*cin*, capsicum contains some fat, wax, resin, minute amounts of volatile oil and alkaloid, and a large amount of coloring matter.

*Capsaicin* ($C_9H_{14}O_2$) dissolves in alcohol and fixed oils, as well as in ether. It is so excessively acrid as to be a most dangerous substance to handle. It can be obtained in the form of colorless crystals. It should exist in capsicum in the proportion of about one-fiftieth of one per cent., and its estimation is the only sure means of ascertaining the quality of the ground drug.

"Capsicin" is merely a soft extract, consisting chiefly of resin and fixed oil, and of very indefinite strength.

ACTION AND USES.—Externally, capsicum is a powerful counter-irritant, capable of blistering if suitably applied. Internally, its recognized effects are due entirely to its direct and reflex stimulating action. This action is seen directly in increased movement and secretion throughout the alimentary tract, and in increased renal secretion, and reflexly in increased spinal and cerebral activity. Its aphrodisiac action is both local and spinal.

Advantage is taken of these properties for the production of ordinary carminative and laxative effects, but more especially for its use as a stomachic. Mild cases of dyspepsia and habitual indigestion can be greatly benefited by its moderate use, its eliminative tendency aiding the stomachic effect. In extreme cases of habitual indigestion, especially that of alcoholism, it is frequently the only available agent. Its mental effects in such cases are often quite as notable as its stomachic. Its use is of assistance in overcoming narcotic habits. It has been suggested that the alkaloid of the drug may be partly responsible for the cerebral effects. As a diuretic, it is not ordinarily to be recommended, as its irritating effects are apt to be too pronounced. Throughout the tropics it is confidently recommended both as a prophylactic and as a curative agent against malaria, and it is frequently so prescribed in temperate regions also. The statement is generally made that red and black pepper have equivalent actions, but the statement is not warranted. The irritant effect of black pepper upon the mucous membrane of the stomach is much greater in proportion to its stomachic effects proper than is the case with red pepper, while the irritation of the urethra is greater with the latter. The infusion is very serviceable as a gargle in asthenic cases of sore throat.

The dose of capsicum is .05 to .5 gm. (gr. i. to v. or possibly gr. x.). The five-per-cent. tincture is most commonly employed, in doses of .3 to .4 c.c. (♏ v. to lx.). The oleoresin is given in doses of ♏ ½ to i., and the fluid extract, ♏ i. to x. There is a plaster which contains about .25 gm. (gr. iv.) of the oleoresin of capsicum spread evenly upon a surface 10 cm. (4 in.) square.

The stronger preparations of capsicum are to be regarded as ordinary irritant poisons.

*Henry H. Rusby.*

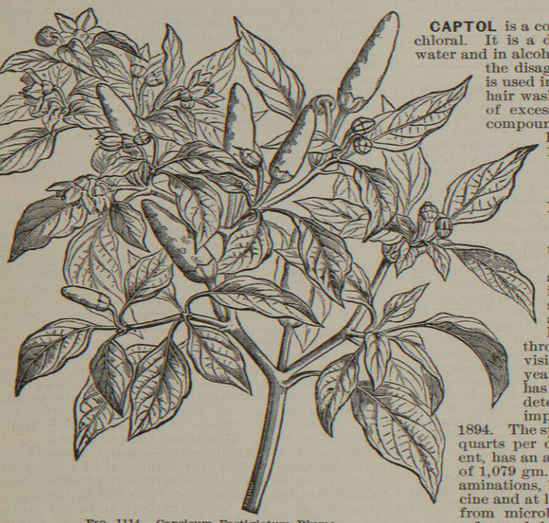

FIG. 1114.—Capsicum Fastigiatum Blume.

**CAPTOL** is a condensation product of tannic acid and chloral. It is a dark-brown powder, soluble in warm water and in alcohol, and claimed to be free from any of the disagreeable effects of its components. It is used in the form of the compound spirit as a hair wash and stimulant to the scalp in cases of excessive dandruff. The formula for the compound spirit of captol is: Captol, 2; chloral hydrate, 2; tartaric acid, 2; castor oil, 1; alcohol, 65 per cent., to make 1,000.

*W. A. Bastedo.*

**CARABAÑA MINERAL SPRING.**—Province of Madrid, Spain.

POST-OFFICE.—Carabaña.

ACCESS.—From Madrid by rail, a twenty-minute ride.

This celebrated spring has been in active use since 1885. The location is in a country broken by sandy hills of slight elevation. It is not widely used as a resort, although a thermal establishment for bathing is maintained throughout the year. The location is best visited during the cooler months of the year. The water of the Carabaña Spring has become widely known for its valuable detergent effects. It has been extensively imported into the United States since 1894. The spring yields about twenty-five hundred quarts per day. The water is perfectly transparent, has an alkaline reaction, and a specific weight of 1,079 gm. per litre. Careful bacteriological examinations, both at the Madrid Academy of Medicine and at laboratories in Paris, show it to be free from microbic contamination. As an additional safeguard, however, the water is filtered by the Pasteur method before it is put up in bottles. According to an analysis made under the direction of the Paris Academy of Medicine, the Carabaña water is composed as follows:

ONE UNITED STATES GALLON CONTAINS:*

| Solids. | Grains. |
|---|---|
| Sodium sulphate | 7,012.89 |
| Magnesium sulphate | 214.10 |
| Sodium chloride | 112.08 |
| Magnesium chloride | 33.41 |
| Calcium chloride | 13.76 |
| Sodium phosphate | 1.47 |
| Alumina | .03 |
| Total | 7,387.74 |

* Converted from grams per litre.

