I N S E C T S I N R E L A T I O N
T O
N A T I O N A L D E F E N S E

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Circular 21

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INSECTICIDES AND SUBSIDIARY MATERIALS

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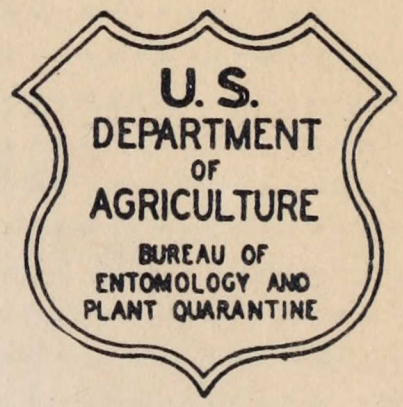

November 1941

INSECTS IN RELATION

TO

NATIONAL DEFENSE

Circular 21 - Insecticides and Subsidiary Materials

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FOREWORD

Chemicals in various forms when employed to kill or repel insects, mites, and related pests are known as insecticides. For convenience insecticides are classified as stomach poisons, contact poisons, and fumigants. Stomach poisons are used to combat many insects that feed by chewing and gnawing. The insecticides are applied to the material used as food by the insects and

the poison is taken into the insect's stomach with the food. Some examples of stomach poisons are Paris green, calcium arsenate, lead arsenate, and cryolite. Contact insecticides are developed primarily to kill insects that obtain their food by sucking or extracting the juices from plants or the blood of animals upon which they feed. Such insects are not affected by stomach poisons and must be combatted with contact insecticides. These materials kill the insects by their caustic action, by suffocation, or corrosion of the insect's body. Certain species of chewing insects may be killed by contact insecticides, whether applied directly to their bodies or indirectly through the material which they are damaging. Some examples of contact poisons are pyrethrum, nicotine, and derris.

Insecticides are applied in several ways: as liquid sprays or dips, dusts, or fumigants, depending on the insect problem. In the case of wood products certain chemicals of a preservative nature may be applied by impregnation rather than by superficial treatment as just mentioned.

Insecticidal sprays consist of a liquid such as water or oil to which is added one or more active insecticidal ingredients in definite quantities where they remain in suspension or solution so that they can be applied to plant, man, or animal, or their habitations to destroy insects thereon or therein. Such mixtures are usually applied with a mechanical device called sprayer or atomizer (See Circular 20) and under considerable pressure or mixed with air so that they can be broken into very fine particles or droplets.

Spreaders and wetters are materials that are added to insecticidal sprays or dusts to make them spread over and wet the surfaces of the insects or materials to which they are applied and thus increase their effectiveness. Many wetting and spreading agents used in the dyeing industry have been found during recent years to be valuable when used with such contact insecticides as nicotine, pyrethrum, and derris. These materials are usually harmless to plants, generally available, and are sold under various trade names.

Spray emulsions are mechanical mixtures of two liquids. One of the liquids is kept finely divided, at least until applied, in small droplets in the other by the use of a third substance. This third substance is called an emulsifier. Commonly used emulsifiers include soaps, casein, sulfated alcohols, sulfonated oils, blood albumin, and vegetable gums. The emulsions most commonly encountered in insect control are of the oil-in-water type. The oil droplets are prevented from uniting through the action of the emulsifier. Emulsions may be prepared by stirring or by both heating and agitation, depending on the kind of ingredients and quantities used, method of mixing, and other factors.

Insecticidal dusts are prepared in three ways. In one type, the active insecticidal agent is used in the undiluted form. The second type is prepared by mixing the undiluted insecticidal powder with some inert dust such as talc, clay, or similar material which serves to dilute the powder and act as a carrier for the active ingredient. The third type is prepared by mixing a liquid concentrated toxic agent, with a powder such as clay or talc and is known as an impregnated dust. Dusts are generally

applied with mechanical devices called dusters (See Circular 20), of which several efficient types are available.

Fumigants are materials which give off poisonous gases, fumes, or vapors and for this reason are used chiefly to fumigate enclosures such as rooms, houses, vaults, storage warehouses and the like where the gas can be confined with the insects and the products. Fumigants are also employed to kill soil and wood-boring insects.

Frequently, because of their pronounced odor, taste, or other qualities, certain substances are useful in repelling the attack of insects, or relieving the effects of their stings or bites. These include certain essential oils and their constituents. They are generally derived from plants and usually have a very pungent odor characteristic of the plant. Common examples are camphor, cedar oil, oil of citronella, menthol, oil of peppermint, and oil of wintergreen.

In the several Defense Circulars dealing with the various insects and pests that may be encountered in military camps or posts, definite recommendations are given for the control of each insect or pest under consideration. Specific information is given also on the kind of insecticide to employ, the dilution to use, and the manner and time of application.

This circular deals with the nature of the chemicals or insecticides that are used in the control of insects discussed therein. Since the uses of these materials are given only in a generalized way, the circulars dealing with specific pests should be consulted before treatment is attempted.

It also contains a list of manufacturers and firms from whom such materials may be obtained, although many of them can be procured under Government contract, and also from local stores. Prices given herein were obtained largely from the 1939-40 Chemical Industries Buyers Guide Book, also from the 1941 August issue of Oil Paint and Drug Reporter. These prices apply only to open market purchases and not to those quoted on the General Schedule of Supplies. In view of the unsettled conditions, prices are continually changing and are likely to be higher.

ALCOHOL

Alcohol (Ethyl) at a concentration of 70 percent in water is used as a preservative for insect specimens, such as the larvae or wrigglers of mosquitoes, for identification purposes in connection with mosquito control operations. The ordinary rubbing alcohol also will suffice for this purpose.

Ethyl alcohol (C_2H_5OH) is a colorless, volatile, inflammable liquid which is a product of fermentation. In its pure state it is obtained chiefly from potatoes and various grains by a process of brewing followed by fractional distillation.

The price of alcohol in drums in carload lots varies from \$6.02½ to \$6.44 per gallon. In barrels it is 2 cents higher than in drums.

Available on contract: see Class 51, General Schedule of Supplies, Procurement Division, Treasury Department.

ARESKET

Aresket is useful as an emulsifier in place of soap in preparing certain spray emulsions when it is necessary to use hard or sea water which would precipitate the soap. Like other similar wetting and spreading agents, it is useful for incorporation in pyrethrum sprays intended to kill mosquito larvae when applied to pools, marshes, or other bodies of water having a salt content higher than 5 percent.

Aresket is a proprietary product known chemically as the sodium monosulfonate of monobutyl diphenyl. It is a fine, tan-colored powder soluble in water and alcohol but not in acetone. It is available at most seed and insecticide stores at about 50 cents a pound.

For manufacturers and distributors see number 76 of list at end of this circular.

ASBESTOS

Asbestos is not an insecticide but it is sometimes employed in the powdered form in combination with calcium chloride to make a paste for sealing large cracks and crevices in connection with insect control operations such as the fumigation of buildings. It is used also in connection with termite control operations for enclosing water and heating pipes under buildings in place of wooden encasements, especially for pipes running vertically. In this way termites are prevented from reaching the superstructures.

Chemically, asbestos is a soft and fibrous silicate mineral which resists fire and most solvents. It is employed in the building industry for insulation or fireproofing in a great variety of forms.

Asbestos fibre can be purchased for from $15.00 to $42.50 per ton in carload lots.

For manufacturers and distributors see numbers 13, 31, 34, 40, 48, 60, 62, and 74 of list at end of this circular.

BENZENE

This liquid is also called benzol, C_6H_6, and is used to kill the larvae of the human botfly and screwworm infesting the wounds of animals, i.e., cows, horses, and other livestock. The benzene is applied preferably as a spray, after which the larvae are removed.

Benzene is a clear, colorless, highly inflammable liquid, lighter than water, and has a characteristic odor suggesting that of coal gas. In addition to medicinal uses, it is employed in the manufacture of medicinal chemicals, dyes, linoleum, oilcloth, varnishes, lacquers, and airplane dopes. It is a good solvent for waxes, resins, oils, and rubber. Benzene should not be confused with benzine which is derived from petroleum oil.

Caution: Since benzene is highly inflammable, it must be kept in well-closed containers in a cool place and away from fire. The vapor is poisonous.

Benzene or benzol is obtainable in tank cars and drums, the price ranging from 14 to 19 cents per gallon.

Benzene is available on contract: See Class 51, General Schedule of Supplies, Procurement Division, Treasury Department.

BORAX

Borax as sold commercially is used to kill housefly and stablefly larvae in manure, feces, garbage, sludge beds, and other refuse, either as a powder or dissolved in water. Treatment is made by dusting or sprinkling the surface of the refuse piles. A 5 percent borax solution is used for immersion of lumber to protect it from attack by Lyctus powder-post beetles. Water kept in open containers such as fire buckets or barrels and which is not to be used for drinking purposes or watering plants is protected from infestation by mosquito larvae by using borax at the rate of 2 ounces per gallon of water. Borax powder may be dusted about similarly to the use of sodium fluoride for controlling cockroaches but is not so effective as the latter.

Borax, or sodium borate ($Na_2B_4O_7 10H_2O$) may be white granules, colorless crystals, or crystalline powder. Commercially it is cheap and readily obtained as a white powder. In medicine it is used as an antiseptic and industrially in soldering metals, in cleansing compounds, for fireproofing fabrics and wood, for manufacturing enamels, and as a preservative for wood and hides.

It is generally considered free from health hazards when used externally.

Borax is marketed in carload lots of 300-pound bags and in barrels of 300 to 370 pounds, also in 100-pound kegs and in small lots in bottles. In carload lots it runs from $48 to $74 a ton.

Available on contract: See Class 51, General Schedule of Supplies, Procurement Division, Treasury Department.

CALCIUM CHLORIDE

Calcium chloride ($CaCl_2$) is used in combination with asbestos to make a paste to seal cracks and crevices in connection with the fumigation of rooms and buildings. A technical or commercial grade is sufficiently pure for this purpose and considerably cheaper than the chemically pure reagent. This salt is white, usually granular, very soluble in water, and is very hygroscopic, i.e., absorbs water readily. Since it combines with moisture in the air very readily, calcium chloride must be kept in airtight containers.

Among the many industrial uses for this material may be mentioned its importance in the manufacture of antifreeze, fire extinguisher solutions, cotton fabrics, and rubber.

Calcium chloride may be purchased in paper bags at $20 to $35 per ton in carload lots.

Available on contract: See Class 51, General Schedule of Supplies, Procurement Division, Treasury Department.

CAMPHOR

Camphor is used for local external applications to alleviate flea and mosquito bites. Spirits of camphor which is used for this purpose is a liquid containing the camphor in solution in alcohol. Mixed with cedar oil, and oil of citronella, it serves as a repellent against mosquitoes.

Camphor is a gumlike, crystalline compound, $C_{10}H_{16}O$, often called camphor gum, which is a fragrant substance slowly volatilizing on exposure to air. It is obtained from the bark and wood of the camphor tree, chiefly from Japan and Formosa, and is used in medicine, in celluloid manufacture, and in pyrotechny. A synthetic camphor is also manufactured from certain terpenes.

Camphor is marketed in 100 pound cases containing 2½ pound slabs, tablets in 1 pound tins or in powder form at a cost range of from $1.15 to $1.20 per pound. In larger quantities it is cheaper.

Available on contract: See Class 51, General Schedule of Supplies, Procurement Division, Treasury Department.

CARBOLIC ACID

Carbolic acid is often used to disinfect skin wounds caused by attachment of various species of ticks, also as a spray for animal pens in the control of scab mite and as a larvicide for no-see-um larvae.

Carbolic acid is obtained from coal tar, and the commercial form contains at least 98 percent phenol (C_6H_5OH). It is a white, crystalline mass which reddens on exposure to air and has a characteristic coal-tar odor. It is very soluble in alcohol, chloroform, carbon disulfide, and petroleum. Carbolic acid has many uses in medicine and industrially, also as a general disinfectant.

Caution: Since carbolic acid is poisonous and very caustic, great care should be used in handling it. Do not handle with bare hands. It should be kept well closed and protected from light.

This chemical is obtainable in 100-pound carboys, in 850-pound drums, at 12½ to 14 cents per pound.

Available on contract: See Class 51, General Schedule of Supplies, Procurement Division, Treasury Department.

