours begin to arise, which condense in irregular streaks, or in drops: we must therefore either put a stop to the process, or change the receiver. In the latter case, the products are sulphureous acid, acetic acid, water, and oil of wine, as it was called, accompanied towards the end by a peculiar species of carburetted hydrogen gas, called by the Dutch chemists *Olefiant gas*; because, when mixed with oxygenized muriatic acid, it forms oil. At last the matter in the retort, which has now become thick and black, swells up, and prevents us from carrying the process further.

If we stop the process before the sulphureous vapours arise, the whole acid, diluted with a proportion of water, and mixed with charcoal, remains in the retort; but if we allow the process to go on, there is a continual decomposition of the acid, which is therefore diminished in quantity. Mr Phillips has ascertained the sp. gr. of the products at different periods of the distillation. From 16 oz. of acid sp. gr. 1.837, and an equal weight of spirit sp. gr. 0.830, he got 12 ounces of product; 4 of ethereal spirit of sp. gr. 0.779; 4 more of sp. gr. 0.753; then $2\frac{1}{2}$ of yellow sulphureous spirit of sp. gr. 784; and lastly, $1\frac{1}{2}$ of heavy fluid of 0.981.

According to Proust, the sulphuric acid may be obtained from the black residuum in the retort, by diluting it with twice its weight of water, filtering it through linen, and evaporating it till it acquire the specific gravity 1.84, then adding about one five-hundredth part of nitrate of potass, and continuing the evaporation until the acid become perfectly colourless, and acquire the specific gravity of 1.86. The residuum, however, may be more advantageously preserved, as the colleges direct, for preparing more ether, by repeating the process with fresh quantities of alcohol. Proust indeed denies that this residuum is capable of converting more alcohol into ether; but that excellent chemist has somehow fallen into an error; for it is a fact, that was known in the time of that no less excellent chemist Dr Lewis, and inserted in the

first edition of this Dispensatory, published in 1753, and not a recent discovery of Citizen Cadet, as Fourcroy would lead us to believe. If farther confirmation be wanted, we shall instance Götting, who says, that from three or four pounds of this residuum he has prepared 60 or 70 pounds of the spirit of vitriolic ether, and more than twelve pounds of vitriolic ether, without rectifying the residuum, or allowing the sulphureous vapour to evaporate.

Mr Phillips, from a pound each of acid and of spirit got seven ounces and a half of ether, specific gravity 0.768, and by a second distillation, after eight ounces more of spirit were added to the residuum, eight ounces, of 0.807. The mixture of these gave a specific gravity about 0.788, whereas the former of these products alone constituted the *spiritus ætheris vitriolici* of the late Pharmacopœia. By adding the spirit ordered to convert it into *spiritus ætheris vitriolici*, it acquires specific gravity 0.816, which is much weaker than the liquor of the same name in the former London Pharmacopœia.

The ether may be separated from the alcohol, water, and sulphureous acid, with which it is always mixed, by re-distilling it with a very gentle heat, after mixing it with potass, which combines with the acid, water, and alcohol. The alkali ought to be added in substance according to the directions of the Edinburgh college, not in solution as prescribed by that of London.

Medical use.—The chemical properties of ether have been already noticed. As a medicine taken internally, it is an excellent antispasmodic, cordial, and stimulant. In catarrhal and asthmatic complaints, its vapour is inhaled with advantage, by holding in the mouth a piece of sugar on which ether has been dropt. It is given as a cordial in nausea, and in febrile diseases of the typhoid type; as an antispasmodic in hysteria, and in other nervous and painful diseases; and as a stimulus in soporose and apoplectic affections. Regular practitioners most frequently give only a few drops for a dose; but empirics have sometimes ventured upon much larger quantities, and with incredible benefit. When applied externally, it is capable of producing two very opposite effects, according to its management; for, if it be prevented from evaporating, by covering the place to which it is applied, closely with the hand, it proves a powerful stimulant and rubefacient, and excites a sensation of burning heat. In this way it is frequently used for removing pains in the head or teeth. On the contrary, if it be dropt on any part of the body, exposed freely to the contact of the air, its rapid eva-

poration produces an intense degree of cold; and as this is attended with a proportional diminution of bulk in the part to which it is applied, in this way it has frequently facilitated the reduction of strangulated hernia.