These findings represent the anhydrous state of the components. With the water of crystallization the weight of the solid elements would be rather more than twice that here expressed. The analysis shows a very powerful mineral water. It may be properly classed as a sodic and magnesic sulphated saline. The large proportion of sulphate of sodium combined with the sulphate of magnesium gives the water potent properties as a saline cathartic. Given in doses of a claret-glassful before breakfast it secures a prompt evacuation of the bowels. As a laxative it may be given in somewhat smaller dosage, and repeated if necessary. The water has found its best application in the various intestinal, hepatic, and gastric disturbances in which constipation is a cause or a symptom.

*James K. Crook.*





**CARAMECUARO.**—Huaniqueo, Michoacan, Mexico. A bathing establishment has been constructed at this spring. The water is hot, and it is recommended for the treatment of paludal fevers. No analysis of the water has as yet been made.

*N. J. Ponce de Léon.*

**CARAMEL.**—A black, semi-liquid substance, brown when diluted, into which sugar is converted by depriving it of two molecules of water, through the application of a temperature of 400° to 420° F. It is not medicinally active, and is used as a coloring agent, chiefly for liquids, and especially for brandy and whiskey, also for leather.

*Henry H. Rusby.*

**CARAWAY.**—*Carum.* The fruit of *Carum Carvi* L. (fam. *Umbelliferæ*). The spelling of the specific name "Carvi" is a relic of the use of but one character for both our *u* and *v*. The sound is, therefore, that of *u*, from which comes the pronunciation *caraway*. This is a biennial herb, with a long, brown, tapering, edible root, a slender, erect, branching, hollow stem, bi- or tri-pinnate leaves, with narrow linear segments, and small, compound umbels of white flowers. It is a native of Northern and Central Europe and Asia, and is cultivated and naturalized in nearly all temperate countries. The dried fruits, usually separated into their respective mericarps, are from 3 to 5 mm. long (⅛ in.), slender, slightly curved, tapering at each end, and marked with five fine yellow ribs, alternating with dark brown intervening spaces. There is one large oil tube between every two adjoining external ribs, and two between every two adjoining ventral ones, six in all. The characteristic odor and taste are familiar to nearly every one. The active constituent is carvol, which constitutes a large part of its four to seven per cent. of volatile oil, and which can advantageously be substituted for the latter. There is also some fixed oil, resin, gum, sugar, and tannin. The stimulant and carminative properties are those of the family. The odor and taste are characteristic, and make of it and its oil a favorite flavoring. It is mostly used as an ingredient of bread and cakes. The medicinal dose is .5 to 2 gm. (gr. viij. to xxx.). It enters into the Compound Tincture of Cardamomum, the only official preparation.

FIG. 1115.—Caraway Fruit. Enlarged about four times. (Baillon.)

The so-called "Black Caraway," also largely used by German bakers, is not at all related, being the seed of *Nigella*.

*Oil of Caraway* (*Oleum Carvi*).—A volatile oil existing in caraway to the extent of from four to seven per cent. It has the characteristic odor, taste, and properties of caraway. Its specific gravity is .910 to .920 at 15° C. It is soluble in an equal volume of alcohol. It consists of carvol and dextrogyrate limonene (*carvene*). The dose is ♏ i. to x., but it is preferable to use carvol. It enters into the Spiritus Juniperi Compositus, its only official preparation.

*Carvol* ($C_{10}H_{14}O$).—A ketone which constitutes the essential constituent of oil of caraway, and which also occurs in oil of dill and oil of spearmint. It is a colorless, or pale yellow, transparent liquid, having a specific gravity of .960 and boiling at 224° C. One cubic centimetre diluted with the same amount of alcohol should at most assume only a slightly reddish or violet tint on the addition of a drop of a very dilute solution of ferric chloride. It has the odor, taste, and properties of oil of caraway, and is, in addition, quite uniform. It is official in the German Pharmacopœia. The dose, if the preparation is pure, is 1–5 minims.

*Henry H. Rusby.*

**CARBOLIC ACID.**—*Phenic Acid. Phenylic Alcohol. Phenol:* $C_6H_5OH$. This important substance, though commonly called an acid, is, properly, not an acid at all, but a member of the group of *phenols*, bodies regarded as derivates of hydrocarbons of the benzene series by the replacement of one or more atoms of hydrogen of the principal chain by hydroxyl (OH). In carbolic acid a single hydrogen atom of benzene itself is so replaced, so that this derivate is the simplest possible phenol in point of chemical constitution. Being also the best-known member of the group it is chemically entitled *phenol*, simply. Carbolic acid is an ingredient of coal tar, and is obtained therefrom. The tar abounds in phenols, and by fractional distillation and certain special manipulations carbolic acid is separable from the other constituents in varying degrees of purity. In the markets may be found pure carbolic acid, crystalline at ordinary temperatures, and impure acids of different grades, of which the best are crystalline, but the others fluid. These impure acids consist of carbolic acid (phenol) and the closely related phenol "cresylic acid" (cresol), and other phenols in admixture. The lower grades, indeed, may contain but little carbolic acid, but yet are efficient, since the other phenols of coal tar possess properties similar to those of carbolic acid. These impure carbolic acids are often sold under the name of *coal-tar creosote*, and are graded "No. 1" and "No. 2," according to purity. The United States Pharmacopœia recognizes as official pure carbolic acid, and an impure article corresponding to the "No. 1" of the fluid impure acids of commerce.