CARBON DIOXIDE

Carbon dioxide as a liquid is used in combination with ethylene oxide for the fumigation of cured meats, cheese, grain, and household furnishings. As a solid, dry ice, it is used to chill cans of hydrocyanic acid discoids before fumigation to retard the evolution of the gas and thus increase the safety of their use.

Carbon dioxide (CO_2) is a colorless liquid condensed from a heavy gas called carbonic acid gas which is produced by the action of acids on carbonates, by the

fermentation of liquors or by the combustion and decomposition of organic substances. The liquid when cooled forms a solid called "dry ice" which vaporizes without melting (at ordinary pressures) and is used as a refrigerant.

Liquid carbon dioxide is sold in 20 to 25 pound cylinders at 6 to 8 cents per pound. Dry ice is also sold in 50-pound blocks.

Available on contract: See Class 51, General Schedule of Supplies, Procurement Division, Treasury Department.

CARBON DISULFIDE

The commercial grade of carbon disulfide, also called carbon bisulfide, is used to destroy ants by pouring a small quantity into the opening of the nests. It has been used in the past in the fumigation of grains, cereals, and other commodities but, owing to its inflammability, it is now used to a lesser degree and often in combination with carbon tetrachloride to reduce the fire hazard. It is also used as a fumigant to delouse clothing, and to control horse bot larvae.

Chemically, carbon disulfide (CS_2) is a heavy, colorless, or faintly yellowish liquid which boils at 115° F. It has a disagreeable odor and is quite volatile. The vapors are poisonous and very explosive when mixed with air in certain proportions. It will sometimes ignite from contact with hot steam pipes. It is only slightly soluble in water, but is a good solvent for many substances, including rubber, gums, waxes, varnishes, and oils.

Caution: Because of its inflammability and poisonous nature, the greatest caution should be used in handling it. It should be kept in tightly closed containers, in a cool place and away from fire. Because of the fire hazard this chemical cannot be shipped by mail or express. Inhaling the gas causes dizziness and nausea and if inhaled in large amounts it is deadly.

Carbon disulfide is obtainable in small quantities in bottles or cans and in large quantities in steel drums. It ranges in cost from 6 cents a pound in 500-pound lots to 30 cents or more in 1-pound lots. Firms dealing in chemicals and insecticides usually sell it in 5-gallon cans for about 95 cents per gallon.

Available on contract at $1.08 in gallon cans: See Class 51, General Schedule of Supplies, Procurement Division, Treasury Department.

CARBON TETRACHLORIDE

Commercially available carbon tetrachloride, (CCl_4), is useful as a fumigant in the control of insects attacking certain stored products such as food stuffs, grains, seeds, and fabrics. It may be used alone or in combination with carbon disulfide or ethylene dichloride to reduce the fire hazard of the latter two. Clothing may be freed from ticks after wearing by fumigating them with carbon tetrachloride.

Carbon tetrachloride is a colorless, noninflammable liquid heavier than water. It has a characteristic pungent but not disagreeable

odor. Medicinally it is used to destroy intestinal parasites, especially hookworms. Industrial uses included are as a fire extinguisher, as a dry-cleaning agent, and as a solvent for oils, waxes, rubber, and varnishes.

Caution: Carbon tetrachloride is toxic and similar to chloroform in its action on the human system. Exposure to it in enclosed places should be avoided.

This chemical may be purchased in tank cars and drums at from 5 to 6 cents per pound. Small quantities are obtainable in bottles of various size. For prices of a mixture with ethylene dichloride see information given under latter material, page 29.

Available on contract: See Class 51, General Schedule of Supplies, Procurement Division, Treasury Department.

CAUSTIC SODA

Caustic soda is used to wash garbage pails in connection with sanitary measures that are employed in the control of flies around army camps.

Caustic soda, NaOH, also known as sodium hydroxide, is available as white flakes, lumps, or rods. It is very caustic to tissue. It is soluble in water, alcohol, and glycerine. Industrially it is used extensively in various manufactures and processes.

Caution: Since this material is very caustic it should be kept in tightly closed containers. Do not handle with bare hands.

Caustic soda is marketed in barrels and drums from $2.70 to $2.95 per 100 pounds.

Available on contract: See Class 51, General Schedule of Supplies, Procurement Division, Treasury Department.

CEDAR (OR CEDARWOOD) OIL

This volatile oil is useful in the preparation of certain mosquito repellents. Application of the repellents is made locally to the afflicted portions of the skin.

Cedar oil or cedarwood oil is a colorless or slightly yellow, somewhat viscid liquid. It is one of the volatile or essential oils and is characterized by a distinct cedar-like aroma. The oil is extracted from wood of the red and other species of cedar. The uses of this substance are not extensive but it is an ingredient in some perfumes, soaps, and toilet preparations. This material should be kept well closed, cool, and protected from light.

Cedar oil may be purchased in cans and drums at a cost of 28 to 34½ cents per pound.

For manufacturers and distributors see numbers 1, 25, 34, 38, 50, and 74 of list at end of this circular.

CHLOROFORM

This liquid may be used in the same way as benzene (benzol) for treating wounds infested with screwworm larvae especially when such infestations occur in the nose of man. The

larvae are carefully picked out after the chloroform has been applied, preferably as a spray. Chloroform is also used in making killing tubes for collecting adult mosquitoes for identification purposes.

Chloroform, $CHCl_3$, is a heavy, clear, colorless, sweet-tasting liquid. Although noninflammable, it is very volatile and has a characteristic odor. It is not very soluble in water but mixes readily with most other solvents, and is employed industrially as a general solvent.

Caution: Keep away from flame when using. Even though noninflammable, the vapors are decomposed by fire and there is involved very irritating and possibly poisonous gas. Care should be used to avoid unnecessary inhalation.

Chloroform is marketed in 50 to o50 pound drums at a cost of 30 to 33 cents per pound and is available locally in smaller containers at relatively higher prices.

Available on contract: See Class 51, General Schedule of Supplies, Procurement Division, Treasury Department.

CHLOROPICRIN

Chloropicrin may be used to delouse clothing in a tight container and will kill both the lice and their eggs. It may also be employed as a fumigant for large enclosures, for the treatment of grain in bins and other bulk commodities in vaults.

The liquid is noninflammable, heavy, colorless, and pungent, having the formula CCl_3NO_2, obtained by subjecting picric acid to the action of chlorine. Chloropicrin was used in the world war as a lethal, tear and vomiting gas. It has been used for killing rats in ships and as a soil disinfectant.

Chloropicrin may be purchased in 1-pound glass bottles or in cylinders from 1 to 100 pounds capacity at a cost of $1.20 per pound for 1-pound cylinders down to 85 cents per pound in 100-pound lots.

For manufacturers and distributors see numbers 8, 9, 36, and 58 of list at end of this circular.

COAL TAR PITCH

In insect control operations coal tar pitch is used to fill voids in concrete, cracking of walls or expansion joints, and where pipes or steel columns penetrate ground slabs of concrete, to block termites from entering a building.

Coal tar pitch is a dark-colored, viscous substance obtained as a residue in distilling coal tar. It is used in the manufacture of varnishes, roofing paper, calking seams, as a preservative coating, and for insulating purposes.

The material is shipped in barrels at $8.25 to $8.50 per barrel in less than carload lots, and at $19 to $22 for a single ton or in 50-pound containers for $1.50.

Available on contract: See Class 59, General Schedule of Supplies, Procurement Division, Treasury Department.

COAL TAR PLASTIC CEMENT

One of the procedures in the control of termites is the sealing of expansion joints in floors and spaces around pipes or steel penetrating floors and walls with coal tar plastic cement.

This material is composed of refined coal tar fluxed to the proper consistency with mineral fillers such as asbestos fibre and slate flour. In construction work it is used for sealing flashings and joints in roofing and in general roofing repairs.

Coal tar plastic cement is procurable at a cost of $3.25 in 5 gallon cans.

For manufacturers and distributors see numbers 63, 86, 94, 95, and 106 of list at end of this circular.

COCONUT OIL SOAP (LIQUID)

Liquid coconut oil soap (40 percent) is useful as an emulsifier in preparing a pyrethrum-oil emulsion for use on fresh water or water of less than 5 percent salinity as a larvicide for killing mosquito larvae. This soap is diluted with water and the pyrethrum extract added. The emulsion is sprayed on the surface of mosquito breeding areas such as ponds, marshes, and pools of water.

Coconut oil soap (liquid) is a potash soap made from coconut oil and, as explained above, is useful in the preparation of emulsions and as a spreader or wetter in spray combinations. Most soaps, including coconut oil soap, have value as contact insecticides against various soft-bodied insects when used at sufficient strengths. Other uses for coconut oil soap are for the preparation of shampoos, toilet soaps, and shaving soaps.

For manufacturers and distributors see number 30 of list at end of this circular.

COLLODION

The application of collodion (new skin) to chigger bites is soothing.

Collodion is a viscous solution of pyroxylin in a mixture of alcohol and ether, or a similar solution of pyroxylin in some other solvent such as acetone. It is used as a coating for wounds, for photographic films, small balloons and membranes.

The material is sold in 325 pound drums at 15 cents per pound, or in 25 pound cans at 19 to 20 cents per pound.

Available on contract: See Class 51, General Schedule of Supplies, Procurement Division, Treasury Department.

COTTONSEED OIL

This oil is used in combination with orthodichlorobenzene for killing powder-post beetles in infested wood. Treatment consists in applying it to the surface or by immersion of the wood in vats, depending on the quantity of wood requiring treatment and facilities available. When combined with pine tar oil it is used to kill ticks in the ears of animals.

Cottonseed oil is a pale yellow, practically odorless liquid. It is used in the manufacture of soaps, butter and lard substitutes, salad and cooking oils, leather dressings, and lubricants.

Cottonseed oil is sold in tank cars, barrels, 5-gallon cans, and small bottles, at a price range of 14-1/2 to 14-3/4 cents per pound.

Available on contract: see Class 51, General Schedule of Supplies, Procurement Division, Treasury Department.

CREOSOTE OIL

Impregnation of wood with coal-tar creosote oil by standard pressure processes renders it resistant to attack by termites and other wood-boring insects such as Lyctus powder-post beetles. Creosote oil is also used effectively, as a spray, in controlling fleas and ticks in basements, dog-kennels, warehouses, outbuildings, or other places in which staining is not objectionable. It is used to spray dead animal carcasses, to rot holes in trees to kill sandflies, and in combination with fuel oil may be sprayed into windrows of bay grasses for the

control of the stable fly. When coal-tar creosote oil is used for termite control as a soil poison about the foundations of buildings, American Wood Preservers Association or Federal Specifications grade should be obtained. An effective soil poison is prepared by mixing 1 part of creosote oil with 3 parts of light fuel oil.

Chemically, coal-tar creosote oil is a mixture of phenols from coal tar. It is available commercially as a dark-colored, oily liquid possessing a strong, tar-like odor. It is used extensively as a wood preservative, as a disinfectant, and in various other ways industrially.

Caution: Great care should be used when handling creosote oil, since the liquid and also the fumes from it are irritating to the skin when allowed to remain in contact with it for any length of time. Coating the hands and face with petrolatum or cup grease helps to prevent creosote burns.

Coal-tar creosote similar to that described in Federal Specification TT-W-556 is recommended. Dealers in coal-tar creosote are usually familiar with these specifications. If not, a copy of them may be obtained from the Superintendent of Documents, Washington, D. C., price 5 cents.

Creosote oil may be purchased in tanks at a cost of 13½ to 14½ cents per gallon.

For manufacturers and distributors see numbers 17, 27, 28, 47, 57, 65, 76, and 115 of list at end of this circular.

CRESOLS

In the control of body lice by chemicals, cresol solutions have been recommended for infested articles which may be damaged by other materials and for spraying into cracks in floors and walls.

Commercial cresol contains three substances, $CH_3C_6H_4OH$ resembling phenol, which are distinguished as orthocresol, metacresol, and paracresol. It is obtained from coal tar, wood tar, and petroleum, as a colorless liquid or oily solid, and is used in disinfectants, fumigants, medicines, and many other products.

The cost of cresol in 450 to 850 pound drums ranges from 10-1/4 to 10-3/4 cents per pound. In smaller lots it may be obtained in bottles at the rate of one pound for 40 cents, five pounds at 33 cents per pound, and 40 pounds at 22 cents per pound.