The mixture of ether with alcohol, whether prepared directly by mixing them as the Edinburgh college direct, or in the impure state in which it comes over in the first part of the process for distilling ether, possesses similar virtues with ether, but in an inferior degree.

ÆTHER NITROSUS. *Dub.*
Nitrous Ether.

Take of

Nitrate of kali, dried, and in coarse powder, one pound and a half;

Sulphuric acid, one pound;

Rectified spirit of wine, nineteen ounces, by measure.

Put the nitrate of kali into a tubulated retort, placed in a bath of cold water, and pour upon it gradually, and in different portions, the sulphuric acid and spirit, previously mixed, and allowed to cool after having been mixed. Without any external heat, or only a very slight degree of it (such as the addition of tepid water to the bath), an ethereal liquor will begin to arise, without applying fire under it. In a short time, the heat will spontaneously increase in the retort, and a remarkable ebullition will take place, which are to be moderated, by cooling the bath with cold water. The receiver ought also to be cooled with water or snow, and furnished with a proper apparatus for transmitting the very elastic vapour (arising from the mixture, with very great force, if the heat should accidentally become too high) through a pound of rectified spirit of wine, placed in a cooled phial.

Put the ethereal liquor, which has distilled spontaneously, into a phial with a ground glass-stopper, and gradually add (closing the phial after each addition) as much very dry subcarbonate of kali in powder, as shall be sufficient to saturate the superabundant acid, according to the test of litmus. This commonly takes place on the addition of about a drachm of the salt; and in a short time, the nitrous ether will swim on the surface, and is to be separated by means of a funnel.

If it be required very pure, re-distil the ether from a water-bath, at about 140°, to one-half.

Its specific gravity is 900.

WHEN alcohol and nitrous acid are mixed in the proportion necessary for the formation of nitrous ether, the utmost precautions must be taken to diminish their action on each other. Dr Black contrived a very ingenious method of doing this, by rendering their mixture extremely slow. On two ounces of strong nitrous acid, put into a phial, having a conical ground glass-stopper, and a weak spring fitted to keep the stopper in its place, pour slowly and gradually about an equal quantity of water, which, by being made to trickle down the sides of the phial, will float on the surface of the acid, without mixing with it; then add, in the same cautious manner, three ounces of alcohol, which, in its turn, will float on the surface of the water. By this means the three fluids are kept separate, on account of their different specific gravities, and a stratum of water is interposed between the acid and spirit. The phial is now to be set in a cool place, and the acid will gradually ascend, and the spirit descend, through the water; this last acting as a boundary to restrain their action on each other. When this commences, bubbles of gas rise through the fluids, and the acid gets a blue colour, which it again loses in the course of a few days, and a yellow nitrous ether begins to swim on the surface. As soon as the formation of air-bubbles ceases, it is time remove the ether formed; for if allowed to remain, its quantity decreases. By this method, nitrous ether is formed, without the danger of producing any explosion. The residuum of this process is still capable of forming a spirit of nitrous ether, with an additional quantity of alcohol.

By adding the acid to the alcohol in very small quantities, and at considerable intervals, Mr Dehne procured from two pounds of alcohol, and one pound ten ounces and three drachms of nitrous acid, one pound nine ounces and three drachms of ether; the residuum weighed one pound twelve ounces. There was therefore a loss of five ounces. Mr Dehne put the alcohol into a tubulated retort, to which a receiver was luted, and poured the acid through the tubulature, and the ether passed over into the receiver, without the application of any heat. The action of the acid on the alcohol did not begin until six ounces and a half were added, and was found to be exhausted, when, on adding more acid, it fell to the bottom in the form of green drops. By using Mr Dehne's precaution, of adding the acid gradually, I prepared nitrous ether in a Woulfe's apparatus, with perfect ease and safety, although Fourcroy represents it as a most dangerous operation. I introduced the acid gradually through a funnel luted into the tubulature of the retort. The tube of the fun-

nel was very long, and its extremity was immersed in the alcohol in the retort. This simple contrivance not only enabled me to add to the acid as I pleased, but also acted as a tube of safety.