*Acidum Carbolicum*, Carbolic Acid (U. S. P.). By this title is designated the pure article, described as follows: "Colorless, interlaced or separate, needle-shaped crystals, or a white, crystalline mass, sometimes acquiring a reddish tint; having a characteristic, somewhat aromatic odor, and, when copiously diluted with water, a sweetish taste with a slightly burning after-taste. Deliquescent on exposure to damp air. Soluble at 15° C. (59° F.), in about fifteen parts of water, the solubility varying according to the degree of hydration of the acid. Very soluble in alcohol, ether, chloroform, benzol, carbon disulphide, glycerine, fixed and volatile oils. Almost insoluble in benzin. When gently heated, carbolic acid melts, forming a highly refractive liquid. It is also liquefied by the addition of about eight per cent. of water. If the acid be liquefied by a gentle heat, and then slowly cooled, under constant stirring, until it is partly recrystallized, the semi-liquid mass should have a temperature (remaining stationary for a short time) not lower than 35° C. (95° F.). The acid should have a boiling point not higher than 188° C. (370.4° F.). A lower boiling point, or a higher melting point, indicates a purer or less hydrated acid. When heated upon a water bath, the acid should be volatilized without leaving a residue. The vapor of the acid is inflammable. Carbolic acid is faintly acid to litmus paper" (U. S. P.).

As regards the color of carbolic acid, the tendency to acquire a pink tinge is the stronger the purer and more anhydrous the sample (Squibb). Good specimens, therefore, unless recently made, are more likely than not to be of pinkish hue. As regards the odor, it is much less rank and disagreeable than that of other associated phenols, a fact that, apart from other considerations, constitutes a good reason for selecting a chemically pure carbolic acid for surgical use. An absence of creosote-like odor is a good practical test of the purity of a given sample of carbolic acid. The reaction between carbolic acid and water is peculiar. On adding water to carbolic acid in small measure, the crystals first liquefy by the solution of the water, forming a transparent fluid. The proportion of water thus soluble in carbolic acid seems to be variable. The pharmacopœial description states that the acid "is liquefied by the addition of about eight

per cent. of water," but Squibb has reported samples of pure acid dissolving as much as thirty-five per cent. of water. These saturated carbolic-acid solutions of water are fluid, and are themselves soluble in additional water only to a limited extent—between five and six per cent., according to the degree of hydration of the sample. As regards the melting and boiling points, these are affected by the amount of water that a sample may contain, and perfectly anhydrous commercial samples are rare, from two to four per cent. of water almost always being present. The congealing point is readily further reduced by a small addition of water, such as may easily occur through spontaneous deliquescence in a stock bottle frequently opened. A sample permanently fluid at ordinary temperatures is therefore not to be regarded as in any way inferior. So small an addition as that of three per cent. of water to a good commercial sample may be enough to determine permanent fluidity. Carbolic acid should be kept in well-stoppered bottles, protected from the light.

Besides carbolic acid from coal tar, which alone is official in the United States Pharmacopœia, there is commercial an article of German manufacture, prepared synthetically either from benzene or from a pure aniline oil. This synthetic carbolic acid is claimed to be exceptionally pure, but it is more expensive than the ordinary coal-tar acid.

*Acidum Carbolicum Crudum*, Crude Carbolic Acid (U. S. P.). This article is a distillate of *dead oil*, itself a distillate of coal tar taken between certain temperatures (165° to 190° C.). It corresponds to what was official in a former revision of the Pharmacopœia under the title *impure carbolic acid*, and to what is sold commercially as *impure carbolic acid No. 1*, and must not be confounded with what is *commercially* known as *crude carbolic acid*. According to Squibb, the products of distillation of "dead oil" are as follows: A first immediate distillate, which is the crude carbolic acid of commerce; this subjected to redistillation, yields, as secondary products, a first redistillate, highly charged with carbolic acid and the source of the purified article, and subsequently a second redistillate, coming over between the temperatures of 185° and 195°C., which redistillate, mixed with the "uncrystallizable drainings and residues" left over from the first after separation of the pure carbolic acid, constitutes the article under present consideration. It thus appears, as Squibb justly points out, that this officially so-called *crude* acid is not such in the proper sense of the word, but is properly an *impure* acid. The article is thus officially defined and described: "A liquid consisting of various constituents of coal tar, chiefly cresol and phenol, obtained by practical distillation. A nearly colorless, or reddish, or brownish-red liquid, of a strongly empyreumatic and creosote-like odor; having a benumbing, blanching, and caustic effect upon the skin or mucous membrane; and gradually turning darker on exposure to air and light. The aqueous solution of crude carbolic acid has a slightly acid reaction on litmus paper. In an aqueous solution of the acid, bromine water produces a white precipitate. Crude carbolic acid should not be soluble in less than fifteen parts of water at 15° C. (59° F.), and the aqueous solution should not have an alkaline reaction" (U. S. P.). The tests just mentioned are important for the reason that the addition of an alkali to crude carbolic acid increases the latter's solubility in water, and hence a frequent adulteration is effected by watering the acid with the solvent assistance of an alkali. Crude carbolic acid is cheaper than the pure crystalline acid, equally, if not even more, efficient as a germicide and antiseptic, but is rank and offensive in odor—the odor in this case really resembling that of creosote,—and is more irritant to animal tissues.