For manufacturers and distributors see numbers 4, 19, 23, 30, 70, 73, 75, and 76 of list at end of this circular.

CUBE POWDER

This material may be used in the same way as derris powder to kill fleas infesting cats, dogs, and other animals. The cube powder may be applied pure or mixed with talc as in the case of derris (page 25). A similar method of application is prescribed. Cube powder may be used to kill human body and pubic lice, also lice and ticks infesting domestic animals and livestock.

The toxic ingredients of cube and derris are similar, and of them rotenone ($C_{23}H_{22}O_6$) is probably the most important. The rotenone content of pure cube powder should be 4 to 5 percent with about $3\frac{1}{2}$ to 4 times as much total extractives. Other toxic ingredients which help make up the total extractives are similar to those of derris. The roots of the tropical plants from which cube is made are ground to a fineness equal to the derris powder.

Caution: The same precautions as given for derris powder apply to cube.

In barrel lots, cube powder (containing 5 percent rotenone) is obtainable for 27 to 28 cents per pound, New York City.

For manufacturers and distributors see numbers 24, 35, 72, 79, 91, and 113 of list at end of this circular.

DERRIS POWDER

Derris powder is used to kill fleas when found infesting cats, dogs, and other animals. It may be used also to control ants in and around buildings. The pure derris powder as manufactured as an insecticide is used for this purpose or it may be mixed with talc or other inert materials. The dust is applied directly to the skin of the infested animal. This material is also effective in killing body lice and ticks when dusted behind baseboards or similar places where they may be hiding in infested buildings. A wash made of derris powder, neutral soap and water is effective against human head and pubic lice and as a dip against wood ticks on dogs. The undiluted powder may be applied directly on the scalp for head lice.

Derris powder, and a similar material, cube powder, are prepared by grinding finely the roots of certain tropical plants which contain several toxic ingredients of which rotenone is the most important. Good grades of derris powder contain from 4 to 5 percent of rotenone and about 3½ times that quantity of total extractives. It is usually ground sufficiently fine that most of it will pass a 200 mesh screen.

Caution: Dusts and powders made from derris and cube are not considered poisonous to man, but when inhaled the dust causes mild irritation and a slight paralytic effect in the tongue and throat. They are also somewhat irritating to the pubic regions.

Derris powder containing 5 percent rotenone may be purchased in barrel lots at prices ranging from 28 to 30 cents per pound f.o.b. New York City.

For manufacturers and distributors see numbers 3, 35, 72, 79, and 113 of list at end of this circular.

DIATOMACEOUS EARTH

Diatomaceous earth (infusorial earth) may be used as a carrier in various insecticidal dusts, especially for paris green in the control of mosquito larvae which carry malaria. The dust is usually mixed at the rate of 4 or 5 parts of the earth to 1 of paris green.

Diatomaceous earth is comprised chiefly of the siliceous remains and fragments of small marine animals known as diatoms. It is obtained as a white or light gray to pale buff powder insoluble in water. Industrially it is important in the manufacture of insulating materials, as a clarifying agent in making oils, varnishes, and drugs, and as an absorbing agent.

The price of diatomaceous earth ranges from $22 to $55 per ton in bags of 42, 90, and 120 pounds.

For manufacturers and distributors see numbers 4, 32, 64, 78, and 111 of list at end of this circular.

DIPHENYLAMINE

Diphenylamine ($C_{12}H_{11}N$) is applied directly to the wounds of animals to kill young screwworm larvae.

Chemically, diphenylamine is an organic, colorless or white, crystalline compound of rather pleasant aromatic odor. It is insoluble in water but readily so in benzene. It is of importance in the manufacture of many dyes and in stabilizing explosives.

Caution: It should be protected from light, as it discolors rapidly.

Diphenylamine is merchandised in 350 pound barrels at 25 cents per pound.

For manufacturers and distributors see numbers 36, 37, 39, and 66 of list at end of this circular.

DUPONOL W. A.

Duponol W. A., like Gardinol W. A. and Orvus W. A., is a proprietary wetting and spreading agent that is used as an emulsifier in place of soap, because it does not form a precipitate as does soap when hard water must be used. It is especially useful in the preparation of pyrethrum larvicidal sprays with salt or hard water for application to the surface of mosquito infested pools, streams, and other breeding places.

Duponol W. A. is a proprietary product prepared as a paste or in flakes, known chemically as sodium sulfate of technical lauryl alcohol (sodium lauryl sulfate). Like Gardinol W. A. and Orvus W. A., Aresket, and similar products, Duponol W. A. is used in the dyeing industry.

For manufacturers and distributors see number 37 of list at end of this circular.

ETHER

In the control of screwworms, human nasal infestations may be treated by the use of ether to anesthetize the larvae before removal from the nose.

Ether, $(C_2H_5)_2O$ or ethyl oxide, is a light, volatile, mobile, highly inflammable liquid with a characteristic aromatic odor. It is obtained by the distillation of alcohol with sulfuric acid, hence is called also sulfuric ether. Ether is a powerful solvent of many organic substances, is important in making rayon and smokeless powders. In medicine it is an important anesthetic.

The price of ether ranges from 11 cents per pound in 310 pound drums to 16 cents per pound in 27 pound drums. It may also be obtained in 5 pound and 1 pound containers at 36 cents and 45 cents per pound respectively.

Available on contract: see Class 51, General Schedule of Supplies, Procurement Division, Treasury Department.

ETHYLENE DICHLORIDE

A mixture of 3 volumes of ethylene dichloride to 1 volume of carbon tetrachloride is a very useful fumigant for the control of stored food, grain and seed insects as well as for fabric pests such as clothes moths and carpet beetles. The addition of the carbon tetrachloride makes the mixture free from fire hazard, while ethylene dichloride if used alone has a slight fire hazard. The mixture is generally used at the rate of 5 quarts per 1000 cubic feet of space fumigated.

Ethylene dichloride, $C_2H_4Cl_2$, is a colorless, heavy liquid. It has a pleasant ether-like odor and a sweetish taste, but the vapors are somewhat irritating. The liquid will keep indefinitely but is volatile and must be kept tightly stoppered. Ethylene dichloride is a solvent for fats, waxes, resins, and rubber, and is used in the manufacture of acetyl cellulose.

Caution: Keep in tight containers in a cool place. Avoid exposure to the vapors and inhaling of the gas, especially since it may be dangerous to man in cases of long exposure or high concentrations.

Ethylene dichloride in admixture with carbon tetrachloride can be purchased in 55 gallon drums for about 6½ to 7 cents per pound. In smaller quantities it can be purchased for about 75 cents per gallon.

For manufacturers and distributors see numbers 14, 16, 21, 36, 37, 68, and 116 of list at end of this circular.

ETHYLENE OXIDE

Ethylene oxide, in admixture with carbon dioxide, may be used to fumigate small quantities of cured meats or cheeses in atmospheric vaults to control mites, ham beetles, and skippers that infest these commodities. It is also used to control the various pests affecting furs and fabrics in storage rooms. It does not injure fabrics or furs or leave any obnoxious odor or poisonous residue on foodstuff.

Ethylene oxide (C_2H_4O) is a colorless liquid which boils at 51.8° F. The concentrated vapor of this material is inflammable. It is a product of the natural gas chemical industry. The material has been used in rather large quantities in atmospheric vault and vacuum fumigation. Although ethylene oxide may be used alone for some purposes, it is safer to use it in admixtures with carbon dioxide to make it noninflammable. See Circular No. 22.

Caution: As ordinarily used the danger from breathing the vapors of ethylene oxide are not considered to be great. However, precautions taken against breathing the vapors should be the same as with other poisonous gases.

The cost of ethylene oxide in steel cylinders ranges from 50 to 55 cents per pound. The mixture of 1 part of ethylene oxide and 9 parts of carbon dioxide by weight is sold in 30 to 60 pound cylinders under high pressure at prices ranging from 14.5 to 16 cents per pound, f.o.b. factory.

For manufacturers and distributors see numbers 21 and 36 of list at end of this circular.

FLY SPRAYS

Fly sprays are used to kill house flies or flies affecting livestock, mosquitoes, fleas, and certain other insects. A great number of commercial fly sprays or household insecticides of the liquid spray type are now available. For the most part these consist of certain combinations of highly refined petroleum oils with pyrethrum extracts, derris extracts, or organic thiocyanates added as the active insecticidal ingredient. They may vary considerably as to the nature or quantities of ingredients used. As a result of the need for some standard by which sprays of this type could be evaluated, the National Association of Insecticide and Disinfectant Manufacturers, Inc., The National Bureau of Standards, and other interested organizations and individuals have cooperated in establishing specifications for the liquid spray type of household insecticides. The establishment of the standard was announced June 10, 1938. The specifications agreed upon and discussion are contained in the publication, "Commercial Standards CS 72-38," by the National Bureau of Standards, Department of Commerce, Washington, D. C.

To be acceptable for use, a fly spray of this type should meet the requirements set forth in the publication referred to above. Briefly, these requirements specify that the killing power of the liquid spray shall be determined by the Official Peet-Grady Method in conjunction with the Official Test Insecticide of the National Association of Insecticide and Disinfectant Manufacturers, Inc. In 1940 the Official Test Insecticide (O.T.I.) was an oil pyrethrum spray containing 0.113 percent pyrethrins. Insecticides are rated according to their killing power as follows:

Grade	Percent kill after 24 hours as compared to the O. T. I.
AA	16 (or more) greater
A	5 to 15 greater
B	5 less to 5 greater

In addition, when used in the customary manner the spray shall be harmless to man and warm-blooded household animals, shall not stain fabrics, wallpaper, and general household furnishings, shall not contaminate closed packages of commonly found food materials, shall not corrode metals, shall have no objectionable odor, and shall have a flash point of not less than 125° F. when tested in the Tagliabue closed cup. Certain combinations of highly refined petroleum distillates with pyrethrum extracts, derris extracts, or organic thiocyanates meet these standards and form the basis for numerous commercial fly sprays.

When a commercial fly spray is to be purchased, it would be advisable to specify clearly that the requirements of the Commercial Standards CS 72-38 of the National Bureau of Standards are to be met. For general use Grade B is quite satisfactory. Sprays of this grade designation may be procured from most local oil companies and filling stations or from the firms that are listed in the Bureau of Standards Publication No. CS 72-38 referred to above. Orders may be placed through local representatives of these firms.

A satisfactory fly spray may also be obtained under Class 51 of the General Schedule of Supplies, Procurement Division, Treasury Department.

FORMALIN

Commercial formalin diluted in milk or milk and water with a small quantity of brown sugar added, is a safe and effective poison for killing house flies that may occasionally gain entrance to mess halls, barracks, and other buildings. The poison is conveniently exposed to the flies by inverting a partially filled drinking glass of it as a reservoir on a saucer or plate lined with blotting paper. A match stick should be placed under the edge of the glass.

Formalin as ordinarily obtained is an aqueous solution of formaldehyde gas (CH_2O). The commercial solution contains 40 percent of formaldehyde and is colorless, but on standing it may become cloudy. The odor of this substance is sharp, choking, irritating to the eyes, and penetrating. It is miscible

with water, alcohol, and acetone. Its chief uses are in the manufacture of dyestuffs, as a food preservative, and as a disinfectant.

Caution: Because of its poisonous nature, care should be exercised in handling it and inhaling of the fumes should be avoided. It should be stored im a moderately warm place and kept tightly closed. Rubber gloves should be worn while handling it, as it will corrode the skin.

Formalin may be obtained in barrels, drums, carboys, and kegs at prices ranging from 5.4 cents in drums to 9.5 cents in kegs.

Available on contract: see Class 51, General Schedule of Supplies, Procurement Division, Treasury Department.

FUEL OIL

Fuel oil or light petroleum oil has been recommended in the control of powder-post beetles, termites, and surface-breathing species of mosquito larvae. Seasoned wood may be protected from Lyctus powder-post beetles by soaking with a solution of pentachlorophenol in light fuel oil. Light petroleum oil may be used to dilute orthodichlorobenzene to double its volume for surface application to wood to kill all stages of powder-post beetles. Light fuel oil combined with coal-tar creosote makes an effective soil poison for killing termites. A film of light fuel oil (grade No. 2) on water will prevent mosquito larvae from obtaining air at the water surface, which results in the death of the surface-breathing larvae. It is also used with creosote oil in controlling stableflies.