The method of forming nitrous ether, now directed by the Dublin college, is indeed said to be preferable to those mentioned. It was first practised by M. Voigt.

When alcohol is converted into ether by the action of nitrous acid, the change produced on it is nearly the same with that produced by sulphuric acid; but, in the latter case, it is effected by the affinities which form water, and charcoal is precipitated; and in the former, by the affinities which form carbonic acid, and no water is produced.

Nitrous ether seems to differ from sulphuric ether only in being combined with nitric oxide, at least it is highly inflammable, pungent, volatile, and is not soluble in water, while it gives a deep olive colour to green salts of iron, and has a considerable specific gravity. When simply washed with water, I found its sp. gr. to be 0.912; when the acid which it evidently contained was removed, by saturating it with potass, it became 0.896; and when rectified, by redistilling it, it became 0.866, but recovered decidedly acid properties, probably from the nitric oxide being acidified by the air of the apparatus.

SPIRITUS ÆTHERIS NITROSI. *Ed.*

Spirit of Nitrous Ether.

Take of

Alcohol, three pounds;

Nitrous acid, one pound.

Pour the alcohol into a capacious phial, placed in a vessel full of cold water, and add the acid by degrees, constantly agitating them. Let the phial be slightly covered, and placed for seven days in a cool place; then distil the liquor, with the heat of boiling water, into a receiver kept cool with water or snow, till no more spirit comes over.

SPRITUS ÆTHEREUS NITROSUS. *Dub.*

Nitrous Ethereal Spirit.

Add to the matter which remains after the distillation of the nitrous ether, the rectified spirit of wine, which was employed in that operation for condensing the elastic vapours, and distil, with the greatest heat of a water-bath, to dryness. Mix the distilled liquor with the alkaline liquor which remained after the separation of the nitrous ether,

and also add as much very dry subcarbonate of kali as shall be sufficient to saturate the predominant acid, according to the test of litmus. Lastly, distil by the medium heat of a water-bath as long as drops come over. The specific gravity of this liquor is 850.

SPIRITUS ÆTHERIS NITRICI. *Lond.*
Spirit of Nitrous Ether.

Take of

Rectified spirit of wine, two pints;

Nitric acid, three ounces, by weight.

Pour the acid gradually upon the spirit, and mix them, taking care that the heat do not exceed 120° , and distil with a gentle heat twenty-four fluidounces.

THE action of alcohol and nitrous acid upon each other is much influenced by their proportions. If we use a small proportion of alcohol, or pour alcohol into nitrous acid, there immediately takes place a great increase of temperature, and a violent effervescence and disengagement of red fumes. On the contrary, by placing the phials containing the alcohol and acid in cold, or rather iced water, they may be mixed, without danger, in the proportions directed by the colleges; and if the acid be added in small quantities at a time, and each portion thoroughly mixed with the alcohol by agitation, I find that no action takes place until heat be applied. It is therefore unnecessary to keep the mixture for seven days; but we may immediately proceed to the distillation, which must be performed with a very slow and well-regulated fire; for the vapour is very apt to expand with so much violence as to burst the vessels; and the heat must at no time exceed 212° , otherwise a portion of undecomposed acid will pass over, and spoil the product. By performing this operation carefully in a Woulfe's apparatus, I got in the receiver, from three ounces of alcohol, specific gravity 0.841, and one ounce of nitrous acid, two ounces four drachms of spirit of nitrous ether, specific gravity 0.887. Eight ounces of alcohol, contained in the first phial connected with the receiver, gained one drachm and a half, and acquired specific gravity 0.873, and eight ounces of water in the second, 18 grains: the residuum weighed seven drachms and a half. There was therefore a loss of 2 drachms 42 grains of permanently elastic fluids. The first portion of these that was examined seemed to be the air of the apparatus: In the next, the candle burnt with an enlarged and brightened flame: was it nitrous oxide? and all that passed afterwards was a