Besides the foregoing, other grades of so-called impure carbolic acid or coal-tar creosote are to be found in the markets, which are later redistillates from the commercial crude carbolic acid, obtained as the immediate product of distillation of dead oil, as already described. These second grades of so-called impure carbolic acid consist mainly of cresylic acid (cresol), xylol, and other phenols of a higher boiling point than carbolic acid, and contain none, indeed, of the latter substance, all the carbolic acid of the original crude substance having come over in the earlier distillations. These latter distillates, however, have germicidal and antiseptic powers similar to those of carbolic acid, and, being cheap, may be used effectively for the purposes of carbolic acid elsewhere than directly upon living tissues. "Impure carbolic acid No. 2" of commerce is a fluid, soluble in water to the extent of from forty to sixty per cent. (Squibb).

The *effects* of carbolic acid and of the other phenols associated with it in coal-tar distillates are substantially identical, so that a single description will suffice. The effects of these substances which the physician needs to note may be divided into three categories for practical study, as follows: (1) effects upon the vital endowments of bacteria and allied organisms; (2) local effects upon the tissues of the human body; and (3) constitutional effects upon the human system.

1. *Effects upon the Vital Endowments of Bacteria and Allied Organisms.*—By immersion in carbolic-acid solutions microbes may suffer temporary arrest or permanent loss of vital activity, the degree of the effect depending partly on the strength of the solution and partly on the vital tenacity of the particular organism, or even of the special stage of being of the organism under observation. To determine the exact toxic power of carbolic acid in this direction, an enormous number of experiments have been made, attacking the problem in a variety of ways. Of the more reliable of these experiments the results substantially agree, and these at the present writing justify the following broad statements: 1. Rod forms of bacteria and allied organisms soaking in aqueous solution of carbolic acid tend to suffer arrest of vital activity when the strength of the solution reaches a point between one-fifth and one-half of one per cent., and to suffer death when the strength rises to one per cent. 2. Spore forms, such as the spores of the anthrax bacillus, are much more tenacious of life, requiring for their certain killing a solution of from four to five per-cent. strength, and a soakage of from two to three days' duration (Koch). 3. Aqueous solutions of carbolic acid are far more toxic to microbes than solutions in oil or alcohol (Koch). 4. Exposure to *vapor* of carbolic acid under the conditions obtaining in practical disinfection is practically without effect upon microbes or disease germs, whether these be in rod form or spore form, and whether moist or dry.

2. *Local Effects upon the Tissues of the Human Body.*—Prudden * has observed under the microscope the effect upon living leucocytes and ciliated cells of soakage in carbolic-acid solutions, with the following results: Under soakage in solutions ranging between one-thirty-second and one-fourth per-cent. strengths, amœboid and ciliary movements slow or stop, but resume activity upon withdrawal of the carbolized fluid, and its replacement by a normal one. Under soakage in solutions of from one to five per-cent. strength, however, the bodies under observation speedily lose their power of movement, without possibility of resumption, and their protoplasm soon suffers disintegration. Applied to the human skin, comparatively weak solutions, such as the one and two per-cent. solutions used in surgery, objectively cause a whitening and shrivelling of the cuticle, and subjectively a conjoint numbness and prickling sensation, followed, if the application be prolonged beyond a few minutes, by smarting. These painful sensations Squibb declares to be aggravated by elevating, and alleviated by depressing, the affected part—phenomena contrary to those which usually obtain under circumstances of painful irritation. After withdrawal of the application the skin gradually resumes its normal appearance and tactile sensibility, recovery from the numbness, however, being slower than the return to natural appearance. Touched with the undiluted acid, the skin immediately whitens, while the circumjacent parts redden by irritation. Sharp pain, passing

* American Journal of the Medical Sciences, January, 1881.





over into numbness, is experienced, the pain gradually subsiding after an hour's lapse, and the surface presenting the dry, scaly exudation so often seen on surgeons' hands in the days when operating under a carbolized spray was in vogue. The results of a continuous application of the pure acid are exemplified in a case reported, in which, through a misunderstanding, a finger was wrapped in cloths soaked in undiluted carbolic acid, and kept so dressed throughout a night. The next morning the dressings were removed, and on the third day, when first seen by the reporter, the tissues of the finger were found black as jet, hard as wood, wrinkled and shrivelled, cold, and absolutely anæsthetic, and with a pronounced line of demarcation between the unaffected and the mummified portion. Strange to say, however, under careful treatment the parts recovered.