Fuel oils ordinarily have a somewhat higher boiling point than kerosene. The lighter fuel oils are somewhat kerosene-like in character. In color they may be clear or yellowish to somewhat brownish, depending on the type of crude petroleum from which they are derived. The chief use of fuel oil is for oil burners, to provide heat for houses, commercial establishments, or industrial processes.

Caution: Fuel oil is inflammable. Spontaneous combustion of oil-soaked rags left in poorly ventilated places may occur.

Fuel oil is obtainable at most oil refineries and from local distributors. Available on contract: see Class 14, General Schedule of Supplies, Procurement Division, Treasury Department.

GARDINOL W. A.

Gardinol W. A. is used as a substitute for soap and as an emulsifying agent in the preparation of mosquito larvicides such as emulsions of pyrethrum extract in kerosene oil. This or a similar emulsifier is an essential component where larvicides are to be used on water having a salt content higher than 5 percent. Larvicides containing soap cannot be used in such situations because the salt water would precipitate the soap. The spray emulsion is diluted for use at the rate of 1 part to 10 parts of water and then sprayed over the surface of mosquito breeding areas such as pools, ditches, streams, and the like. It is used also as a wetting and spreading agent in the preparation of various other horticultural sprays.

Gardinol W. A. is a proprietary product known chemically as sodium sulfate of oleyl alcohol. It comes prepared in the form of paste and flakes.

For manufacturers and distributors see numbers 37 and 92 of list at end of this circular.

GASOLINE

This liquid has a very limited use for killing insects. Torches made of gasoline-soaked burlap or other fabric are sometimes used to destroy pests such as ticks in fire-proof buildings.

Gasoline is a volatile, low-boiling fraction of crude oil and is so well known as to require no further description. Certain other substances such as tetraethyl lead may be added in the refining process to improve its efficiency as a motor fuel. Pure gasoline is colorless but most of the commercial brands are tinted different colors.

Caution: Gasoline is inflammable and, when mixed with air in certain proportions, it is explosive.

Available on contract: see Class 14, General Schedule of Supplies, Procurement Division, Treasury Department. Also may be obtained from all local oil companies and distributors.

HYDROCYANIC ACID GAS

Hydrocyanic acid gas (HCN) is a widely used fumigant for the control of fabric pests such as clothes moths and carpet beetles; flour and grain beetles; flour, grain and meal moths; granary, bean, and pea weevils; and similar food insects infesting grains, dried fruit, meats, cheese, and other stored foods. In certain situations where this fumigant can be used it provides an effective means of eradicating fleas, lice, bedbugs, and cockroaches.

A detailed discussion of fumigation procedure is given in Circular No. 22. As explained therein, hydrocyanic acid gas may be obtained in several ways. The chief ways are by evaporation of hydrocyanic acid in liquid form or from discoids impregnated with the liquid, by the action of dilute sulfuric acid on sodium cyanide, and exposure of calcium cyanide to moist air.

The gas, from whatever source derived, is extremely poisonous to all animals and plants. It is colorless, lighter than air, and has an odor resembling that of peach kernels or crushed almonds.

Liquid hydrocyanic acid is a colorless liquid, boiling at 70° F. (26.1° C.), which gives off the gas having the characteristics described above when the material is exposed to the atmosphere. The liquid may be obtained in 30 or 75 pound cylinders which are more conveniently used for fumigating large warehouses than the barrel or pot method. It should be used only by a professional fumigator equipped with suitable masks.

Hydrocyanic acid discoids are convenient and useful for the fumigation of houses, barracks, small warehouses, or storage rooms. As with the liquid form their use is not recommended for any but professional fumigators with masks, as the gas is a deadly poison.

This fumigant consists of wafer-like discoids of an inert material, each containing approximately one-half ounce of absorbed liquid hydrocyanic acid, packed in sealed metal cans of various sizes, and sold on the basis of the net content of hydrocyanic acid.

When sodium cyanide (NaCN) and dilute sulfuric acid (H_2SO_4) are mixed, a reaction takes place in which the deadly cyanide gas is liberated. Sodium cyanide is a white, deliquescent, poisonous salt. For fumigation purposes it should be practically free from chloride and contain not less than 51 percent of cyanogen. This salt may be purchased in the form of eggs weighing $\frac{1}{2}$ or 1 ounce, which provides an easy method of calculating dosages by counting out the number of eggs required for a certain weight of sodium cyanide. Sulfuric acid is described under that heading on page 75 of this circular.

Calcium cyanide ($Ca(CN)_2$) on exposure to the air reacts with the moisture in the atmosphere and gives off the poisonous HCN gas. When the reaction is completed, the residue remaining consists chiefly of calcium hydroxide or hydrated lime. This form of cyanide is obtainable in granules, dust, or flakes. The granular form, which is dark gray in color, is most frequently used for fumigation. It can be purchased in 1, 5, 25 pound, or larger sized containers.

Caution: Because of their extremely poisonous nature, all forms of cyanide should be handled with the greatest of care and only by competent persons thoroughly familiar with the hazards involved. It is always necessary to wear a gas mask provided with the proper canister for absorbing hydrocyanic acid gas when working with the fumigant. The materials should be kept in tight containers, labeled plainly, and kept in a safe place. While the gas burns freely in air, it is not considered dangerously inflammable or explosive at the concentration normally employed in fumigation. For complete safety, however, all fires should be extinguished when fumigating. Also the draft or currents of air caused by a fire will exhaust the gas from a building and thereby reduce its effectiveness. The liquid hydrocyanic acid deteriorates slowly and under no conditions should cylinders of liquid be stored for more than five months.

In the fumigation of food products, the liquid hydrocyanic acid should not be used in such a way that the liquid will come into contact with the product; otherwise undue absorption may occur and render the food dangerous for consumption.

Liquid hydrocyanic acid is sold for $1 per pound. Discoids sell for $1.20 per pound in 1-pound cans. Sodium cyanide can be purchased in 100 pound lots for about 16 cents per pound. Calcium cyanide dust containing 50 percent available hydrocyanic acid ranges in price from $1.60 per pound in 1-pound cans, to $1.20 per pound in 25-pound cans.

Sodium cyanide is available on contract: see Class 51, General Schedule of Supplies, Procurement Division, Treasury Department.

For manufacturers and distributors of hydrocyanic acid discoids, liquid hydrocyanic acid (HCN), and calcium cyanide, see number 4 of list at end of this circular.

HYDROGEN PEROXIDE

Hydrogen peroxide solution (USP) may be applied locally to the affected areas of the skin to relieve irritation caused by the bites of fleas and various other insects. For this purpose the common medicinal peroxide of the druggist is used, which is a water solution containing 3 percent by weight of the peroxide.

Hydrogen peroxide (H_2O_2) as a pure compound is a colorless liquid and, like water, is composed of hydrogen and oxygen, but in a different proportion. It is a common article of commerce, being available in a 3 percent and a 30 percent solution. It has many medicinal and industrial uses.

Caution: Hydrogen peroxide solution must be protected from the light, as in a brown glass container, to prevent decomposition of the compound, and should also be kept in a cool place.

This material is available in barrels of 375 pound capacity, 8 pound jugs, 120 pound carboys, ranging in price from 3-3/4 cents in barrel lots and 16 to 18½ cents in carboys. It is also available in small sized packages at local drug firms.

Available on contract: see Class 51, General Schedule of Supplies, Procurement Division, Treasury Department.

IODINE

Iodine is often used as a mild tincture to disinfect skin wounds caused by attachment of ticks to the body of man or animals. It is most effective when applied to the point of attachment after the tick has been removed.

Iodine from which a tincture is made consists of bluish-black scales, having a metallic lustre, characteristic odor, and a sharp, acrid taste. It attacks metals in the presence of moisture and acts slowly on organic tissue. It is used in the manufacture of iodine compounds, germicides, antiseptics, in engraving, and in chemistry.

Caution: It is poisonous and should be kept tightly closed and plainly marked.

The price of iodine ranges from $2.00 per pound in 50-pound jars to $2.10 in 5-pound bottles. It is also available in smaller containers at a slightly higher price.

Available on contract: see Class 51, General Schedule of Supplies, Procurement Division, Treasury Department.

IODOFORM

Among the uses of this material is the preparation of certain louse powders for killing lice attacking human beings. The preparation and use of some of these powders is described in the circular on lice.

Iodoform or tri-iodomethane (CHI_3) consists of a yellow powder or crystals

possessing a characteristic, somewhat disagreeable odor suggestive of iodine. It melts at about 120° C. (248° F.) and is only slightly soluble in water. Its chief uses are medicinal.

Iodoform is sold at a price of $3.95 to $4.10 in 100-pound drums and in jars at $4.20 per pound.

Available on contract: see Class 51, General Schedule of Supplies, Procurement Division, Treasury Department.

KEROSENE

Of the many petroleum products, kerosene (kerosene oil) probably has been used more extensively than any other in connection with the control of insect pests. Kerosene may be applied to the shoes and outer clothing in place of sulfur to repel chiggers and if applied to the body before bathing it facilitates their removal. It may be used alone or in combination with turpentine for controlling powderpost beetles by dipping the infested wood. Bedbugs can be killed with kerosene or a similar light petroleum oil or they may be prevented from infesting beds by placing the legs of the bed in shallow dishes of kerosene. When combined with an oil extract of pyrethrum (containing 2 percent pyrethrins) at the rate of 1 gallon of pyrethrum extract to 19 gallons of kerosene or similar oil, a contact spray is made which is useful in killing flies, mosquitoes, ticks, cockroaches, and other insects. An emulsion of kerosene, soap (or other emulsifier), pyrethrum extract, and water is an effective mosquito larvicide when applied to the surface of water pools or other breeding

areas. This spray is also useful against chiggers on the body. Ticks or other pests when removed from the clothing or body of man or skin of animals may be killed by dropping them into kerosene. Equal parts of kerosene and either olive oil or vinegar may be applied to the hair and scalp to control human head lice. An emulsion of kerosene, soap and water is also used to kill body lice.

Kerosene is a mixture of hydrocarbons, lighter than water, and boiling between about 400° and 575° F. Ordinarily it is colorless but may be colored as sold commercially. The chief source of kerosene is from crude oil but some is obtained from oil shale. It is also known as coal oil or lamp oil and is used in some internal combustion engines, in oil stoves and oil lights.

The price of kerosene in tank cars at the refineries is 4-5/8 to 11-1/2 cents per gallon depending upon the location in the United States.

Available on contract: see Class 14, General Schedule of Supplies, Procurement Division, Treasury Department.

LAMP BLACK

Lamp black is one of the ingredients of Formula No. 62 of the Bureau of Entomology and Plant Quarantine, which is a combination of screwworm killer and wound protector in the form of an ointment or smear for animals.

The fine, bulky, black soot deposited by the smoke from burning oil, tar, or rosin

is called lamp black. It has a blue undertone and varying amounts of oily matter, and is used in paints, varnishes, and printers ink and as a filler for rubber, etc.

The cost of lamp black is from 2.7 to 3.8 cents per pound in carload lots of 12½ pound paper bags.

For manufacturers and distributors see numbers 44, 71, and 112 of list at end of this circular.

LARKSPUR

A solution of larkspur is used as one treatment for human hair in the control of the head louse.

The principal alkaloid, Delphinine (probably $C_{31}H_{49}O_7N$), a white, crystalline, poisonous substance, soluble in ether and alcohol, is extracted from the larkspur herb. It is used as an ointment or lotion to destroy lice and to relieve neuralgia.

This material may be bought in pint bottles for $1.75.

For manufacturers and distributors see number 85 of list at end of this circular.

LIME

Lime (hydrated, $Ca(OH)_2$) may be used as a diluent for paris green to make a dust for the control of malaria-carrying mosquito larvae. One part of paris green is usually mixed with 4 or 5 parts of lime. It is also used in reducing the acidity of other arsenicals for spray purposes. The ordinary hydrated mason's lime as commercially marketed is satisfactory for this purpose.

Hydrated lime is a white, soft powder which has a slightly bitter, alkaline taste. It absorbs carbon dioxide (CO_2) from the air, thus changing to calcium carbonate ($CaCO_3$). The hydrate is used extensively industrially in mortars, plasters, and pastes, for dehairing hides, in water paints, and for an agricultural lime for reducing the acidity of soils.