mixture of carbonic acid and the etherized nitrous gas first described by the Dutch chemists. When recently prepared, this gas is inflammable, and does not form red fumes on coming into contact with atmospheric air: but when attempted to be kept over water, the water becomes acidulous, the gas is diminished in bulk about two-thirds, loses its inflammability, and is now converted into red vapours on the admission of atmospheric air. It therefore appears to consist of nitric oxide gas, holding ether in chemical solution. I have formed a similar gas, by admitting a few drops of ether to nitrous oxide gas over mercury.

The Edinburgh college directs the distillation to be continued till no more spirit comes over. But how is this to be ascertained? After having drawn off about two-thirds, according to the directions of the London college, I again applied heat to the retort; and examining the air, which began to come over into the pneumatic apparatus, by carelessly approaching a lighted candle to the extremity of the tube, it kindled, and burst the whole with a violent explosion.

When only 24 fluidounces are drawn off, a perfectly colourless and very slightly acid product is obtained, of sp. gr. 0.834, but immediately afterwards the spirit becomes coloured and very acid. Hence the quantity, which was 26 ounces in Phar. 1809, has been reduced.

The spirit of nitrous ether, thus obtained, is a colourless fluid, of a fragrant odour, lighter than water, extremely volatile and inflammable, possessing properties in general analogous to the spirit of sulphuric ether, but of considerably greater specific gravity, striking a deep olive, with a solution of green sulphate of iron, and often, if not always acid. By age and exposure to the air, it is gradually decomposed, and gives rise to the reproduction of nitrous acid. When this change has taken place, it may be rectified, by saturating the acid with lime-water, and re-distilling the ethereal fluid.

In all probability, spirit of nitrous ether is a mixture of nitrous ether and alcohol; for, by diminishing the quantity of alcohol employed, we obtain a fluid having a similar relation to the spirit of nitrous ether that sulphuric ether has to the spirit of sulphuric ether. By adding alcohol to the residuum of nitrous ether, the Dublin college prepare their spirit of nitrous ether, in the same way as spirit of sulphuric ether is prepared from the residuum of sulphuric ether: and by mixing nitrous ether with alcohol, we obtain a fluid exactly resembling spirit of nitrous ether.

Medical use.—Spirit of nitrous ether has been long deser-

vedly held in great esteem. It quenches thirst, promotes the natural secretions, expels flatulencies, and moderately strengthens the stomach. It may be given in doses of from twenty drops to a drachm, in any convenient vehicle. Mixed with a small quantity of spiritus ammoniæ aromaticus, it proves a mild, yet efficacious diaphoretic, and often remarkably diuretic, especially in some febrile cases, where such a salutary evacuation is wanted. A small proportion of this spirit added to malt spirits, gives them a flavour approaching to that of French brandy.

CHAP. XV.—VEGETABILIA. *Lond.*

Vegetables.

Vegetables are to be gathered in their native soil and situation, and in a dry season, when they are neither wet with showers nor dew; they are to be collected every year, and what are older must be thrown away.

Roots, for the most part, are to be dug up before they shoot up their leaves or stalks.

Barks ought to be gathered when they can be separated most easily from the wood.

Leaves are to be plucked after the flowers have faded, and before the seeds are ripe.

Flowers are to be gathered when just opened.

Seeds are to be collected when ripe, and before they fall, and are to be kept in their proper coverings.

VEGETABILIIUM PRÆPARATIO. *Lond.*

Preparation of Vegetables.

Vegetables, soon after they are gathered, except those which are used fresh, are to be loosely spread out, and dried as quickly as possible, with a heat so low as not to alter the colour. They are then to be preserved from the action of light and moisture in proper situations or vessels.

Roots, which are directed to be preserved fresh, are to be buried in sand. The *SQUILL*, before drying it, is to have its arid coats peeled off, and to be cut transversely into thin slices.