3. *Constitutional Effects upon the Human System.*—Carbolic acid is very poisonous to all living things. In man, in mild poisoning, such as may follow slight absorption from carbolized dressings in surgical cases, the symptoms are restlessness and rise of temperature—symptoms easily mistaken for those of the very septic infection sought to be averted by the use of the acid; or in other cases occur headache, loss of appetite, languor, and cough, followed, if the poisoning continue, by persistent bronchial irritation, itching of the skin, dragging lumbar pains and a sense of heaviness, and want of power in the legs. In severer poisoning, such as may occur again from absorption from surgical dressings, or as will certainly result if any considerable quantity of carbolic acid be swallowed, the toxic action falls heavily upon the central nervous system. The sufferer passes rapidly into a condition of coma, with loss of reflex irritability, and occasionally, but exceptionally, with convulsions. Convulsions, however, are common in cases of poisoning of the lower animals. The breathing is stertorous, the heart's action disordered—pulse at first unduly slow, afterward rapid, and, perhaps, intermittent, and the arterial pressure diminished. The skin is covered with sweat, the lips and hands are livid, and the whole aspect is that of great prostration. When the poisoning has occurred from swallowing the acid in concentrated condition, there are added to the above symptoms burning pain, extending from mouth to stomach, experienced at the moment of swallowing, and nausea and vomiting—symptoms due to the local action of the poison upon the mucous membrane of the alimentary canal. Carbolic-acid poisoning may result in death, which may begin either at the heart or at the lungs. In such cases the lesions, apart from the local effects when the strong acid has been swallowed, are not characteristic. There is a tendency to congestion of the great viscera; the blood may seem unduly dark and fluid, and there may be some fatty degeneration of the liver and kidneys, especially the latter, but yet none of these changes are invariable.

Analysis of carbolic-acid poisoning in man and animals points to the following specific derangements as wrought by the agent: As regards the nervous system, *coma* and *convulsions*—the latter phenomenon of spinal origin—and *modification of reflex activity*, such activity being at first increased, but, later, lessened and finally abolished. As regards the *circulation*, the heart's action may at first be intensified, but, in the later stages of the poisoning, is always enfeebled. Death is frequently by cardiac failure, and the heart is commonly found, post mortem, in diastole, with flabby walls. Similarly the arterial pressure, which may be increased in the earlier stages of the poisoning, particularly if convulsions be present, notably sinks as the case progresses, apparently through paralysis of the vaso-motor centre. Upon *respiration* the action more commonly than not is opposite at the two extremes of the poisoning, the breathing at first being unnaturally rapid and shallow, whereas, later, it becomes slow, deep, and markedly stertorous. Duly devised experiments seem to show that these effects are due to a primary excitation of both the pneumogastric peripheries and centres followed by a secondary paralysis. *Body temperature*, in poisoning in the normal human subject, is variably affected, in some instances rising, in others falling, and in still others remaining unchanged. When, however, carbolic acid is administered to a fevered subject, a considerable fall of temperature may occur, accompanied by sweating. In such case the loss of heat is probably independent of any effect in that direction wrought by the sweating, since a temperature reduction has been observed in cases in which all action of the sweat glands was held in abeyance by duboisine (Raymond).

The fate of absorbed carbolic acid is obscure. Some of it is undoubtedly excreted, since it has been found by a number of observers in the urine, by Hoppe-Seyler in the saliva, and is believed by Lemaire to be present in the breath. Other portions are probably chemically transformed within the system. A result of excretion by the kidneys is to produce peculiar coloration of the urine, a fact furnishing a valuable clew to diagnosis in obscure cases of poisoning. The tint of the urine varies in different cases, in some being brownish, in others greenish-black, and in others olive green, turning a smoky black upon standing. Such urines may or may not have an adventitious odor, aromatic, or even distinctly that of carbolic acid. Exceptionally, furthermore, albumin, blood, or excess of urates may be present. These altered urines probably contain both carbolic acid under its own form and some product or products of its chemical transformation; but what these latter substances may be has not yet satisfactorily been determined.