Caution: The dust if inhaled is somewhat irritating to the respiratory passages. Keep containers well closed.

Hydrated lime is obtainable in ton lots packed in paper bags at $8.50 to $13.00 per ton depending upon location.

Available on contract: see Class 59, General Schedule of Supplies, Procurement Division, Treasury Department.

LIME SULFUR (DRY)

Lime-sulfur is used as a dip or surface treatment for protecting rough and green as well as seasoned woods against powder-post beetles. The material acts as a repellent to the insects.

This material consists of lime and sulfur boiled together to form a series of salts. The dry form is prepared by adding a stabilizer such as cane sugar and then evaporating to dryness. Lime-sulfur is used as a summer fungicide and insecticide for fruit trees and is of special value for the control of scale insects. It is frequently used in connection with other insecticides for the simultaneous control of chewing and sucking insects as well as certain fungus diseases.

The cost of lime-sulfur in bags and drums in carload lots varies in different parts of the United States but ranges from 7½ to 12 cents per pound.

For manufacturers and distributors see numbers 2, 7, 19, 22, 69, 90, and 101 of list at end of this circular.

LINSEED OIL, BOILED

Linseed oil is used to prepare certain insecticides and to treat seasoned wood products in the control of Lyctus powder-post beetles. The boiled linseed oil, while still hot, is preferable for use on wood products since it penetrates and dries more rapidly than the raw linseed oil. It stains wood slightly yellow.

Linseed oil is a yellowish drying oil expressed or extracted from flaxseed. It is used extensively in paints, also in making printer's ink, linoleum, soap, and in medicine as a laxative.

This oil is available in 8,000 gallon tanks, 375 to 400 pound barrels, and in 1 and 5 gallon cans ranging in price from 10 to 12 cents per pound.

Available on contract: see Class 52, General Schedule of Supplies, Procurement Division, Treasury Department.

LUBRICATING OIL

Lubricating oil has limited use as an insecticide. A mixture of 20 parts lubricating oil (SAE 10) and 1 part of kerosene-pyrethrum concentrate lightly painted on window screens will keep out the flies known as eye gnats for several hours when these are troublesome.

Lubricating oil is one of the higher boiling fractions of crude oil. The color varies considerably from one brand to another but is usually some shade of yellowish-brown or amber. It is obtainable in various degrees of viscosity. The SAE 10 mentioned is a very thin grade while increasingly heavy grades are SAE 20, 30, 40, 50, and 60.

Caution: Lubricating oil will burn and oil-soaked rags left in poorly ventilated places may ignite by spontaneous combustion.

The price of lubricating oil varies from 7 to 33 cents per gallon in tanks at the refinery depending upon the location.

Available on contract: see Class 14, General Schedule of Supplies, Procurement Division, Treasury Department.

MENTHOL

A solution of menthol in alcohol or other solvent is often helpful in reducing irritation caused by flea and chigger bites suffered by susceptible persons. The application of the solution is made locally to the affected area of the skin.

Chemically, menthol is a white or colorless, crystalline solid having the formula $C_{10}H_{19}OH$. It is also called mint camphor or peppermint camphor, has the cooling taste and odor of peppermint, and is the principal constituent of oil of peppermint.

Menthol is used externally as a lotion or ointment to relieve aches and pains, and respiratory troubles, as well as industrially in liqueurs, confectionery, perfumery, and tobacco.

Menthol is sold in cases of tins at $7.00 to $7.50 per pound.

Available on contract: see Class 51, General Schedule of Supplies, Procurement Division, Treasury Department.

MERCURIC CHLORIDE

Mercuric chloride, also known as corrosive sublimate, is used in the control of plant diseases and certain insects. In military camps where ants become a serious nuisance mercuric chloride is useful when incorporated in a specially prepared cloth tape which is tied around the legs of tables, refrigerators, and other objects frequented by ants. Mercurial ointment is used to control pubic lice.

Chemically, mercuric chloride ($HgCl_2$) is a white solid, soluble in water. It is obtainable commercially as a white powder or in the form of tablets (each containing 7.5 grains $HgCl_2$). It is also widely used as a disinfectant and in dilute solution is used as an antiseptic in dressing wounds.

Caution: Since mercuric chloride is extremely poisonous, it should be stored in tightly sealed containers and plainly marked. It corrodes metals, and solutions should be prepared in wooden, glass, or earthenware containers. It is advisable to wear rubber gloves when working with this poison.

Mercuric chloride is sold in 250 pound kegs and drums of 50 or more pounds at prices varying from $2.24 to $2.39 per pound. It is also procurable in 1, 5, and 25 pound packages.

Available on contract: see Class 51, General Schedule of Supplies, Procurement Division, Treasury Department.

METHYL BROMIDE

Methyl bromide is used as a fumigant for the control of storage pests in modern concrete or brick warehouses of tight construction because of its ability to penetrate closely-packed products. Excellent results can be obtained even if a warehouse is loaded with food supplies, whole grains, or feeds. It should not be used, however, to fumigate flour or other milled cereals, or products high in fat content, since these products may retain harmful quantities of residual bromides. The method of application is discussed in Circular 22, pp. 20-23 and 37.

Methyl bromide is also used extensively for the fumigation of plants and plant products in connection with the enforcement of insect quarantine regulations. It may also be employed as a fumigant in the control of fleas in situations where it is necessary to kill rats, mice, and other rodents which harbor these pests.

Methyl bromide, CH_3Br, is a gas at summer temperatures, and is about 3½ times heavier than air. It has a boiling point of 40.1° F. and below this temperature is a heavy, colorless, liquid which is but slightly soluble in water. It is freely soluble, however, in alcohol, chloroform, ether, and carbon disulfide. It was originally used as a fire extinguisher and has been used in refrigeration. The gas is non-inflammable, very penetrating, and is poisonous, which makes it of value as a fumigant. As commercially produced it is of a purity of 99½ percent or better.

Caution: When working with methyl bromide it is necessary to use a gas mask provided with a canister that will absorb this gas. The chemical is toxic and therefore should not be allowed to come into contact with the skin. Containers of this gas should be stored in a cool, well-ventilated place outside of inhabited buildings.

Methyl bromide is obtainable in small 1-pound cans or in cylinders containing 10, 50, or 150 pounds net. In 50-pound cylinders it sells for 70 cents per pound.

For manufacturers and distributors see numbers 36, 37, and 67 of list at end of this circular.

MINERAL OIL

Sprays for the control of bedbugs generally consist very largely of a light mineral oil with small additions of pyrethrum extract.

Mineral oil is derived from any oil of mineral origin, such as petroleum or shale oil, by refining. It is a mixture of liquid hydrocarbon which is colorless, oily, non-fluorescent, transparent, becoming thicker with cold. Mineral oil is used in medicine, insecticidal sprays, paints, varnishes, lacquers, and as a solvent.

The containers in which mineral oil is shipped are various sized drums, ranging from 34 to 75 cents per gallon depending on the viscosity.

Available on contract: see Class 14, General Schedule of Supplies, Procurement Division, Treasury Department.

MOLASSES (Black Strap)

Black strap molasses is used as an attractive bait for house flies and blow-flies, in connection with fly traps. It is a thick, sticky, brown or dark colored, viscid sirup and contains impurities. Black strap is the final mother liquid remaining after the crystallization of sugar from the juice of sugar cane or beet sugar, more particularly the third molasses. It is also a by-product of raw sugar. Molasses is extensively used as a constituent of many mixed cattle feeds and as a raw material for the manufacture of industrial alcohol.

Black strap molasses is obtainable in tanks at a cost of 9½ to 11 cents per gallon, the price varying in different parts of the country.

Available on contract: see Class 56, General Schedule of Supplies, Procurement Division, Treasury Department.

MOTH PROOFING MATERIALS

These are solutions that are used for making fabrics and furs resistant to such insect pests as webbing clothes moths and related forms, also carpet beetles and buffalo moths. They are best applied in the hot dye bath while the clothes or fabrics are being manufactured. Most of these materials are patented and the process is described in the patents. Fabrics, if properly treated, remain resistant to insect attack for a long time.

Two well known commercial products are Demotex, manufactured in America, and Eulan C. N., a foreign product.

For manufacturers and distributors see numbers 3, 4, 15, 33, 37, 46, 70, 74, 75, and 109 of list at end of this circular.

NAPHTHALENE

Naphthalene is used extensively in preventing injury by and for killing such fabric pests as the various kinds of clothes moths, and carpet beetles which attack woolen fabrics used for making uniforms, blankets, wool- and fur-lined helmets, boots, also furs, and various other items. The flakes are ordinarily used for this purpose and are about as effective as paradichlorobenzene.

When fabrics become saturated with the fumes they kill the insects and prevent them from attacking the materials. Naphthalene is applied directly to the fabrics in enclosed containers at the rate of 2 to 4 pounds per 100 cubic feet of space. It is also used to kill fleas in living quarters and in the preparation of certain louse powders.

Chemically, naphthalene, $C_{10}H_8$, is a white, crystalline, flaky material and is the chief constituent of moth balls. It vaporizes very slowly and forms a noninflammable gas having a pungent, tarry odor. It is used in various industries such as in the manufacture of dyes, resins, and in disinfectants.

The strong odor of naphthalene may be disagreeable but is not considered dangerous and presents no fire hazard.

Caution: It should not be used as a fumigant for grains, cereals, and other food products because it imparts very persistent odors and flavors.

Naphthalene flakes or balls may be obtained in 180- or 200-pound barrels, 50-pound cases, and smaller containers with the cases, at a price of 8¼ cents, and 16-ounce packages at 8½ cents per pound.

Available on contract: see Class 51, General Schedule of Supplies, Procurement Division, Treasury Department.

NICOTINE SULFATE

Commercially available nicotine sulfate (a solution containing the equivalent of 40 percent of nicotine) is mixed with water and used as a spray for killing wood ticks on vegetation.

A commercial solution of nicotine sulfate, $((C_{10}H_{14}N_2)_2 \cdot H_2SO_4)$, is a dark brown or blackish, poisonous liquid with a strong penetrating tobacco-like odor. It is somewhat heavier than water and will readily mix with it. Nicotine sulfate is used extensively as a contact insecticide for spraying aphids and other soft-bodied sucking insects on plants. Black Leaf 40 is the trade name of a widely distributed commercially prepared nicotine sulfate.

Caution: Nicotine sulfate is very poisonous and should be kept in a safe place in tight containers plainly labeled and marked "Poison." Avoid wetting the skin with the spray.

This material may be purchased in drums at the factory at 70.3 cents per pound and in 10-pound tins at 86.5 cents per pound.

For manufacturers and distributors see numbers 19, 24, 30, 37, 45, 79, 81, 82, and 108 of list at end of this circular.

OIL OF CITRONELLA

Oil of citronella is often used alone or in combination with other materials, such as camphor, to repel mosquitoes. Application of the repellent is made to the exposed portions of the skin.

This oil is derived from citronella grass, chiefly from Ceylon and Java. It is a volatile, almost colorless to pale yellow or reddish liquid having a pleasant, pungent aroma. Citronella oil is used in liniment for rheumatism and in perfumes.

The material should be kept in a cool place, well closed, and protected from light.

Oil of citronella is marketed in drums at 90 cents per pound, and in 1-pound cans at 95 cents (Ceylon) and drums and cans at 85 to 90 cents per pound (Java).

Available on contract: see Class 51, General Schedule of Supplies, Procurement Division, Treasury Department.

OLIVE OIL

The use of kerosene oil and olive oil is recommended in the control of head lice.

Olive oil is a pale-yellow or yellowish-green non-drying oil expressed from olives. It is used as a salad oil, in cooking, as a lubricant and illuminant, and in toilet soaps.

The commercial containers for olive oil are barrels weighing 375 and 500 pounds, and cans containing 1/4, 1, 5, and 10 gallons. In drums the oil is priced from $3.85 to $5.50 per gallon.

Available on contract: see Class 51, General Schedule of Supplies, Procurement Division, Treasury Department.

ORTHODICHLOROBENZENE

Orthodichlorobenzene ($C_6H_4Cl_2$) in the crude form is used for checking the activity of Lyctus and other powder-post beetles working in seasoned wood, and for poisoning the soil about the foundations of buildings for termite control. For the latter purpose it can be used alone or diluted with coal-tar creosote, or light fuel oils.