The *therapeutic applications* of carbolic acid are utilizations of its *antiseptic*, *disinfectant*, *anæsthetic*, and *antipyretic* powers. As regards the *antiseptic* use, it is to be noted that carbolic acid is decidedly inferior in antiseptic power to quite a number of available substances, and that for surgical employment it has the positively objectionable features of strong odor, disagreeable action upon the skin, and capability of absorption to the point of producing dangerous and even fatal constitutional poisoning. For surgical purposes aqueous solutions are commonly employed, of strengths ranging from one to five per cent., the weaker for dressings to remain in contact with tissue, the stronger for occasional use or to disinfect hands, instruments, ligatures, etc. As a *disinfectant*, carbolic acid operates, of course, exclusively by its germicidal action, thus holding in abeyance or destroying, according to strength of application, the septic or infective activity that inheres in certain living protoplasms. For certainty of disinfection, as has been seen already, actual soakage of the culprit germ in a carbolic solution of at least two-per-cent. strength is essential. Dainty sprinklings of carbolic lotions are therefore futile, and the hanging about a chamber of carbolized cloths with a view to aërial disinfection by the fumes therefrom is but a noisome advertisement of ignorance or stupidity. Legitimately and thoroughly used, a two-per-cent. solution of carbolic acid is an efficient disinfectant, with the advantage of cheapness—the impure grades of the acid being for this purpose even more powerful than the pure—but with the ever-present disadvantage of a rank and even offensive odor. A solution of two-per-cent. strength does not injure textile fabrics. Carbolic acid has been given internally in the hope that the power which proves germicidal without the body will oppose within the system the career of so-called zymotic diseases. But theoretically, for this purpose, if we are to argue from the point of view of germicide action, the blood of the subject should be charged with at least one per cent. of carbolic acid, a condition involving a dosage overwhelmingly poisonous; and practically, the use of the remedy in the category of diseases referred to has been, so far, barren of important results. The *anæsthetic* action of carbolic acid is most strikingly utilizable for the relief of the pain of burns, for which purpose nothing is better than one-half or one per-cent. aqueous solution of carbolic acid applied on thin cloths—the cheap "crude" acid being here more effective than the pure (Squibb). Similar lotions may palliate also the itching and burning of skin disease or the irritation from catarrhs of mucous membranes. Thus in bronchitis the inhala-

tion of the fumes of a bowl of boiling water charged with a few drops of carbolic acid may allay pain and cough considerably. So, again, irritability of the stomach may be quieted by this agent, and carbolic acid in small doses ranks among the standard means for arrest of vomiting. As an *antipyretic* carbolic acid is undoubtedly powerful, but its poisonousness will probably always defeat it in competition with such potent and at the same time innocent antipyretics as sodium salicylate, the cinchona alkaloids, antipyrin, etc.

For *internal administration* the dose of carbolic acid should not exceed from one to four or five drops, and the daily allowance should not surpass 1 gm. (gr. xv. or ℥ xv.). A convenient way of giving is first to dissolve in glycerine, in which menstruum carbolic acid dissolves in all proportions, and then dilute the necessary quantity of glycerine solution with water. Each dose of acid should be diluted to at least the volume of a tablespoonful for the taking. Under the title, *Glyceritum Acidi Carbolici*, Glycerite of Carbolic Acid, the United States Pharmacopœia makes official a twenty-per-cent. (by weight) solution of the acid in glycerine.

For *external uses* aqueous solutions are most generally serviceable, as already so frequently seen. There is official in the United States Pharmacopœia a preparation entitled *Unguentum Acidi Carbolici*, Ointment of Carbolic Acid, which consists of official "ointment" charged with five per cent. of carbolic acid.

*Edward Curtis.*

**CARBOLIC ACID, POISONING BY.**—Carbolic acid or phenol is one of the most common materials used for suicidal purposes at the present time. This is especially to be wondered at because of its corrosive action and the consequent pain it causes. It is, however, easily obtainable without the need of a prescription, and it does its work with certainty and generally with despatch.

Carbolic acid is a name that was given to the substance obtained from coal tar on account of its corrosive action and because it readily combined with certain basic substances to produce so-called carbolates. In its chemical relations, however, it has been shown to be closely allied to a class of compounds of the fatty-acid series known as tertiary alcohols, or, in the case of the aromatic or cyclic compounds, as phenols. It seems to unite chemically with a few bases, making compounds known as carbolates in which it acts like an acid. It also unites with acids, especially sulphuric acid, and forms salts in which it acts like an organic base.

Phenol is met with in commerce in a number of forms. First, as crude carbolic acid used as a disinfectant and germicide. This preparation is reddish or dark brown, and contains not only phenol but one or more higher homologues known as cresols. It has an odor like smoke and a strongly caustic and biting action on the skin. Secondly, as the carbolic acid or phenol of the United States Pharmacopœia, consisting of a mass of interlaced crystals, white or slightly reddish in color. These crystals are deliquescent on exposure to moist air. This phenol melts readily to a clear, oily liquid, and as it cools again becomes once more a crystalline mass. The addition of eight per cent. of water to the melted liquid prevents its solidifying on cooling. It dissolves in about fifteen parts of water, and also dissolves readily in alcohol, ether, chloroform, benzole, carbon bisulphide, glycerin, and fixed and volatile oils. Thirdly, a solution of the crystals more or less strong kept in every pharmacy as a stock material for prescription use. Fourthly, a mixture of phenol with lard and yellow wax known as *Unguentum Acidi Carbolici* (U. S. P.).

All these forms of phenol are intensely corrosive and deadly in their action. On the skin the strong phenol causes a numbness and sense of irritation or burning. The surface of the skin becomes white, the cuticle after a time falling off and leaving a dark stain. At times the sensibility of the skin is nearly destroyed by contact with the acid, a sense of numbness only being noticed.

A number of fatal cases of poisoning have occurred in which phenol has either been applied to the surface of the unbroken skin or to a mucous membrane, or has been used as an antiseptic material in treating wounds. In these cases of direct absorption the action of the phenol has been very rapid, producing sudden insensibility.