Chemically, orthodichlorobenzene is a colorless, stainless liquid, soluble in alcohol or ether, which mixes readily with various oils. The commercial product ordinarily sold is a crude chlorinated benzene product. It is somewhat expensive but very effective. It is very penetrating and may mar the finish on wood, which can, however, be refinished without difficulty. Orthodichlorobenzene is noninflammable but is

slightly poisonous. It possesses a strong, nauseating odor resembling that of moth balls which may persist for several days after application.

Caution: The odor might cause headache to one confined with it in an enclosed space for an hour or so. In treating infested wood overhead, care should be taken to keep the liquid from dripping on the body as it might burn the skin slightly and would be especially painful if it came in contact with the eyes. Goggles should be worn and the hands and body protected by rubberized fabric or neoprene-treated gloves and apron. Although orthodichlorobenzene is practically noninflammable, as a matter of precaution it should not be atomized in the air by spraying near a furnace while the latter is in operation. It should not be used in the ground near wells or springs which serve as a source of drinking water. It should be kept away from exposed food materials.

Orthodichlorobenzene may be obtained in tanks, 1000-pound drums, and 50- and 100-pound tins at a price ranging from 5½ to 10 cents per pound.

For manufacturers and distributors see numbers 20, 36, 37, 55, 70, 76, and 104 of list at end of this circular.

ORVUS W. A.

Orvus W. A. is a wetting and spreading agent which is used as an emulsifier in place of soap to prepare insecticides, because it does not form a precipitate as soap does when hard water must be used. Like other similar wetters and spreaders, Orvus W. A. is especially useful when under certain conditions a

pyrethrum spray has to be prepared with hard or salt water or when the finished spray is applied to the surface of water pools and marshes having a salt content higher than 5 percent, to kill mosquito larvae.

Orvus W. A. is a proprietary product known chemically as sodium lauryl sulfate. It comes prepared in the form of paste or flakes in 25-pound cartons, the paste costing 30 cents per pound and the flakes 53 cents per pound.

For manufacturer and distributor see number 92 of list at end of this circular.

PARADICHLOROBENZENE

Paradichlorobenzene is used as a soil fumigant to kill various insect pests, and as a repellent and fumigant for such fabrics pests as clothes moths and carpet beetles. Recent results indicate that it is not always effective as a soil poison for termite control, hence it is not recommended for this use.

Chemically, this material ($C_6H_4Cl_2$) is a white, crystalline compound which volatilizes slowly. The vapor formed is noninflammable, penetrating, and has a somewhat ether-like odor. It is not explosive nor dangerous to handle. It is marketed in the form of crystals or in cakes, and is obtainable in any quantity desired.

Paradichlorobenzene should be stored in air-tight containers to avoid loss by evaporation.

Caution: Food substances, including grains, exposed to the fumes of the chemical may retain residues that render them unfit for consumption. Therefore it should never be used to fumigate such materials.

This chemical is shipped in carload lots at 11 to 12 cents per pound, in less than carload lots at 12½ to 13½ cents per pound, in 25- to 200-pound barrels, 150-pound drums, and 1- to 5-pound cans.

Available on contract: see Class 51, General Schedule of Supplies, Procurement Division, Treasury Department.

PARIS GREEN

This bright green arsenical compound is used to kill malaria-carrying mosquito larvae when applied as a dust to the surface of the water. The dust is prepared by mixing the poison with a carrier like talc, diatomaceous earth, or lime.

Paris green, which is chemically acetoarsenite of copper ($3Cu(AsO_2)_2 \cdot Cu(C_2H_3O_2)_2$), was one of the first stomach poisons used in America to destroy insects. It is a very poisonous, heavy, emerald-green powder and when used as a spray requires constant agitation to keep it in suspension. Commercial paris green should be ground finely, should contain not less than 50 percent of total arsenious oxide, and not more than 3½ percent water soluble arsenic oxide.

Caution: Paris green is extremely poisonous and therefore should be kept in a

safe place away from foods. Tight containers plainly labeled and marked poisonous should be used for storing the material. The dust should not be inhaled and the skin, especially open wounds, should be protected from the material or serious poisoning may result.

This insecticide may be purchased in 500-pound barrels, drums, 100-pound kegs, bottles, and tins. The price in drums and kegs varies from 24 to 27 cents per pound.

Available on contract: see Class 51, General Schedule of Supplies, Procurement Division, Treasury Department.

PENTACHLOROPHENOL

Pentachlorophenol (C_6Cl_5OH) is one of the most effective chemicals for use as a dip in preventing and checking Lyctus powder-post beetle infestations in seasoned wood. It is a valuable chemical for preserving wood and other products and for the control of slime and algae.

Pure pentachlorophenol is a white, needle-like, crystalline material which when hot has a very pungent odor. It is almost insoluble in water but soluble in alcohol, ether, benzene, and oil. The crystals are available commercially and should be dissolved in a light fuel oil. It is also available in liquid form already mixed by the manufacturer.

Caution: Care should be taken to observe the precautions mentioned by the manufacturer in handling it, otherwise it is likely to irritate the skin. Rubberized

fabric or neoprene-treated gloves and aprons should be used to protect the body. Its dust causes sneezing.

Pentachlorophenol may be bought in drums at 20 to 25 cents per pound.

For manufacturers and distributors see numbers 36 and 76 of list at end of this circular.

PETROLATUM

In the semisolid form of carbolated petrolatum or carbolated vaseline this material is useful for the relief of flea and chigger bites when applied to the affected area of the skin. The liquid petrolatum designated as white mineral oil or liquid vaseline is used to prepare a mosquito repellent by mixing with pyrethrum extract.

Petrolatum is a neutral, practically odorless and colorless, grease-like, oily substance which is derived from petroleum by distilling off the lighter portions and purifying the residue. Several forms of petrolatum are available commercially, the semisolid, yellow form, and a colorless or faintly yellow liquid known as liquid petrolatum, liquid paraffin, white mineral oil or paraffin oil. The semisolid form is used as a carrier for medicants, the liquid as a lubricant for the intestinal tract, in sprays for the nose and throat, and in hair dressing. Petrolatum preparations of many kinds are sold under the trade name of vaseline.

Petrolatum is marketed in 400-pound drums, 1- to 50-pound cases of cans, the drums costing

3½ to 4-3/4 cents per pound for the yellow, and 5 to 8 cents per pound for the white form.

Available on contract: For Yellow see Class 29, for Liquid see Class 51, General Schedule of Supplies, Procurement Division, Treasury Department.

PETROLEUM (CRUDE OIL)

Petroleum or crude oil is sometimes used to kill fly larvae which develop in manure piles, garbage, feces, or other refuse. For this purpose, application is made by sprinkling the surfaces of such breeding places so as to form a protective oil covering.

Crude petroleum is obtained from the ground as an oily, inflammable liquid ranging from almost colorless to nearly black, but usually of a dark greenish or brownish hue. The specific gravity varies considerably, depending on the source, but crude oil is usually lighter than water. It is a complex mixture of hydrocarbons in which small quantities of other materials such as sulfur, nitrogen compounds, water, and silica are also present. Crude oil is refined by a process of distillation which yields gasoline, kerosene, fuel oil, lubricating oil, and other petroleum products. The chief oil-producing regions of the United States at present are California, Oklahoma, and Texas.

Caution: Crude oil is inflammable. Oily rags in poorly ventilated places often cause fire by spontaneous combustion.

Petroleum in crude form may be bought at the wells for 43 cents to $2.19 per barrel depending upon the location.

Available on contract: see Class 14, General Schedule of Supplies, Procurement Division, Treasury Department.

PHOSPHORUS PASTE

Phosphorus paste is useful in the control of cockroaches in tropical and damp climates. Its use is advisable in cases where roaches are present but not especially numerous. It is particularly effective against the American cockroach.

Phosphorus paste is prepared commercially from yellow phosphorus. Essentially these pastes are made by grinding the yellow phosphorus in the presence of water and then mixing with flour in the proper proportion. Glycerine is sometimes used as an ingredient. Commercial preparations usually contain from 1 to 2 percent of phosphorus.

Yellow phosphorus is a white to yellowish, translucent, waxy solid, which turns more yellow as it ages. When exposed to air it takes fire at 34° C. (93.2° F.) and burns with a yellowish flame.

Caution: Phosphorus paste, because of its very poisonous nature, should be handled with the greatest of care. Since the yellow phosphorus is so inflammable and poisonous, it is safer to purchase the commercial paste rather than attempt to prepare it.

For manufacturers and distributors of phosphorus paste see numbers 26, 29, 83, 88, 93, 99, 105, and 110 of list at end of this circular.

PINE OIL

Pine oil is used to aid in dissolving pentachlorophenol in light fuel oil for the treatment of seasoned wood to protect it from attack by Lyctus beetles. Pine oils alone have been used to treat wood infested with powder-post beetles.

Pine oil is a colorless to pale yellow, oily liquid insoluble in water and has a turpentine-like odor. It is obtained by steam distillation from certain species of pine trees. The oil is used as a solvent, in the manufacture of textiles and paints, and for the flotation of lead and zinc ores.

Pine oil is sold in tanks, 55-gallon drums, at a price ranging from 54 to 65 cents per gallon.

For manufacturers and distributors see numbers 5, 14, 27, 42, 52, and 113 of list at end of this circular.

PINE TAR OIL

This substance is used in combination with cottonseed oil to kill ticks in the ears of domestic animals. Pine tar oil is also used to protect wounds on animals from screwworm attack, in which use it should have a specific

gravity of 1.025. Pine tar oil is also employed in sprays designed to kill and to repel flies.

Pine tar oil is a dark brown or blackish, heavy, viscous liquid obtained by the destructive distillation of wood of several species of pine trees. It has a sharp taste and a somewhat pronounced burnt or tarry odor, definitely pine-like in character. Pine tar is heavier than, and only slightly soluble in, water. Among the principal constituents of this substance are turpentine, resin, creosol, phenol, xylene, and other hydrocarbons.

In medicine, pine tar oils are chiefly used for the treatment of skin diseases and respiratory disorders. Industrially, it has many uses including the manufacture of automobile tires.

This oil sells at 20 to 55 cents per gallon in 600-pound barrels.

For manufacturers and distributors see numbers 5 and 12 of list at end of this circular.

PYRETHRUM

Pyrethrum consists of dried flowers or buds of plants of any one of three particular species of the genus Chrysanthemum (Pyrethrum). These contain compounds known as pyrethrins I and II that are very toxic to insects. Flowers are now available from Kenya Colony which will average about 1.3 percent pyrethrins. Insect powders may be prepared by grinding the flowers, and used pure or diluted with some inert carrier.

The undiluted ground flowers may be dusted into clothing as a repellent against fleas, or scattered around infested areas to control roaches. A good diluted dust may be prepared from pure fresh powder and from 2 to 5 parts of some inert carrier such as talc or diatomaceous earth. In this form it may be applied directly to infested animals to control fleas and lice or dusted behind baseboards and similar locations to destroy fleas, bedbugs, or roaches in buildings.

The pyrethrins are also extracted from the flowers with various solvents such as acetone, alcohol, ethylene dichloride or mineral oil, according to the purpose for which they are to be used. Those prepared with alcohol and acetone are commonly used agriculturally; the oil sprays find application against insects affecting man, animals, and stored commodities. Such oil sprays are frequently prepared in the form known as 20-to-1 concentrates which contain 2 grams pyrethrins per 100 cc. For many purposes these are diluted about 20 times with kerosene or other light petroleum oil to make sprays containing about 0.10 to 0.12 grams pyrethrins per 100 cc. The oil used should be readily volatile and leave no stain on the sprayed objects. A perfume is often added to mask the odor.

The diluted oil-pyrethrum extract may be used against house flies, stable flies, mosquitoes, eye gnats, sand flies, chiggers, fleas, cockroaches, bedbugs, ticks, clothes moths, silverfish and ants in and around military establishments.

When pyrethrum is used in livestock or cattle sprays to kill and repel flies, the oil solution must be of such a nature as not to be

injurious to the animals, not to stain the coat, and in the case of cows not to taint the milk. They are made up with a less volatile oil than household sprays but to about the same pyrethrin content plus 5 percent pine oil, oil of camphor, cloves, safrol, or other aromatic.