When swallowed there is at once a hot, burning sensation in the mouth, throat, and stomach. The lining membrane of the mouth is whitened by the contact of the phenol, while the lips are usually more or less brown where the liquid has come in contact with them.

The skin is dry and livid, the pulse is feeble, the pupils very much contracted, the breathing noisy, and the breath smells more or less strongly of the poison. Cases are on record, however, in which the odor has been entirely absent from the breath. At times vomiting occurs. There are usually delirium and giddiness, passing soon into a condition of insensibility. The urine, if any, is dark colored and cloudy.

Death usually occurs within a few hours, and in some instances has occurred within a few minutes.

The amount necessary to cause death is unknown. As with many other poisons, recovery has taken place after a large quantity has been swallowed and death has followed the ingestion of a few drops only.

The *Treatment* consists in the use of the stomach pump, the administration of saccharate of lime and of soluble sulphates, and, recently, very excellent results have been obtained by the use of strong alcohol after the stomach pump has taken out the most of the poison. Alcohol has proved useful also to check the action of the poison when applied to the skin. Stimulants are to be used to combat symptoms of collapse.

In fatal cases the lips where the phenol has come in contact with them are stained brown, the mucous membrane of the mouth is dirty white or brown; the stomach is contracted, and its mucous membrane in folds and white in some places, and in some spots greatly inflamed. The odor of phenol is generally noticeable on opening the stomach. The brain, lungs, liver, and kidneys usually show marks of congestion. The left ventricle of the heart is usually contracted, while the right is flaccid. The blood throughout the body is dark-colored and fluid. When phenol is absorbed by the skin there are no characteristic internal post-mortem changes.

The odor of phenol gives the best indication of its presence, but chemical tests in addition should be made to make the identification certain. To this end the material for examination is made acid with sulphuric acid and distilled. The distillate may or may not give the odor of phenol.

In a portion of the distillate place a splinter of pine wood, and on removal from the distillate moisten the splinter with hydrochloric acid. If phenol is present the splinter will turn blue or green. This test should be corroborated by a known solution of phenol.

To a small portion of the distillate add about one-fourth its volume of ammonium hydrate and then a small quantity of a solution of calcium hypochlorite. A blue color appears at once or on standing for a time in the presence of phenol.

To a portion of the distillate add bromine. If phenol be present a white precipitate of bromo-phenol is formed. This may be further tested, after it has been thoroughly washed, by treating it with sodium amalgam (prepared by dissolving sodium in mercury), and then making the solution acid. If phenol be present the characteristic odor of phenol will be developed. *Herbert M. Hill.*

**CARBON DISULPHIDE.**—$CS_2$. This body, commonly called by the older chemical title *bisulphide of carbon*, is official in the United States Pharmacopœia as *Carbonei Disulphidum*, Carbon Disulphide. It is thus described: "A clear, colorless, highly refractive liquid, very diffusive, having a strong, characteristic, but not fetid, odor, and a sharp, aromatic taste. Soluble in 535 parts of water at 15° C. (59° F.); very soluble in alcohol, ether, chloroform, fixed and volatile oils. Specific gravity, 1.268 to 1.269, at 15° C. (59° F.). Carbon disulphide vaporizes rapidly at the ordinary temperature, is highly inflammable, boils at 46°–47° C. (114.8°–116.6° F.), and, when ignited, burns with a blue flame, producing carbon and sulphur dioxide. It should not affect the color of blue litmus paper moistened with water" (U. S. P.). Carbon disulphide should be kept in tightly closed vessels and away from lights or fire. The "strong characteristic, but not fetid, odor" of the above description, though "not fetid" in a perfectly pure sample, is, in the article as commonly met with in the shops, of a rotten-egg quality, so disagreeable and so strong as to constitute a practical bar to a common medicinal use of the compound. The high volatility and extreme inflammability are also points of inconvenience, and the latter quality one of danger also.





Carbon disulphide is a powerful agent, of the general type of the volatile alcohols and ethers. It is locally irritant while yet specifically anæsthetic, and, absorbed into the blood, profoundly deranges the nervous functions in the same general manner as chloroform does. Habitually absorbed, as may occur by breathing the fumes in india-rubber factories, where the agent is largely used, carbon disulphide produces a peculiar form of chronic poisoning, elaborately described by Delpech as observed in Paris workshops. The poisoning commonly begins by severe headache, sometimes accompanied by an exhilarant intoxication. Later follow depression, mental apathy and dulness, loss of memory, impairment of sight, hearing, and sexual desire, and a very pronounced loss of muscular power. Cramps and various dysæsthesiæ are also common. The poisoning is seldom fatal, but, on the other hand, after full development, entire recovery of health and strength is unusual. Treatment is upon general principles, the only special agent recommended being phosphorus, by the use of which in small doses Delpech thinks he has abated the failure of muscular and virile power.

Medicinally the only properly allowable use of carbon disulphide is as a local application for the relief of surface pains. In this employment the action is like that of chloroform—conjointly anæsthetic and sharply irritant. An application of carbon disulphide causes for a few minutes severe pain, and may or may not be followed by subsidence of a neuralgia. The remedy may be used in vapor by saturating with carbon disulphide a sponge at the bottom of a wide-mouthed flask, and then pressing the mouth of the flask to the skin. Carbon disulphide has been given internally in doses of a few drops, but in the absence of any unique therapeutic powers such administration is certainly not to be recommended.

*Edward Curtis.*

**CARBON, HYDRIDES AND OXIDES OF.**—There are two well-known oxides of carbon, viz., carbon monoxide and carbon dioxide, or carbonic anhydride. They are both invisible gases at ordinary temperatures and pressures; and are of interest to the physician from the fact that they are both irrespirable gases with which persons are frequently brought in contact, and which frequently produce poisonous and even fatal results. Carbon dioxide plays an important rôle in the physiology of the human organism. The names used to designate these compounds are somewhat variable and confusing, and, to avoid this uncertainty, we place all the names commonly met with at the head of the proper sections.

Carbon Dioxide.—Also called *carbonic-acid gas* and *carbonic anhydride*. (Fixed air, choke damp.) Chemical formula, $CO_2$. Specific gravity (air = 1), 1.52; density (hydrogen = 1), 22.

*Sources.*—When carbon is burned in oxygen, or with a free supply of air, this gas is formed; hence it is a product of the combustion of all combustible bodies containing carbon. It is prepared in large quantities, by many manufacturing processes, from the combustion of coal. The burning of lime kilns sends large volumes of this gas into the air, partly from the fire and partly from decomposition of the limestone ($CaCO_3$) into lime and $CO_2$. Respiration is another source of the gas, and the expired air may accumulate in a tight room to such an extent as to become poisonous,—indeed, in some cases, to such an extent as to cause death. An adult man exhales about .7 cubic foot (20 litres) of $CO_2$ per hour, or 18 cubic feet (499 litres) per day. Another source of carbon dioxide is the alcoholic fermentation of saccharine fluids. This source is usually limited to certain kinds of industries, such as beer, wine, alcohol, and whiskey manufactories. In badly ventilated fermenting rooms, deaths have often occurred from the accumulation of this gas. The subterranean heat of volcanic regions causes the decomposition of limestone as above mentioned, giving off $CO_2$, which either escapes through crevices, or accumulates in underground caverns, under pressure, and finally becomes absorbed by the water, and comes to the surface in the form of effervescing spring-water, as at the well-known Saratoga Springs. The gradual oxidation of vegetable matters, either upon the surface of the soil or buried in it, generates a considerable quantity of carbon dioxide. The gas from these various sources may filter through the soil, crevices in the rock, or coal bed, and accumulate in mines, wells, cellars, etc., in such quantities that the miners are unable to work in it. It is called by them *choke damp*, to distinguish it from *fire damp*. It is produced in mines by an explosion of marsh gas (fire damp), so that if the explosion does not kill persons unfortunate enough to be in the mine at the time, they may die from breathing the $CO_2$ developed by the explosion. The atmosphere, as will be seen, is continually receiving this gas in abundance from the above sources; hence, outdoor air always contains about .4 part per 1,000. The air of rooms and closed places frequently contains a much larger proportion than this. A well-ventilated room should contain not more than .6 part per 1,000; but owing to poor ventilation it frequently rises as high as 4 parts per 1,000 or more. Even in the open air, the amount depends somewhat upon the state of the weather, season of the year, etc. In still, foggy weather in large cities, the amount present in outdoor air may rise as high as .8 part per 1,000, or enough to give the air a peculiarly suffocating effect upon those who breathe it.

*Properties and Preparation.*—Carbon dioxide is a colorless, transparent, odorless gas, about one and a half times heavier than air, and may be poured from one vessel into another like water. It has a faintly acid taste. At ordinary temperatures it is soluble in its own volume of water, with which it probably enters into combination to form carbonic acid: $CO_2 + H_2O = H_2CO_3$. By increasing the pressure, water will absorb a very large amount of the gas, a large portion of which escapes again when the pressure is removed. The so-called *plain soda* is a strong solution of carbonic acid ($H_2CO_3$) in water, made under pressure. The gas may be expelled by heat, by freezing, or by removing the pressure. Under a pressure of fifty atmospheres at 15° C. (59° F.), it is condensed to a transparent, colorless, mobile liquid, not miscible with water or fixed oils, but readily so with ether, alcohol, naphtha, turpentine, and carbon disulphide. When the pressure is removed from the liquid it evaporates with great rapidity, freezing a portion of the liquid into a snow-like solid, by the heat absorbed in the evaporation. The solid evaporates very slowly, and may be kept longer than the liquid. By moistening this solid with ether, and placing it under the bell-jar of an air pump, a temperature of −110° C. (−166° F.) may be obtained. Carbon dioxide is soluble in about one-third its own volume of alcohol at the ordinary temperature and pressure. Dry carbon dioxide has no effect upon litmus paper; but if the latter be first moistened it is reddened. On drying, the blue color is restored. Lime water is at first rendered turbid by $CO_2$, owing to the precipitation of calcium carbonate; but on conducting the gas into the turbid liquid for some minutes, the precipitate is redissolved, and the solution becomes clear again, owing to the formation of calcium bicarbonate ($H_2Ca(CO_3)_2$). This process frequently takes place in natural waters to produce *temporary hardness*, so called, because