A special pyrethrum oil emulsion is prepared from kerosene and pyrethrum extract as explained in the circular on mosquitoes. This larvicide is useful in killing the larvae of both malaria-carrying mosquitoes and buffalo gnats in infested water. The extract used with petrolatum or liquid vaseline may be applied to the skin to repel mosquitoes.

The extracts of pyrethrum may also be mixed with fine talcs, powdered charcoal, tobacco dust, sulfur, or various inert earths to make insecticides to be applied as dusts. These should not be confused with the dusts prepared from powdered flowers discussed above.

As previously stated, pyrethrum is very toxic to insects but is generally considered nonpoisonous to man. Certain individuals may be allergic to it and experience an irritation to the respiratory passages.

Pyrethrum is packed in barrels in the form of ground flowers and fine powders for sale at 21 to 22 cents per pound. The liquid extract, 20 to 1, may be purchased in drums at $4.40 to $4.60 per gallon. Smaller lots are also obtainable at a slightly higher rate.

For manufacturers and distributors see numbers 6, 11, 19, 43, 54, 80, 98, 102, and 107 of list at end of this circular.

SASSAFRAS OIL

Oil of sassafras is of some value as a repellent to protect the human body from sand-fly attack.

This material is a volatile oil distilled from the roots of Sassafras, and its chief use is in the manufacture of perfume. It is a yellow or reddish-yellow liquid, having the characteristic odor and taste of sassafras.

Natural sassafras oil comes in cans and drums at $1.05 to $1.20 per pound.

For manufacturers and distributors see numbers 1, 25, 34, 38, 50, and 74 of list at end of this circular.

SILVER NITRATE

Silver nitrate is used as a disinfectant for skin wounds caused by ticks. It is applied locally to the skin after the tick has been removed.

Commercial silver nitrate, $AgNO_3$, is practically 100 percent pure. It is a poisonous, colorless, odorless, crystalline powder. It is widely used in medicine. especially as an antiseptic, germicide, also in photography, silverplating, manufacture of inks, hair dyeing, and other industries.

Caution: This material is very poisonous and should be plainly labeled and kept out of reach of children and others unfamiliar with it.

Silver nitrate may be obtained in 100- and 200-ounce bottles at 24 cents per ounce. It is packed also in 1-, 4-, and 16-ounce bottles.

Available on contract: see Class 51, General Schedule of Supplies, Procurement Division, Treasury Department.

SODIUM ARSENITE

Sodium arsenite is used in the preparation of poison baits for ants, grasshoppers, and in livestock dips. A 10 percent solution is used for controlling termites in the soil about the foundations of buildings.

Chemically, sodium arsenite ($NaAsO_2$) is a white powder and very soluble. It is more generally available in liquid form containing about 32 percent As_2O_3, although it can also be purchased as a powder. It is used also as a weed killer, as an antiseptic, and for dyeing purposes.

Caution: Like all other materials containing arsenic, sodium arsenite is poisonous and care must be exercised in handling it. Care must be taken not to use it in locations near wells or springs used for drinking purposes. Children should not be allowed to play in soil treated with this chemical. Sodium arsenite in solution is very caustic to the skin and rubberized gloves should be worn while handling it.

In the powder form sodium arsenite may be obtained in drums in carload lots at a cost of 7-3/4 to 9-1/2 cents per pound.

For manufacturers and distributors of sodium arsenite see numbers 2, 18, 24, 59, 61, and 79 of list at end of this circular.

SODIUM BENZOATE

Benzoate of soda ($C_7H_5O_2Na$) or sodium benzoate as commercially obtained, is used in the preparation of some insect baits and poisons. For example, a combination of granulated sugar, crystallized tartaric acid, benzoate of soda, sodium arsenite, strained honey, and water is especially recommended as a poison bait for the Argentine ant. The benzoate of soda is added as a preservative to keep the solution from putrefying.

Sodium benzoate is a metallo-organic compound obtained commercially in the form of white, odorless granules or crystalline powder, possessing a sweetish astringent taste. It is used in medicine as a mild external antiseptic. Industrially, it is important as a food preservative.

Benzoate of soda is available in barrels at a cost of 39 to 43 cents per pound.

For manufacturers and distributors see numbers 36, 37, 56, 75, 76, 89, and 97 of list at end of this circular.

SODIUM BICARBONATE

Sodium bicarbonate has no direct entomological uses but it is employed as a 2 percent solution in an eye wash to relieve eyes affected by chloropicrin if the latter chemical accidentally reaches the eyes as in fumigation operations.

It is a white, crystalline salt, $NaHCO_3$, found in many mineral springs, and produced artificially by treating the normal carbonate with carbon dioxide, and, in the Solvay process, as an intermediate product. It is used in cookery, in baking powders, and in medicine.

This material may be obtained at any drug or grocery store. It is available on contract: see Class 51, General Schedule of Supplies, Procurement Division, Treasury Department.

SODIUM FLUORIDE

This poisonous powder is considered as one of the best all-round cockroach remedies. Sodium fluoride when dusted in their runways will sometimes drive them away. The commercially available product and commonly employed grade of the powder contains 94 to 97 percent sodium fluoride.

Sodium fluoride, NaF, is a white, very poisonous powder soluble in water but insoluble in alcohol. It is sometimes used medicinally and for the preparation of pastes, and for disinfecting fermentation apparatus in breweries and distilleries.

Caution: Since sodium fluoride is poisonous if taken internally it should be put in tight containers, plainly marked "Poison," and kept in a dry, safe place away from foods. It is somewhat irritating to the respiratory passages if the dust is inhaled.

In New York City all sodium fluoride must be colored blue and the National Association of Insecticide and Disinfectant Manufacturers Inc. has gone on record favoring this practice throughout the United States.

Sodium fluoride may be purchased in small containers up to large 350 to 375 pound barrels. The barrels in carload lots cost from 8¼ to 9¼ cents per pound.

Available on contract: see Class 51, General Schedule of Supplies, Procurement Division, Treasury Department.

SPEARMINT OIL

In the case of sandfly attack on the human body, spearmint oil is of some value as a repellent.

Oil of spearmint is distilled from the fresh parts of the flowering plant Mentha spicata Linne. It is a colorless, yellow or greenish-yellow liquid, having the characteristic odor and taste of spearmint. The price of oil of spearmint in drums is $2.55 to $2.80 per gallon.

For manufacturers and distributors see numbers 1, 25, 34, 38, 50, and 74 of list at end of this circular.

STA-WAY

This is a proprietary compound containing the active ingredients known chemically as diethylene glycol monobutyl ether acetate and diethylene-glycol monoethyl ether. It is used as a temporary but very effective repellent against mosquitoes by applying to the skin as with other preparations of this kind.

It is manufactured by the National Carbon Company of Cleveland, Ohio, and sells for about 25 cents per 6-ounce bottle. See number 77 of list at end of this circular.

SULFONATED CASTOR OIL

Sulfonated castor oil is one of the constituents of an ointment or smear containing diphenylamine, benzene, and lamp black (known as Formula #62 recently developed by the Bureau of Entomology and Plant Quarantine) which is employed on animals as a screwworm killer and wound protector.

Sulfonated castor oil, known also as turkey red oil, is one of the wetting and emulsifying agents used in the preparation of various insecticides. It is a viscous, transparent liquid, and light yellow in color. Industrially, it is widely used in the dye industry.

The oil comes in drums in carload lots with prices ranging from 7-3/4 cents per pound to 12 cents per pound depending upon the percentage of fat.

For manufacturers and distributors see numbers 4, 10, 51, 53, and 100 of list at end of this circular.

SULFUR

Sulfur is used to protect man from chiggers or red bugs. It is dusted on the body, especially the lower limbs or parts where the clothing fits tightly, to prevent chiggers from attacking the skin, when it is necessary to work in or travel through grassy or wooded areas. It may also be dusted on vegetation to control chiggers. Very finely divided sulfur made up as a suspension in water is used to protect green lumber and other rough lumber products while in the process of seasoning against attack by Lyctus powder-post beetles, by a dipping process as outlined in Circular 6. Several proprietary products including "Sulfocide" and "Microfine sulfur" are sold for this purpose. Sulfur dioxide may be used to fumigate empty buildings or houses.

Commercial sulfur is a yellow powder and is obtainable in several forms: flowers of sulfur, and dusting or flour sulfur. Either of these forms may be used against chiggers.

Ordinary sulfur (S) is a yellow, brittle, crystalline solid, which is practically insoluble in water. It has only a faint odor and taste. Commercially, sulfur is used in making sulfuric acid, other sulfur compounds, fireworks and matches, in medicine, for the control of various other insects, and as a fungicide against certain plant diseases.

Caution: Sulfur when used as a dust is often very irritating to some people, especially to the eyes and nose. In such cases it is advisable to wear goggles or respirators of which several efficient types are available.

One hundred pounds of sulfur in carload lots is priced at $2.80. In less than carload lots the same amount costs $3.25.

Available on contract: see Class 51, General Schedule of Supplies, Procurement Division, Treasury Department.

SULFURIC ACID

This acid, H_2SO_4, is not an insecticide but is used in the generation of hydrocyanic acid gas from sodium (or potassium) cyanide as discussed in Circular 22 on fumigation. For this purpose the technical grade having a specific gravity of 1.83 is satisfactory. (For a further description of hydrocyanic acid gas, see the discussion under that heading.)

Sulfuric acid is a colorless liquid when pure but the commercial grades are yellowish or brownish due to the presence of certain impurities. It is a heavy, oily-like, very corrosive liquid which has a great affinity for water. Industrially, sulfuric acid has probably more numerous uses than that for any other chemical.

Caution: Sulfuric acid is highly corrosive and will burn the skin, clothing, and many materials. When diluting, always pour the acid slowly into the water, never attempt to pour the water into the acid. Keep in a safe place, in tight glass containers, plainly labeled and marked "Poison."

It can be purchased in 11-gallon glass carboys (184 pounds) at 6½ to 8 cents per pound. In 9-pound bottles the price ranges from 15½ to 17 cents per pound.

Sulfuric acid is available on contract: see Class 51, General Schedule of Supplies, Procurement Division, Treasury Department.

TALC OR TALCUM

Talc or talcum is a suitable material for mixing with derris powder for the control of fleas on cats. For limited use of this kind, ordinary cheap talcum powder is satisfactory, while if large quantities are required, talc as manufactured for preparing insecticidal dusts should be employed. Talc of insecticidal dust grade is used to make a paris green dust for the control of mosquito larvae.

Talcum, talc, or soapstone occurs in the native mineral state as a magnesium silicate, $H_2Mg_3(SiO_3)_4$. It has a soft, soapy feel and occurs in layers, granules, or fibrous masses usually of a grayish, or greenish color. In addition to its usefulness in preparing insecticidal dusts, it is employed in making soap, paper, paints, insulating materials, textiles, and toilet powders.

The material (325 mesh) is obtainable in 100, 200, and 220 pound bags in carload lots at $14 to $20 per ton.

Available on contract: See Class 51, General Schedule of Supplies, Procurement Division, Treasury Department.

TARTAR EMETIC

One of the insecticidal uses of tartar emetic is in ant poisons, especially for such species as prefer grease and meat to sweetened baits. A small quantity of it is worked into grease or bacon rind and placed in locations where ants will feed upon it. For this purpose tartar emetic, technical grade, is suitable and is available commercially in the form of a white powder.

Tartar emetic, $K(SbO)C_4H_4O_6.\frac{1}{2}H_2O$, is a white, crystalline salt known chemically as potassium antimonyl tartrate. It has a sweetish, metallic taste and is poisonous. This substance is used in the dyeing industry, in medicine, and as an insecticide in the control of certain species of thrips.

Caution: Since tartar emetic is poisonous, care should be used in handling it, and it should be kept in plainly labeled containers marked "Poison."

This chemical is packed in 200- to 700-pound barrels, 100-pound kegs, 25- to 50-pound boxes and in bottles. The barrels cost from 44-3/4 to 50 cents per pound.

For manufacturers and distributors see numbers 10, 49, 89, and 96 of list at end of this circular.

TARTARIC ACID

Tartaric acid is used as one of the constituents of some of the poison ant syrups that are used to kill the worker ants, also the young and queen ants within their nests. It is especially useful against sweets-eating ants when it is impossible to locate and destroy their nests by direct means. The method of feeding these baits to ants is discussed in Circular 15.

Chemically, tartaric acid, $C_4H_6O_6$, is a white, odorless powder with a strong acid taste, which is soluble in water and alcohol. It is used in the dyeing and baking industries, also in medicine and chemistry.

Caution: Although tartaric acid in small quantities is considered harmless, death has resulted from accidental administration of one ounce or more.

Tartaric acid may be purchased in 250-pound barrels, 25-, 50, and 112-pound kegs, at a price range of 63½ to 64 cents per pound.

Available on contract: see Class 51, General Schedule of Supplies, Procurement Division, Treasury Department.

THALLIUM SULFATE

This compound is used with sugar, honey and water in the preparation of a poison bait for the control of ants.

Thallium sulfate, Tl_2SO_4, is a white, crystalline, extremely poisonous compound.

Its uses are somewhat limited. In addition to its employment as an insect poison, it can be used as a rat poison and as a reagent in chemistry.

Caution: Thallium sulfate even in small dosages is a dangerous poison and must be handled with great care. It should be kept in tight, labeled containers and marked "Poison." The vapors which are given off when the material is heated, either alone or in solution, are poisonous and should not be inhaled.

This compound is shipped in 1/4, 1, and 5-pound bottles at $5 to $7 per pound.

For manufacturers and distributors see numbers 18, 41, 84, 87, and 103 of list at end of this circular.

TURPENTINE

Turpentine when combined with kerosene is used to control powder-post beetles. It can be applied to infested flooring at the rate of 9 parts of turpentine to 1 part of kerosene, to kill Lyctus beetles without marring the finish on the wood. When removed from the clothing or from animals, ticks may be dropped into turpentine to insure their death.

Turpentine is a colorless or slightly yellowish, inflammable liquid with a characteristic odor and pungent, biting taste. It consists of terpenes ($C_{10}H_{16}$) and is widely used in medicine and in making paints and varnishes. It is obtained from various pine

and other resinous woods, by steam or other distillation methods, or by extraction with solvents. It is known also under the names of oil of turpentine, wood turpentine, wood spirits of turpentine, and gum spirit.

Caution: Turpentine is very inflammable and clothes saturated with it are a frequent source of fire in buildings.

Steam distilled turpentine is marketed in tanks, 30- to 50-gallon drums, 1- and 5-gallon cans. In tanks it sells for 66 cents per gallon; in drums the material costs from 58 to 71 cents per gallon in carload lots. In less than carload lots the price is 74 cents per gallon.

Available on contract: see Class 52, General Schedule of Supplies, Procurement Division, Treasury Department.

VINEGAR

In the treatment of head lice a mixture of equal parts of vinegar and kerosene may be applied directly to the infested hair. Hot vinegar alone is also used to kill the eggs.

Vinegar is dilute impure acetic acid ($C_2H_4O_2$), a sour liquid used as a condiment or as a preservative. It is obtained by the acetic acid fermentation of dilute alcoholic liquids. Cider and malt are very common sources but it may be made from the fermented juice of nearly any fruits. Vinegar is so well known that it needs no further discussion here.

Vinegar is obtained at all grocery stores in almost any quantity desired.

Available on contract: see Class 56, General Schedule of Supplies, Procurement Division, Treasury Department.

WASHING SODA

Washing soda finds useful application in connection with large-scale fumigation operations, where generators are set in a wash-tub of water containing a few handfuls of the material. This precaution provides for catching and neutralizing small quantities of the acid-water mixture that may leak out of the generator or barrel. It is also used for cleaning garbage of grease and fats to prevent breeding of flies.

Washing soda, sal soda, or alkali ($Na_2Co_3.10H_2O$), known chemically as sodium carbonate, is a white, crystalline powder which is very soluble in water. It is also used as a cleaning and bleaching agent for laundry purposes, in the glass and soap industries, and in medicine.

This soda is marketed in 200- to 400-pound slack barrels, 1 to 400 pound burlap bags and 100-pound paper bags. In carload lots of 100-pound bags the price varies from $1.10 to $3.25 per 100 pounds, depending upon the zone.

Available on contract: see Class 51, General Schedule of Supplies, Procurement Division, Treasury Department.

PROCUREMENT OF INSECTICIDES AND SUBSIDIARY MATERIALS

The accompanying list of concerns and their products is included for the information of the users of this circular, without given or inferred guarantee of the reliability of the firm or endorsement of their individual products. No attempt has been made to make the list fully complete and no discrimination is intended or implied against firms whose names or products are not listed.

It is possible, in addition, that many of the materials herein mentioned may often be obtained from local drug firms and certain of the insecticides may be procured from local stores handling seeds and agricultural supplies.

Many of the materials can also be procured under Government Contract. In such instances the Class is given under which they are listed in the General Schedule of Supplies by the Procurement Division, United States Treasury Department.

List of Manufacturers and Distributors

1. J. C. Ackerman, Pittsburgh, Pa.
2. Acme White Lead and Color Works, Detroit, Mich.
3. Agicide Laboratories, Milwaukee, Wis.
4. American Cyanamid & Chemical Corp., New York City, N. Y.; Kansas City, Mo.; Azusa, Calif.
5. American Turpentine & Tar Co., New Orleans, La.
6. An-Fo Manufacturing Co., Oakland, Calif.
7. Ansbacher-Siegle Corp., Brooklyn, N. Y.
8. Ansul Chemical Co., Marinette, Wis.
9. Ansul Chemical Co. of California, Modesto, Calif.

10. Apex Chemical Co., Inc., New York, N. Y.
11. Associated Chemists, Inc., Chicago, Ill.
12. Atlantic Turpentine and Pine Tar Co., Savannah, Ga.
13. Atlas Asbestos Co., N. Wales, Pa.
14. Barada & Page, Inc., Kansas City, Mo.
15. Barber Laboratories, New Orleans, La.
16. Bartlett Chemicals, Inc., New Orleans, La.
17. J. H. Baxter & Co., Los Angeles, Calif.
18. Braun-Knecht-Heimann Co., San Francisco,Cal.
19. California Spray-Chemical Corp., Richmond, Calif.
20. Capitol Chemical Co., Washington, D. C.
21. Carbide & Carbon Chemical Corp., New York City, N. Y.
22. Central Chemical Corp., Hagerstown, Md.
23. Chicago Sanitary Products Co., Chicago, Ill.
24. Chipman Chemical Co., Inc., Bound Brook, N.J.
25. Harry Cohen, Atlanta, Ga.
26. Common Sense Mfg. Co., Buffalo, N. Y.
27. Wm. Cooper & Nephews, Chicago, Ill.
28. Creosote Sales Corp., Baltimore, Md.
29. Creo-tox Chemical Products Co., Memphis, Tenn.
30. Crystal Soap and Chemical Co., Inc., Philadelphia, Pa.
31. Cunningham & Co., Seattle, Wash.
32. Daigger & Co., Chicago, Ill.
33. Demotex Inc., New York City, N. Y.
34. Denver Fire & Clay Co., Denver, Colorado
35. Derris, Inc., New York City, N. Y.
36. Dow Chemical Co., Midland, Mich.
37. E. I. du Pont de Nemours & Co., Inc., Wilmington, Del.
38. Eastern Color & Chemical Co., New York, N.Y.
39. Eastman Kodak Company, Chemical Sales Division, Rochester, N. Y.
40. Ehret Magnesia Mfg. Co., Valley Forge, Pa.
41. Foot Mineral Co., Philadelphia, Pa.
42. Fritzsche Bros., Inc., New York City, N. Y.
43. Fuld Bros., Baltimore, Md.

44. General Carbon Company, Los Angeles, Calif.
45. General Chemical Co., New York City, N. Y.
46. General Dyestuff Corp., New York City, N.Y.
47. James Good, Inc., Philadelphia, Pa.
48. Goris & Arnstein, Inc., Chicago, Ill.
49. Griffin Chemical Co., San Francisco, Calif.
50. John J. Grote & Co., Cincinnati, Ohio
51. Hart & Harrington, Inc., Chicago, Ill.
52. Hercules Powder Co., Wilmington, Del.
53. Arnold Hoffman & Co., Inc., Providence, R.I.
54. J. I. Hopkins & Co., New York City, N. Y.
55. Hughes Chemical Co., Baltimore, Md.
56. Ideal Chemical & Supply Co., Memphis, Tenn.
57. Inland Tar Co., Chicago, Ill.
58. Innis, Speiden & Co., New York City, N. Y.
59. Insecticide Corp. of America, Medina, N. Y.
60. Johns-Manville Corp., New York City, N. Y.; Washington, D. C.; Boston, Mass.; Philadelphia, Pa.; Atlanta, Ga.; New Orleans, La.; St. Louis, Mo.; Los Angeles, Calif.; Chicago, Illinois
61. Jungmann & Co., Inc., New York City, N. Y.
62. Keasbey & Mattison Co., Ambler, Pa.
63. Kentucky Color & Chemical Co., Louisville,Ky.
64. Kittitas Diatomite Co., Ellensburg, Wash.
65. Koppers Company (Tar & Chemical Division) Pittsburgh, Pa.
66. Lederle Laboratories, Inc., New York, N. Y.
67. Liquid Carbonic Corp., Chicago, Ill.
68. Los Angeles Chemical Co., Los Angeles, Calif.
69. Lucas Kil-Tone Co., Philadelphia, Pa.
70. Mallinckrodt Chemical Works, St. Louis, Mo.
71. The L. Martin Company (Germantown Eagle or Velvet Brand), Tacony, Pa.
72. McCormick Sales Co., Inc., Baltimore, Md.
73. McLaughlin Gormley King Co., Minneapolis,Minn.
74. Mefford Chemical Co., Los Angeles, Calif.
75. Merck & Co., Inc., Rahway, N. J.
76. Monsanto Chemical Co., St. Louis, Mo.
77. National Carbon Co., New York City, N. Y.
78. New England Minerals, Inc., Boston, Mass.

79. Niagara Sprayer & Chemical Co., Inc., Middleport, N. Y.
80. Nico-Dust Mfg. Co., Los Angeles, Calif.
81. Nicotine Manufacturing Co., St.Louis, Mo.
82. Nicotine Production Co., Inc., Clarksville, Tenn.
83. John Opitz, Inc., Long Island City, N. Y.
84. Ore & Chemical Corporation, New York, N.Y.
85. Oregon Forest Products, Gold Beach, Oregon
86. Paraffine Companies, San Francisco, Calif.
87. Pfaltz & Bauer, Inc., New York City, N. Y.
88. Pfeiffer Chemical Co., St. Louis, Mo.
89. Charles Pfizer & Co., 81 Maiden Lane, New York City, N. Y.
90. Pittsburgh Plate Glass Co., Milwaukee,Wis.
91. John Powell & Co.,Inc., New York City, N.Y.
92. Proctor & Gamble Co., New York City, N. Y.
93. Rat-Biscuit Co., Springfield, Ohio
94. Reilly Tar & Chemical Corp., Indianapolis, Indiana
95. Republic Chemical Co., New York, N. Y.
96. Rhom & Haas Co., Philadelphia, Pa.
97. Rogers Chemical Company, Dallas, Texas
98. Sea Coast Laboratories, Inc., New York,N.Y.
99. Sennewald Drug Co., St. Louis, Mo.
100. John Shaw & Co., Inc., Boston, Mass.
101. Sherwin-Williams Co., Cleveland, Ohio
102. Sherwood Petroleum Co., Inc., Englewood,N.J.
103. Soilicide Laboratories, Montclair, N. J.
104. Solvay Sales Corporation, New York, N. Y.
105. Stearn's Electric Paste Co., Chicago, Ill.
106. The Sullivan Co., Memphis, Tenn.
107. Thompson-Hayward Chemical Co.,Kansas City,Mo.
108. Tobacco By-Products & Chemical Corp., Louisville, Ky.
109. United States Rubber Co., General Development Division, Passaic, N. J.
110. Walgreen Co., Chicago, Ill.
111. Western Talc Co., Los Angeles, Calif.
112. Whittacker, Clark & Daniels, Inc., New York, N. Y.

113. Andrew Wilson, Inc., Springfield, N. J.
114. T. C. Wilson Co., San Francisco, Calif.
115. C. A. Wood, Preserver Co., St. Louis, Mo.
116. J. W. Woolfolk Co., Fort Valley, Ga.

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